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Journal of Financial and Monetary Economics is edited by the "Victor Slãvescu" Centre for Financial and Monetary Research of the Romanian Academy since 2014. It is an annual review that has as main objective the dissemination of theoretical and applied economic research presented annually by the researcher in Romania and abroad in the international scientific conference "Financial and Monetary Economics".

Research published scientific research aimed both economic development and clarification of the current economic phenomena and processes. As a result, conclusions and proposals offered by the authors address both academic - scientists, teachers and students - as well as decision makers. We emphasize the importance of scientific contributions, together with the clarity of concepts, methodologies and conclusions offered.

Contents

SECTION I. FISCAL ISSUES IN THE GLOBALIZED ECONOMY & FINANCIAL MICROECONOMICS

THE IMPACT OF FISCAL DECENTRALIZATION ON SOME SOCIO-ECONOMIC VARIABLES AT THE EU27 LEVEL IN THE PERIOD 1999-2023

Alina Georgeta AILINCĂ[1]

Abstract:

Fiscal decentralization often takes on high importance especially during periods of economic rest or even economic boom. However, its high heterogeneously with extremely diverse components make it difficult to define, estimate and measure, and its impact also has a varied connotation depending on which aspects of decentralization are considered. High public responsibility, high administrative capacity, good management in times of crisis, with internal and external shocks kept under control, etc. can outline a success in the process of implementing fiscal decentralization. Thus, starting from the quantitative definition of fiscal decentralization and focusing our attention on decentralization at the local level, this paper explores the impact of fiscal decentralization on some indicators in the sphere of health, education, infrastructure and social inequality at the EU27 level. This paper explores the impact of fiscal decentralization on socio-economic performance in a large sample of EU27 economies over the period 1999 - 2023. The findings may highlight the fact that fiscal decentralization, although under certain conditions, can improve the provision of some public services, equally, can present sufficient risks to their efficiency.

Keywords: *fiscal decentralization, regional disparities, inequality*

JEL classification: *H5, H72, H77*

Introduction

In the context of international and regional political instability, against the background of concerns regarding the growth of centralization, corruption and bureaucracy, discussions in the public space are also confined to the sphere of fiscal decentralization. Thus, fiscal decentralization is sometimes seen as an effective means of achieving welfare and sustainable economic growth. But decentralization, in itself, is not a guarantee for prosperity; it must be doubled by competence, fairness, institutional transparency, clarity and consistency in domestic legislation, as well as its correct implementation, but also a consistent level of political development, with a well-established democracy. Taking into account the above, the article aims to analyze the impact of fiscal decentralization, both in terms of revenues and

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expenditures, on variables such as those related to health, education, infrastructure and social inequality at the level of the EU27 countries. As the specialized literature also surprises, there is a substantial correlation regarding the correlation of income decentralization with that of expenditures, and regarding the chosen dependent variables, the study points out that only the indicator selected for infrastructure seems to gain from fiscal decentralization at the EU27 level, and, with a lower intensity, also the chosen education indicator. Health and social income inequality, reflected in turn by two specific indicators of the sustainable development targets, seem not to benefit so much from the fiscal decentralization process, both in terms of revenues and expenditures, a fact that suggests a more substantial need for coordination at national and European level.

Description of the Problem and Literature Review

Fiscal decentralization is often analyzed in relation to its performance, the advantages and disadvantages brought to the economy. In relation to social outcomes, fiscal decentralization can improve these outcomes through yardstick competition, through better matching of preferences, through minimizing government monopoly power, through imposition of fiscal performance at least equivalent to that at the national level, through the improvement governance and government accountability, through the creation of competition between local authorities at the same level, attracting the population to areas with greater local welfare (Tiebout, 1956; Oates, 1972; Edwards and Keen, 1996; Besley and Case, 1995; Azfar et al, 2006; Altunbas and Thornton, 2012; Escobar-Lemmon and Ross, 2014; Nakatani et al., 2022). In a negative sense, fiscal decentralization presents the common pool problem, diseconomies of scale, flypaper effect, but also increased inefficiency in macroeconomic stabilization policy (Fisher, 1982; Berry, 2008; Sow and Razafimahefa, 2017).

If we refer to the impact of fiscal decentralization on health, many studies refer to studies on specific countries or particular groups of countries, such as OECD countries, generally pointing to the positive effect of decentralization on the health system (Asfaw et al., 2007; Cantarero and Pascual, 2008; Cavalieri and Ferrante, 2011; Di Novi et al., 2019), although there are also contrary results (eg. Kyriacou and Roca-Sagalés, 2021; Lago-Peñas et al., 2022; Nakatani et al., 2022). Regarding the impact of decentralization in education, some studies confirm the positive effect (Falch and Fischer, 2012; Gómez-Reino et al., 2021; Elacqua et al., 2021) others on the contrary (Leer, 2016; Kameshwara et al., 2020). Thus, the present study can contribute to clarifying the situation regarding the impact of fiscal decentralization on some social variables at the EU27 level.

Methodology and Data

The article analysis the relationship between a series of macroeconomic social indicators such as of health, education, infrastructure and social inequality and the fiscal decentralization of local income and expenditure at EU27 level. The method is ordinary least squares estimation and the period of analysis is 1999 - 2023. Where the data stops in the previous periods, they are extended by various methods of extrapolation and forecasting, and where they are missing in the series, interpolation methods are used. In the light of above, the results should be viewed with considerable caution. At the same time, using the panel technique, one must take into account the rather large heterogeneity of information at the EU27 level. The number of observations obtained is 675, and thus informational volume can be considered relevant, but the data time series can be extended also in future studies. Below there are presented the initial selected indicators, their description and source (see table 1).

Table 1

The initial indicators selection and description

Acronym of indicators	Description of indicators	Unit of measure	Source
SPGVGPH	Share of people with good or very good perceived health by sex	% of population 16 years or over	Eurostat, [sdg_03_20]
ELET	Early leavers from education and training by sex	% of population 18 to 24 years	Eurostat, [sdg_04_10]
PCLSWT	Population connected to at least secondary wastewater treatment (Urban, independent and other wastewater treatment - at least secondary treatment)	%	Eurostat, [sdg_06_20]
ISBP40	Income share of the bottom 40 % of the population	% of income	Eurostat, [sdg_10_50]
LFDR	The share of local revenues in total revenues at the national level or the fiscal decentralization of revenues at the local level	%	Eurostat, [gov_10a_main__custom_12974348]
LFDE	The share of local expenditures in the total expenditures at the national level or fiscal decentralization of the expenditures at the local level	%	Eurostat, [gov_10a_main__custom_12974348]
RGPCAP	Real GDP per capita (Chain linked volumes (2010), Gross domestic product at market prices)	euro per capita	Eurostat, [sdg_08_10]

Source: Author's selection

Results

In order to identify the interrelationship between the evolutions of the independent indicators and the dependent variable, the statistical description of the selected specific indicators of Eurostat is presented below (Table 2). Thus, we can analyse the statistical properties of the variables, such as the average value, standard deviation, skewness, and kurtosis.

A low standard deviation below the mean indicates that the values tend to get closer to the mean indicating that the values are spread out over a narrow range close to the mean. Also, the median and the mean are close in value for all the predictive variables studied, suggesting a relatively symmetrical distribution of the series.

We notice that the variables ELET, LFDE, RGDCAP are above the value of 1, which indicates that they are substantially and positively skewed, while for the SPGVGPH, PCLSWT and ISBP40 there is an adverse Skewness. For ELET, LFDR, LFDE and RGDPCAP the kurtosis is above 3, which indicates that the distribution is leptokurtic, producing more values than a normal distribution, while for SPGVGPH, PCLSWT and ISBP40 the Kurtosis is below 3, suggesting that, in relation to the normal distribution, it produces fewer and less extreme values.

Table 2

The statistical description of the variables

	SPGVGPH	ELET	PCLSWT	ISBP40	LFDR	LFDE	RGDPCAP
Mean	64.53815	11.97115	67.83063	21.59037	23.22767	22.37361	24807.91000
Median	67.20000	10.20000	73.37000	22.10000	20.78357	19.62228	20450.00000
Maximum	84.50000	54.40000	99.78000	26.20000	66.04932	66.86293	88120.00000
Minimum	30.80000	2.00000	0.00000	15.50000	1.22783	1.03173	2883.33300
Std. Dev.	11.07760	7.64473	24.56338	2.40717	12.89075	13.22345	16819.17000
Skewness	-0.63682	2.41282	-0.77086	-0.31058	0.95476	1.14556	1.50129
Kurtosis	2.62440	11.12373	2.85244	2.06214	4.43098	4.83044	5.87035
Jarque-Bera	49.59152	2511.05200	67.46238	35.58982	160.14170	241.86630	485.28120
Probability	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Sum	43563.25	8080.53	45785.68	14573.50	15678.68	15102.18	16745342
Sum Sq. Dev.	82708.73	39389.81	406664.30	3905.45	111999.50	117855.30	1.91E+11
Observations	675	675	675	675	675	675	675

Source: Author calculation, EViews 9 processing

Based on the information of above, it can be constructed an Augmented Dickey-Fuller (ADF) unit root test and present the descriptive statistics of the models. The Table 3 demonstrates that all of the variables utilized in this investigation are stable at order 1.

Table 3

Augmented Dickey-Fuller unit root test for the chosen variables

Variables tested for ADF	T-statistic	Mackinnon critical value at 5%	P-value	Order of integration	Observation
SPGVGPH	-26.2081	2.8656	0.0000	I(1)	Stationary
ELET	-24.9920	-2.8656	0.0000	I(1)	Stationary
PCLSWT	-25.1974	-2.8656	0.0000	I(1)	Stationary
ISBP40	-27.2572	-2.8656	0.0000	I(1)	Stationary
LFDR	-25.8583	-2.8656	0.0000	I(1)	Stationary
LFDE	-25.8168	-2.8656	0.0000	I(1)	Stationary
RGDPCAP	-25.0488	-2.8656	0.0000	I(1)	Stationary

Source: Author's calculations, EViews 9 processing

Next, we present the results of the correlation matrix, the regression equations showing the link between the proposed variables.

Table four shows the correlation matrix between the dependent variables: Share of people with good or very good perceived health by sex (SPGVGPH), Early leavers from education and training by sex (ELET), Population connected to at least secondary wastewater treatment (Urban, independent and other wastewater treatment - at least secondary treatment)

(PCLSWT), Income share of the bottom 40 % of the population (ISBP40) and the share of local revenues in total revenues at the national level or the fiscal decentralization of revenues at the local level (LFDR) and the share of local expenditures in the total expenditures at the national level or fiscal decentralization of the expenditures at the local level (LFDE). Also, a control variable was also chosen to adequately describe the economic context, such as Real GDP per capita (Chain linked volumes, percentage change on previous period, per capita) (RGDPCAP).

Table 4

The correlation matrix of the chosen variables

	SPGVGPH	***ELET***	***PCLSWT***	***ISBP40***	***LFDR***	***LFDE***	***RGDPCAP***
SPGVGPH	1						
ELET	-0.0526	1					
PCLSWT	0.2831	-0.3467	1				
ISBP40	0.3377	-0.3135	0.2866	1			
LFDR	-0.0883	-0.2534	0.3139	0.1448	1		
LFDE	-0.0626	-0.2413	0.3269	0.1667	0.9911	1	
RGPCAP	0.5677	-0.1453	0.5157	0.4125	0.0877	0.1291	1

Source: Author's calculations, EViews 9 processing

Thus, we observe that the correlation values are relatively insignificant, suggesting that there is no problem of autocorrelation between the data, and regarding the fiscal decentralization of revenues and expenditures regarding the four dependent variables (SPGVGPH, ELET, PCLSWT, ISBP40), however these values are within an extremely reasonable limit well below 0.500. We thus observe based on the correlation matrix that SPGVGPH is negatively but not substantially correlated both with the decentralization of revenues and local expenditures. On the other hand, the negative correlation of ELET with the decentralization of income and expenditures does not have a negative meaning in the sense that the indicator itself has a negative connotation, being linked to school dropout. With regard to the indicator that transposes the secondary infrastructure of wastewater (PCLSWT) and the one related to social inequity (ISBP40) they are positively but not substantially correlated with the decentralization of revenues and local expenditures respectively. In order to be able to reveal more information, we proceed to develop a series of regression equations.

Generically, the equations are SPGVGPH or ELET or PCLSWT or ISBP40 = f (LFDR or LFDE, RGPCAP) represented as:

$Y=\alpha+\beta1x_1+\beta2x_2+\varepsilon$ (1)

where:

Y= the dependent variables chosen successively as: Share of people with good or very good perceived health by sex (SPGVGPH), Early leavers from education and training by sex (ELET), Population connected to at least secondary wastewater treatment (Urban, independent and other wastewater treatment - at least secondary treatment) (PCLSWT), Income share of the bottom 40 % of the population (ISBP40) α= Constant; β1-6=Slope or x1-X2 coefficients; x1 is the coefficient of the regression or the independent variables, which is, in turn, either fiscal decentralization of revenues at the local level (LFDR) or the fiscal decentralization of the expenditures at the local level (LFDE). x2 is the coefficient of the regression or the independent

variables, which is Real GDP per capita (Chain linked volumes, percentage change on previous period, per capita)(RGDPCAP); ε= error term.

Table 5 shows, in a centralized way, the connection between the predictor variables and the response variable, table 5 is considering the connection with income decentralization, and table 6 is considering the connection with expenditures decentralization.

Table 5

The results of the regression equations that have income decentralization among the independent variables

Method: Least squares; included 674 after adjustments observations, first difference				Coefficient	t-Statistic	Probability
Dependent Variable	SPGVGPH	**Independent Variable**	LFDR	-0.115956	-3.477822	0.0005
R-squared	0.343654		RGDPCAP	0.000397	18.225390	0.0000
Adjusted R-squared	0.342677		Akaike info criterion		5.069566	
S.E. of regression	3.047627		Schwarz criterion		5.082959	
Sum squared resid	6241.556		Durbin-Watson stat		2.015744	
Method: Least squares; included 674 after adjustments observations, first difference				Coefficient	t-Statistic	Probability
Dependent Variable	ELET	**Independent Variable**	LFDR	-0.105449	-3.086117	0.0021
R-squared	0.030142		RGDPCAP	-7.87E - 05	-3.528294	0.0004
Adjusted R-squared	0.028699		Akaike info criterion		5.118582	
S.E. of regression	3.123240		Schwarz criterion		5.131974	
Sum squared resid	6555.111		Durbin-Watson stat		1.926362	
Method: Least squares; included 674 after adjustments observations, first difference				Coefficient	t-Statistic	Probability
Dependent Variable	PCLSWT	**Independent Variable**	LFDR	0.491526	6.390928	0.0000
R-squared	0.241599		RGDPCAP	0.000677	13.481050	0.0000
Adjusted R-squared	0.240470		Akaike info criterion		6.741234	
S.E. of regression	7.030073		Schwarz criterion		6.754627	
Sum squared resid	33211.53		Durbin-Watson stat		1.932319	
Method: Least squares; included 674 after adjustments observations, first difference				Coefficient	t-Statistic	Probability
Dependent Variable	ISBP40	**Independent Variable**	LFDR	-0.014439	-1.746868	0.0811
R-squared	0.165470		RGDPCAP	6.10E -05	-11.30335	0.0000
Adjusted R-squared	0.164228		Akaike info criterion		2.280155	
S.E. of regression	0.755525		Schwarz criterion		2.293548	
Sum squared resid	383.5898		Durbin-Watson stat		2.127119	

Source: Author's calculations, EViews 9 processing, the grey values show an acceptable probability

Thus, in the case of income decentralization, we observe that almost all the indicators proposed as dependent variables (except ISBP40) have appropriate attached probabilities, being below 0.05. R-squared and adjusted R-squared are relatively high and with satisfactory values for SPGVGPH and PCLSWT.

Table 6

The results of regression equations that have expenditures decentralization among the independent variables

Method: Least squares; included 674 after adjustments observations, first difference				Coefficient	t-Statistic	Probability
Dependent Variable	SPGVGPH	**Independent Variable**	LFDE	-0.149005	-4.583137	0.0000
R-squared	0.352092		RGDPCAP	0.000405	18.721670	0.0000
Adjusted R-squared	0.351128		Akaike info criterion		5.056626	
S.E. of regression	3.027972		Schwarz criterion		5.070019	
Sum squared resid	6161.309		Durbin-Watson stat		2.015803	
Method: Least squares; included 674 after adjustments observations, first difference				Coefficient	t-Statistic	Probability
Dependent Variable	ELET	**Independent Variable**	LFDE	-0.089366	-2.660106	0.0080
R-squared	0.026646		RGDPCAP	- 7.27E -05	-3.255589	0.0012
Adjusted R-squared	0.025198		Akaike info criterion		5.122180	
S.E. of regression	3.128865		Schwarz criterion		5.135573	
Sum squared resid	6578.741		Durbin-Watson stat		1.924930	
Method: Least squares; included 674 after adjustments observations, first difference				Coefficient	t-Statistic	Probability
Dependent Variable	PCLSWT	**Independent Variable**	LFDE	0.3595584	4.700730	0.0000
R-squared	0.221115		RGDPCAP	0.000650	12.790720	0.0000
Adjusted R-squared	0.219956		Akaike info criterion		6.767885	
S.E. of regression	7.124379		Schwarz criterion		6.781278	
Sum squared resid	34108.55		Durbin-Watson stat		1.93395	
Method: Least squares; included 674 after adjustments observations, first difference				Coefficient	t-Statistic	Probability
Dependent Variable	ISBP40	**Independent Variable**	LFDE	-0.016500	-2.035593	0.0422
R-squared	0.166817		RGDPCAP	6.19E -05	11.492260	0.0000
Adjusted R-squared	0.165578		Akaike info criterion		2.278539	
S.E. of regression	0.754915		Schwarz criterion		2.291931	
Sum squared resid	382.9702		Durbin-Watson stat		2.124262	

Source: Author's calculations, EViews 9 processing

On the other hand, regarding the dependent variable ELET R-square and adjusted R-square the values are extremely low and can hardly be considered relevant. However, the coefficient of fiscal decentralization for local revenues is relatively satisfactory and substantially different from zero in the case of the equation regarding PCLSWT, i.e. the variable related to water treatment infrastructure. In the case of ELET, although insignificant in terms of importance, the negative coefficient still has a positive meaning, in the sense that when the decentralization of local incomes increases, there may also be a reduction in school dropouts. The same cannot be said about income inequality (ISBP40), an indicator that suggests that fiscal decentralization does not necessarily support the incomes of the population with the lowest 40% incomes. The results are relatively similar in the case of expenditures (see table 6), as mentioned that in this case all the dependent variables can be accepted in the model, although the coefficients of the independent variables are not substantially different from zero (with the exception of PCLSWT).

The probability for the total equations chosen is adequate, being below 0.05. Thus, these variables can be confidently accepted in the models.

The result indicates that fiscal decentralization can be interpreted as beneficial in the case of infrastructure (in our case, wastewater infrastructure), partially beneficial for education, but less effective for the local health system and for reducing the income inequality of the poor population.

It should be mentioned that working with the first difference, the results are relatively blurred compared to the initial series, and the indicators proposed as dependent variables, although they are chosen from among the sustainable development targets, may still not be the most appropriate solutions. In addition, if decentralization is calculated at the local level, the variables of the sustainable development targets are still those at the national level, in the absence of specific social indicators also calculated at the local level. All these mentions can make us take the necessary caution in interpreting the results.

Conclusions

Fiscal decentralization seems to be a discussion on everyone's lips lately. Although it has certain advantages, there are also a multitude of disadvantages and the social benefits are not always so clear or relevant.

Thus, using panel data, the article treats at the level of EU27 countries the subject of fiscal decentralization of incomes and expenditures in relation to a series of social indicators related to health, education, infrastructure and inequity.

Although the results are encouraging regarding the local infrastructure (in our case, an indicator regarding the infrastructure of urban waste water is chosen) and somewhat beneficial for the education system, the same cannot be said for the health system and the reduction of income inequality.

Future Directions

The study can be extended for another geographical area, for substantial data series, including longer time series, it can propose more relevant dependent variables, it can capture through specific indicators at the local level specific elements that may or may not be imposed by the fiscal decentralization process. All these, and many others, will be taken into account for the development of the analysis in the future.

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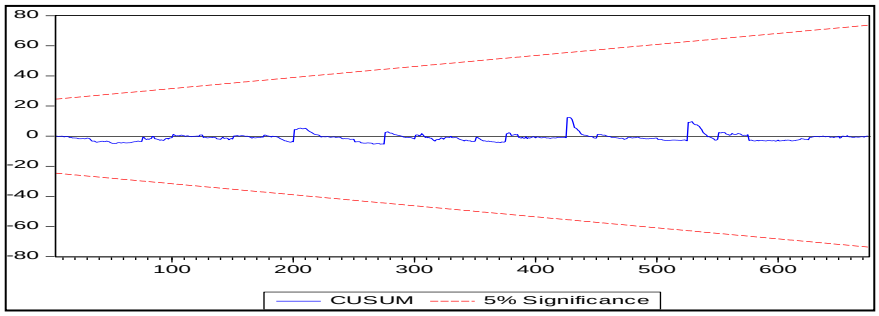
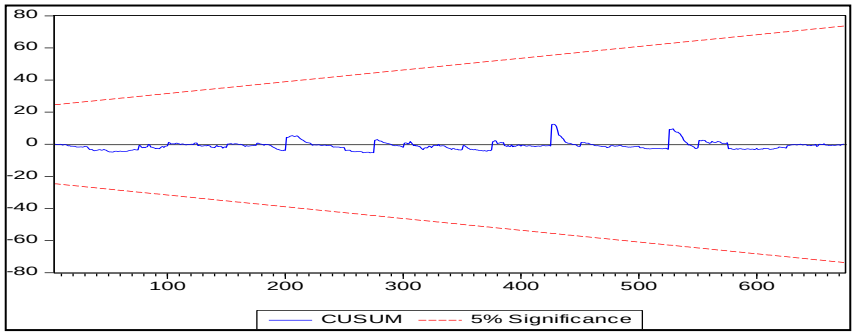
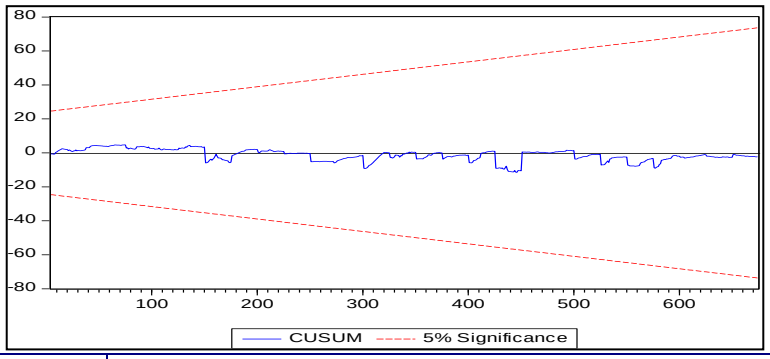
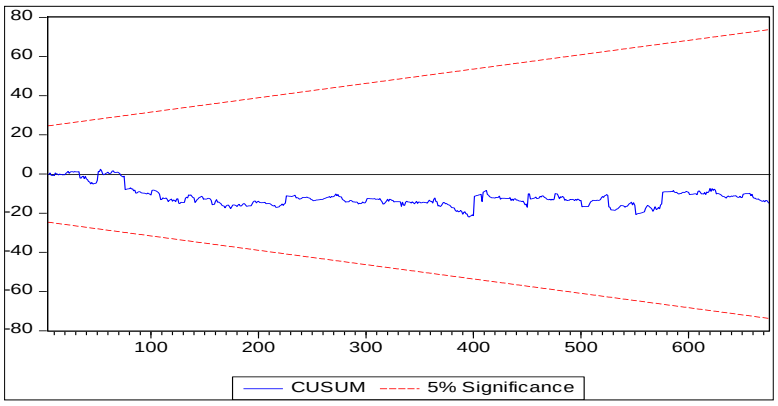
Annex

Table 1

The assessment results for explaining the impact of revenue fiscal decentralization

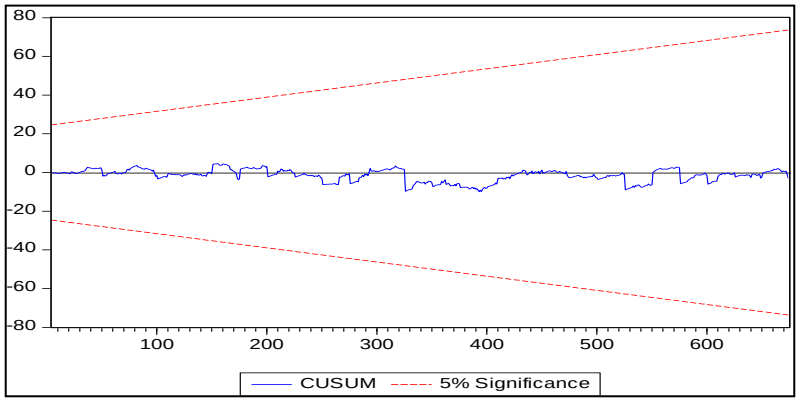
Dependent variable (first diference)	SPGVGPH			
Fact-findings verifications	F - Statistics			P-value
Ramsey RESET -Stability test	0,819549			0,3656
Heteroskedasticity Test: Breusch-Pagan-Godfrey	14,72389			0,0000
LM test	0,035795			0,9648
Multi-Collinearity test for initial equation	Coefficient variance	Uncentered VIF	Result analysis	Observations
DLFDR	0,001112	1,0027	VIF<10	No interconnectivity of independent variables
DRGDPCAP	4.74E -10	1,0027	VIF<10	No interconnectivity of independent variables
CUSUM test				
Dependent variable (first difference)	ELET			
Fact-findings verifications	F - Statistics			P-value
Ramsey RESET -Stability test	36,010280			0,0000
Heteroskedasticity Test: Breusch-Pagan-Godfrey	8,477254			0,0002
LM test	0,548462			0,5781
Multi-Collinearity test for initial equation	Coefficient variance	Uncentered VIF	Result analysis	Observations
DLFDR	0,001167	1,002741	VIF<10	No interconnectivity of independent variables
DRGDPCAP	4,97E-10	1,002741	VIF<10	No interconnectivity of independent variables
CUSUM test				

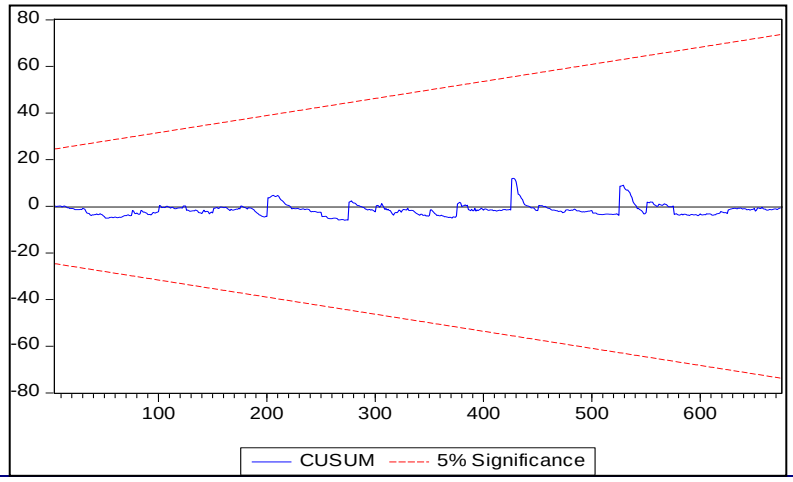
Dependent variable (first difference)	PCLSWT			
Fact-findings verifications	F - Statistics			P-value
Ramsey RESET -Stability test	1,599771			0,2064
Heteroskedasticity Test: Breusch-Pagan-Godfrey	2,633587			0,0726
LM test	0,634054			0,5308
Multi-Collinearity test for initial equation	Coefficient variance	Centered VIF	Result analysis	Observations
DLFDR	0,005915	1,002741	VIF<10	No interconnectivity of independent variables
DRGDPCAP	2,52E-09	1,002741	VIF<10	No interconnectivity of independent variables
CUSUM test				
Dependent variable (first difference)	ISBP40			
Fact-findings verifications	F - Statistics			P-value
Ramsey RESET -Stability test	37,117960			0,0000
Heteroskedasticity Test: Breusch-Pagan-Godfrey	58,258270			0,0000
LM test	1,380998			0,2520
Multi-Collinearity test for initial equation	Coefficient variance	Uncentered VIF	Result analysis	Observations
DLFDR	6,83E-05	1,002741	VIF<10	No interconnectivity of independent variables
DRGDPCAP	2,91E-11	1,002741	VIF<10	No interconnectivity of independent variables
CUSUM test				

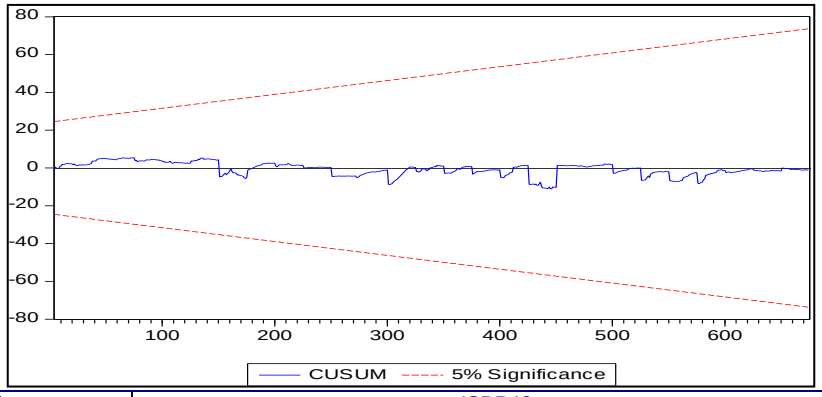
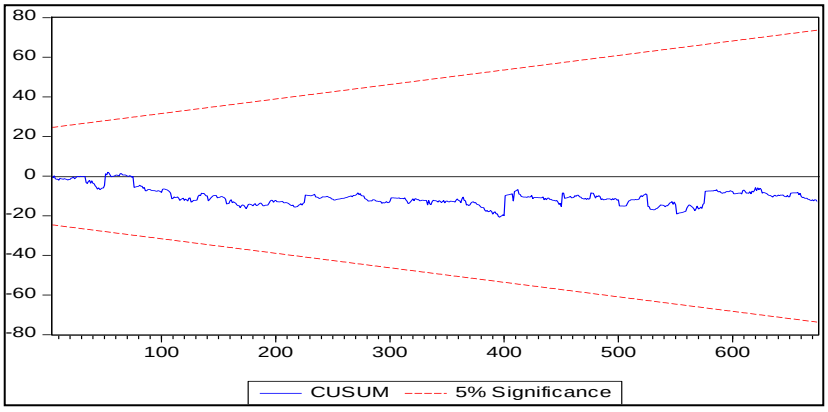
Source: Author's calculations, EViews 9 processing

Table 2

The assessment results for explaining the impact of expenditures fiscal decentralization

Dependent variable (first diference)	SPGVGPH			
Fact-findings verifications	F - Statistics			P-value
Ramsey RESET -Stability test	0,90798			0,3410
Heteroskedasticity Test: Breusch-Pagan-Godfrey	13,82050			0,0000
LM test	0,02409			0,9762
Multi-Collinearity test for initial equation	Coefficient variance	Uncentered VIF	Result analysis	Observations
DLFDE	0,001057	1,001626	VIF<10	No interconnectivity of independent variables
DRGDPCAP	4.67E-10	1,001626	VIF<10	No interconnectivity of independent variables
CUSUM test				

Dependent variable (first diference)	ELET			
Fact-findings verifications	F - Statistics			P-value
Ramsey RESET -Stability test	5,987050			0,0000
Heteroskedasticity Test: Breusch-Pagan-Godfrey	7,184998			0,0008
LM test	0,584132			0,5579
Multi-Collinearity test for initial equation	Coefficient variance	Uncentered VIF	Result analysis	Observations
DLFDE	0,001129	1,001626	VIF<10	No interconnectivity of independent variables
DRGDPCAP	4.99E-10	1,001626	VIF<10	No interconnectivity of independent variables
CUSUM test				

Dependent variable (first diference)	PCLSWT			
Fact-findings verifications	F - Statistics			P-value
Ramsey RESET -Stability test	6,686466			0,0099
Heteroskedasticity Test: Breusch-Pagan-Godfrey	4,282989			0,0142
LM test	0,593590			0,5526
Multi-Collinearity test for initial equation	Coefficient variance	Centered VIF	Result analysis	Observations
DLFDE	0,005852	1,001626	VIF<10	No interconnectivity of independent variables
DRGDPCAP	2.59E-09	1,001626	VIF<10	No interconnectivity of independent variables
CUSUM test				
Dependent variable (first diference)	ISBP40			
Fact-findings verifications	F - Statistics			P-value
Ramsey RESET -Stability test	37,826760			0,0000
Heteroskedasticity Test: Breusch-Pagan-Godfrey	58,803480			0,0000
LM test	1,317265			0,2686
Multi-Collinearity test for initial equation	Coefficient variance	Uncentered VIF	Result analysis	Observations
DLFDE	6.83E-05	1,002741	VIF<10	No interconnectivity of independent variables
DRGDPCAP	2.91E-11	1,002741	VIF<10	No interconnectivity of independent variables
CUSUM test				

Source: Author's calculations, EViews 9 processing

PERFORMANCE MANAGEMENT OF PUBLIC ADMINISTRATION PERSONNEL

Adrian Eugen DINU[2]

Abstract:

This material aims to bring to the fore, through an empirical approach, corroborating the literature with the authors' view, the main features of performance management of public administration personnel – reforms, problems in implementation, team arrangements, on the one hand, but also the directions of use of this information both against the background of conditions for improving the administration personnel in performance management.

Keywords: *administrative capacity, performance management, public policies*

JEL classification: *H400*

Introduction

This study combines significant elements of economic epistemiology, such as: performance management, problem analysis, personnel administration, comparative study, in order to growing the level of public administration capabilities. the needs of society and functions on the basis of organizational structures, processes, roles, relationships, policies and programs.

Public administration reflects the institutional bases of how countries are governed. The public administration responds to the needs of society and functions on the basis of organizational structures, processes, roles, relationships, policies and programs.

Although the main focus of public sector reforms has been on the external environment of the public organization, both through strategic management and improving the relationship with outside groups and other external influences, there have also been major changes in internal management.

Description of the Problem

Public policies and their management are conceptualized in offices, organized and framed more or less bureaucratically and this may be due to the fact that the traditional model focused on organization and, over time, elaborate procedures and systems were built, and the changes made to them were naturally resisted.

There has also been resistance from civil servants and public sector unions who see the changes to personnel systems - performance appraisal, short-term contracts, merit pay - as threats to long-established terms and conditions of employment.

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Employees are the main asset of public organizations. With their aging and the increased automation of routine processes, a greater emphasis must be placed on anticipation and reaction to strategic issues, which require a capable leadership that ensures the involvement of the entire staff.

All have seen major changes in the managerial model, which seek to make the organization and its internal management systems more direct than before. Even though the greater external focus in new public management is an overdue reform, it only directly involves managers at the top strategic levels. However, the various internal management reforms affected everyone in the organization.

All these functions existed to varying degrees in the traditional management model. Attention was always paid to organizational structures, the personnel management system and performance monitoring, although these were considered in a rather narrow, bureaucratic way. Monitoring performance was particularly poor in the traditional model and other internal management components, particularly budgeting, were aimed at monitoring inputs rather than outputs or achievement of objectives. Internal management in the traditional model has been criticized for being obsessed with structure, with any outcome being incidental or assumed to follow naturally from the organization. As with other changes to a managerial model of governance, it is assumed that the emphasis for internal management will now be on results.

Methodology and Data

By any standard, performance management in the traditional management model has been inadequate, and this applies to both individual and organizational performance. The measures that did exist were ad hoc and far from systematic. It is true that there are difficulties in measuring performance in the public sector compared to the private sector, but little effort seemed to have been made. Perhaps it was assumed that results would follow from bureaucratic organization, so that any explicit measure would be unnecessary. Often it was not known what was produced, how well it was produced, who would get the credit or the blame, or even who was a good worker. In any case, an administrator need not worry about performance, since all he does is execute instructions, and measuring performance is a matter for those giving the instructions. Evaluation of programs or individuals was sparse and inadequate, with no sense of progress toward goals, if indeed there were clear goals.

Performance management reforms are a particularly important part of the management program. Agencies in many parts of government are now expected to develop "performance indicators", that is, a way of measuring the progress made by the organization in achieving its stated objectives. Statistical measures can be developed in any organization, although there are more difficulties in practice in the public sector than usually in the private sector. Staff performance must also be measured more systematically than before. The performance appraisal system aims to measure the performance of individual staff, even to the extent of defining expected key contributions during the year, which are then compared with actual achievements at the end of the year. This may extend to rewarding or sanctioning staff based on progress towards agreed targets. Informal evaluation methods are considered ineffective and lead to inferior organizational results.

There is an overall purpose to monitor and improve staff and agency progress towards achieving objectives

One of the starting points was the Financial Management Initiative (FMI) in the United Kingdom, which aimed to promote in every department (UK Treasury and Public Service Committee, 1982) an organization and a system in which managers from all levels have:

• a clear view of their objectives and means of evaluation, measurement of results or performance in relation to these objectives;

• well-defined responsibility for the best use of their resources, including critical control of output and value for money;

• the information (especially about costs), training and access to specialist advice they need to carry out their responsibilities effectively.

This had implications for financial management, but also for personnel and performance. Indeed, all three were tied together in a new management system that involved specifying objectives for all government policies and for individual units within the bureaucracy; accurate allocation of costs for activities and programs; and "developing performance indicators and measures of achievement that can be used to assess success in achieving goals" (Carter, Klein, & Day, 1992, p. 5).

Carter, Klein and Day argue that this move in Britain represented "A movement to institutionalize the search for efficiency and generalize attempts to change the management culture of Whitehall". Performance indicators became a new movement within public services with the express purpose of finding out how hard government activity needed to be measured. Performance indicators have been established for all types of activities and it has been shown that different indicators can be developed for different purposes:

Governments have increased the use of performance indicators, as the managerial system is imposed and these data become the subject of public debate. If central government 'must maintain control over policy implementation while decentralizing day-to-day responsibility, performance indicators become an essential tool: it is necessary to centralize knowledge about key aspects of performance in order to decentralize the work' (1992, p.179)

Performance indicators are open to criticism for trying to specify the unspecifiable, given the inherent difficulties of measuring performance in the public sector. Managers will argue that the benefits of their particular organization cannot be quantified or that empirical measurement distorts what it does by focusing only on those things that can be quantified and that can be processed by the information system (Bellamy and Taylor, 1998). This can be a danger, but it can be overcome by establishing measures directly related to the overall success of the organization. Also, once the objectives are set, they should not be set concretely. Because the objectives of public organizations change frequently, "Management indicators must be flexible and continually reexamined and modified" (Cohen, 1988, p. 68).

Taking such measures is necessary to assess the manager's achievement of results, as is characteristic of public management, even if there are limitations as to the extent to which this can be extended. As Holmes and Shand (1995, p. 563) argue:

Our contention is that performance measurement and its wider use in performance management is a useful exercise, as long as it is done in full awareness of its limitations. At least it can provide improved information relevant to decision making. It can usefully inform the budget process without the pretense that there can be a direct link between budget and performance. It can also provide useful accountability information for public debate. Indeed, a major downfall of the reforms has been a substantial increase in the amount of information on the impact of government policies and programs as reflected in budget documents, annual

reports, etc.… This has largely contributed to much greater transparency in government, a major factor in improving performance

Of course, there are even greater difficulties in measuring performance in the public sector, but this does not mean that no attempt should be made. The original idea of managerial reformers was to provide a surrogate measure for the use of profit and other measures in the private sector. Without an attempt to measure performance, the other aspects of the management program will not work. However, it is important that performance measures are developed for the specific needs of the public sector (see Talbot, 1999).

A measure is unlikely to be as good as profit, but there are several reasons why performance measures will continue to be used. First, individual civil servants may see the use of evaluation indicators as a threat, but it can be an opportunity by pointing to good practice and good performance, both of which can be rewarded. Second, since any public activity is threatened with being cut or eliminated altogether in the current climate, a position or position where performance measures are inadequate is much more vulnerable. Third, there is no point in setting clear targets or funding programs accordingly unless there is some means by which progress towards the targets could be monitored. So much capital has been invested in these other changes that performance measures will be insisted upon.

Personnel issues and performance changes

The various internal management changes have been criticized and given that they have affected everyone, this is quite surprising. Some have argued that a career in public service isn't what it used to be. The notion of career service is disappearing, as is lifetime tenure or the inability to be fired. Promotion prospects are less certain and there has been a bewildering series of morale-damaging reforms.

Staff arrangements

There are several points made by critics regarding the changes in personnel systems. Pollitt and Bouckaert (2000, pp. 162–3) refer to a personal contradiction between motivating public employees and reducing their working conditions. There is a point to this. At the same time that public management reforms are claimed to free managers and allow them to take responsibility, the mandate is removed, as are many of the special terms of service once given to administrators. As Peters (1996, p. 18) argues:

These changes tend to replicate private sector personnel management and also weaken the government's long-term commitment to its employees. Working for the public sector is now less different from working for the private sector and we should think about the implications of these changes.

Personal performance review becomes a control tool. Horton argues that "public servants are now more obviously managed, with personal review acting as a tool of control, although it is more often presented as a tool of individual consultation and empowerment" (1999, p. 153). Pollitt and Bouckaert also argue that managers have more freedom but are simultaneously under greater control (2000, p. 138):

Under the surface, the process of letting - or making - public administrators manage was not so simple. There have been trade-offs and considerable centralization, partly through the establishment of increasingly sophisticated performance indicators and target regimes, supported by rapidly advancing information technologies...Executive politicians have shifted their focus for control from inputs to outputs , through processes. This may explain the somewhat ambiguous responses from public service managers - they experienced greater

freedom to implement their inputs (e.g. shifting money from staff to equipment or vice versa), but at the same time felt under closer scrutiny than ever in terms of their results.

Civil servants have a greater scope to do things and achieve results, but with that has come increased attention to whether or not results have been achieved.

In itself, this may not be a big problem, but it is very difficult for public administrators if they expect to achieve results while following the same detailed procedures as in the bureaucratic model. Management leeway must be significant, but no one can escape scrutiny after results have been achieved.

Another issue was the idea of providing incentives through additional payment. Even though pay-for-performance is a good idea in the abstract, it has been difficult to implement in a fair and reasonable way. It can be used to reward favorites and can cause resentment among those who consider themselves worthy of additional reward but receive none.

Finally, it still remains difficult to measure the performance of public sector staff, so issues of inequity may not be addressed. On the other hand, it could be argued that "fairness" in reward structures is a public service worldview, that the private sector hardly has "fair" reward structures, and that a certain unfairness may be the price to pay for greater flexibility.

Performance management issues

Performance management has attracted a number of criticisms. While it is no longer the case that there are no performance indicators, there is hope that improvements can be made.

Even the financial performance of the private sector is not a perfect measure of organizational performance. Measuring performance is not easy anywhere, and it is certainly the case that private organizations use a variety of measures other than simply profit. Competition is probably a more effective driving force than any form of measurement. However, public organizations are also competitors: competitors for scarce budgetary resources. Governments want to have some means of deciding which parts of their operations make good use of resources.

There are problems in implementing performance measurement. It is difficult to design adequate measures of performance, but since the rest of the management program depends on it, some progress is necessary. There have also been problems with the type of performance indicators that have been used so far. The measures must be significant but parsimonious and have a direct impact on the operations of that part of the public sector. Poorly chosen performance measures can lead management to focus on achieving satisfactory results through the measures used instead of the best possible performance by the organization as a whole. Furthermore, despite the attractions of a rigorous staff performance appraisal system in identifying both good and poor performers, it is difficult to design a system that provides reliable comparisons and is accepted by those involved. In many parts of the public service it is difficult to compare the performance of each individual in a fair and comprehensive way.

Results

Because there are changes affecting so many employees, the use of performance indicators may be abandoned, or it may be suggested that more work should provide better measures.

A pattern appears to be emerging where performance measures are initially both opposite and poorly designed. Osborne and Gaebler argue that "this pattern—the adoption of crude measures of performance, followed by protest and pressure to improve the measures, followed

by the development of more sophisticated measures—is common wherever performance is measured" (1992, p. 156).

Perhaps too much can be claimed for the use of performance indicators. Rather than being performance measures—perfect surrogates for profit in the private sector—they are really performance indicators, which are simply indicators of good or bad performance and do not attempt to measure it precisely. Not measuring performance is now unthinkable, but there are many better ways that performance indicators can and should be used. As Carter, Klein and Day argue, "the real challenge is to move from an exclusively managerial view of responsibility and the role of performance indicators to a broader political definition" (1992, p. 183). In addition to indicators of overall progress towards achieving objectives or achieving financial goals, there should be indicators of client or customer satisfaction or the speed and level of service delivery. Indicators should aim to measure effectiveness and quality rather than efficiency (Flynn, 1997, pp. 170-85) and outputs rather than outputs.

Conclusions

The series of relentless attacks on government and bureaucracy, followed by a series of stunning changes, including those in performance measurement and personnel, caused morale problems. Public administration in its golden age was a valuable and valued profession. This was no longer the case in the 1980s, and individual bureaucrats had to deal with the antipathy of citizens. Weber wanted bureaucrats to be respected as an elite group, but increasingly, they were denounced as wasting scarce taxpayers' money. The public's lack of respect for the bureaucracy no doubt made the process of managerial reform easier to accept, but it probably exacerbated the problem of public service morale. Managerial changes and reforms imputed the motives of civil servants and took away many of their hard-fought benefits, such as the expectation of a lifetime job.

Not only is there a serious morale problem, but there seems to be no quick or easy solution. Demoralized workers are obviously less effective, so improving overall performance requires special attention to morale issues. The problem of morale may be part of a larger problem. Attacks on bureaucracy, even on government as a whole, could be part of some general disenchantment with the idea of politics and government. Perhaps attacks on government affected not only the theory and practice of public administration, but the very idea that government and public service could improve the lot of those in society.

Whatever the cause, the public sector is unlikely to be the cozy and easy place it might have been before the 1980s. Pollitt seems surprised that lower-level staff "show less enthusiasm for the reforms adopted than the 'mandarins' in peak" (2001, pp. 476-7). This should not come as a surprise. The old administration was comfortable and easy, a wonderful place to work for those who valued stability. The managerial job is more difficult; it's more rewarding for the able-bodied, but less comfortable for those who want the easy life. In that sense, it is more like the private sector. As an OECD paper (1998, p. 48) argues:

Some civil servants also say they are concerned about the disruption that change inevitably brings, as well as the number and speed of change. The fact is, however, that the amount of structural adjustment in the public sector is typically no greater than experienced elsewhere in the economy, and the pace of change has accelerated everywhere.

There could be a gradual improvement in morale within the system as the expectations of workers change to resemble those of private sector employees. If civil servants do not expect to

be employed for life, they should have fewer morale problems than those former employees who thought they would be. As the reforms continued, staff expectations changed. This has positive effects as it could result in flexibility in staffing. However, flexibility works both ways. Without expectations, or even desires, for long-term employment, good staff would stay for a short time and then leave for another job in the private sector or elsewhere in government. Perhaps the result of all the changes will be the improvement of quality in the public sector and this development will satisfy both citizens and public employees. However, it will be necessary to treat staff as valuable resources. Old-style authoritarianism is most often counterproductive in dealing with good staff because they will simply walk away.

Future Directions

There have been major changes to various parts of the public sector's internal management system since the early 1980s. Personnel management has moved somewhat away from the unsatisfactory methods of the traditional model where, in the name of fairness, personnel procedures almost guaranteed mediocrity. Performance management is also being transformed, both in the personnel and agency sense. Performance appraisal systems offer more than what previously existed, while performance indicators offer the promise of evaluating the agency's performance toward specified goals. Performance can be measured in the public sector, not perfectly, but this is no reason to abandon the use of performance indicators.

And yet, of all areas of managerial change, there were greater problems in internal management and a sense that there was still a long way to go.

Most of the problems related to implementation. It is not easy to institute a new personnel system or to convince the personnel that it is better than the previous one. The changes have been so frequent that many employees don't know where they are. This causes morale problems, exacerbated by the feeling that a public service career is less attractive. If it was once a permanent career, valued by the community, it certainly isn't anymore. Implementing performance indicators is equally difficult. They should be simple, parsimonious, but still meaningful. All of these changes make a lot of sense in theory, but have been difficult to implement.

There are two points to make in looking further. First, even if there have been problems in setting up new systems, the directions of reform in internal management are quite clear. So if certain changes are difficult, they will be replaced by other changes in the same direction, rather than reverting.

Second, comparisons or studies should not look at how well reforms work in the abstract, but rather how well they compare to what went before. In this sense, all the changes mentioned here are much better than those that existed under the traditional management model. In that model, staffing and performance management existed, but were of such dubious quality that any change would have to prove a significant improvement.

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ASPECTS OF FISCAL TRANSPERANCIES ON CRYPTOCURRENCY MARKET IN 2024

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Abstract:

In the year 2024, cryptocurrencies have proven to be digital assets with a pronounced economic potential, many cryptocurrencies have experienced rapid growth and rapid declines, some countries have banned cryptocurrencies, others have allowed their citizens to trade them. The US Securities and Exchange Commission (SEC) announced on January 10, 2024 that it has approved the listing and trading of 11 open-end Bitcoin investment funds, a much-anticipated move in the crypto market. The European Central Bank (ECB) still does not approve the activity of cryptocurrency trading platforms, and several countries, including India, Romania and Turkey, have banned the circulation of cryptocurrencies on their territory. The paper analyzes the problem of the fiscal transparency evolutions of the cryptocurrency market in the period of first nine month of the 2024 year with the objective to highlighting the changes on this market.

Keywords: *digital assets, cryptocurrency/digital currency, Bitcoin ETF, Bitcoin ETP, crypto industry, reverse solicitation.*

JEL classification: *F38, E42, E44*

Introduction

One of the most surprising developments in recent years has been the cryptocurrency market, a market that has seen spectacular increases and decreases in value, unsuccessful attempts at regulation by the banking authorities, but also a general disorientation, especially on the part of buyers of cryptocurrencies. The years 2023 and 2024 were testing years in the cryptocurrency market: investors regained their hope in the spectacular return of Bitcoin to previous dollar transactions and prices. (Almeida, 2023). All these developments brought to the surface the need for stronger regulation of the field. Crypto transactions are not subject to the same fraud, anti-money laundering or suspicious activity checks as traditional ones. In the crypto industry, black money transactions are a feature: major cryptocurrency exchanges, such as Binance, the world's largest, create a transnational payment network heavily used by criminals. In 2022, illicit cryptocurrency transactions topped 20 billion US dollar, according to data analytics firm China analysis, up from 18 billion in 2021 US dollar, a 68 percent increase. In the UK alone, the National Crime Agency estimates that over a billion US dollars of illicit cash is transferred overseas using cryptocurrencies each year. (Benetton, 2024).

Governments around the world have stepped up their crackdown on terror financing sources after the bloody attack by Hamas in Israel on October 7, 2023. Crypto is a small but deadly part of global terrorist financing: research by the firm of analysis Elliptic in 2021 estimated that wallets linked to the military wing of Hamas received more than 7.3 million US dollar in digital currencies, including Doge coin, Elon Musk's favorite cryptocurrency. (Corbet,2023). These sums are not very

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large compared to the 100 million US dollar that Iran sends annually to Hamas and other Palestinian terrorist groups, or the 360 million US dollar that Qatar provides in annual aid to Gaza, or the approximately 300 of millions of dollars that Hamas obtains through business taxation and extortion, estimated by Matthew Levitt of the Washington Institute. In the context of the war waged by the State of Israel against Hamas since October 2023, Israel raided cryptographic accounts linked to Hamas and froze a Barclays bank account apparently linked to the terrorist group,

The US Treasury has also imposed sanctions on financial entities and operators linked to Hamas, including a Gaza-based cryptocurrency and money transfer firm called Buy Cash, as well as facilitators using Sudanese companies to launder money and generate income. The US Treasury's announcement highlighted not only the cryptocurrency fundraising side, but also the use of Buy Cash to transfer funds to Hamas.

In the US, the Securities and Exchange Commission (SEC) has proposed rules that would require firms, including crypto asset exchanges, to register and comply with a system of rules, in an environment where the provision of custody services by banks it was discouraged by the authorities, who became much stricter.

Binance, the world's largest crypto-asset exchange announced that it is considering ending business relationships with US entities and delisting projects that were created in the US. This response comes after Paxos announced that it has halted, at the request of New York authorities, the issuance of BUSD, a stable coin instrument issued under the Binance brand. The exchange has already announced the suspension of US dollar deposits and withdrawals.(Uzougbo, 2023)

A study by the Bank for International Settlements (BIS) shows that between 2015 and 2022, the average investor lost 431 US dollar, almost half of the 900 US dollar invested through the apps monitored in 95 countries; in emerging countries such as India, Thailand, Brazil or Turkey, the share of losses was even higher. With an increasingly careful and tight regulatory perspective, the medium and long horizon is becoming unclear for most projects in the crypto space, while the modus operandi of exchanges is being questioned.(Corbet,2023)

In Hong Kong, the capital markets supervisory commission published on February 20, 2023 a new set of rules for cryptocurrency transactions, including the licensing of firms in the field and a debate on whether or not to allow access to trading platforms to investors in retail.

Evolution of phenomenon of cryptocurrency by region and country

On March 19, 2024, the European Parliament approved a ban on crypto-currency transactions of any value carried out through crypto-hosted wallets. This comes as the European Council and Parliament temporarily agreed to extend parts of EU anti-money laundering and financing of terrorism legislation. to also cover transactions made on the cryptocurrency market.

The European Securities and Markets Authority (ESMA) has proposed that companies in the crypto industry outside the EU can directly serve their customers from the EU bloc under extremely limited conditions, to avoid unfair competition In 2023, the EU established a regulatory framework applicable to crypto assets, crypto asset issuers and crypto asset service providers, and the European Council adopted a Regulation on Markets in Crypto assets (MiCA), establishing for the first time an EU-wide legal framework for this sector . MiCA protects investors by increasing transparence and by establishing a comprehensive framework for issuers and service providers, including in terms of compliance with anti-money laundering rules. ESMA's new rules target issuers of utility tokens, asset backed tokens and so-called "stable cryptocurrencies". These also apply to service providers, such as trading venues and wallets where crypto assets are held.

Announced on 29 January 2024, the proposals on how crypto industry firms and regulatory authorities should apply the existing legislation relate to non-EU companies that manage crypto assets and want to offer services directly to clients in the bloc without having a physical establishment in the EU.

"ESMA's message is related to the fact that the provision of services in the field of crypto-assets by a firm from a third country is limited, according to the Regulation on crypto-asset markets, to cases where the client is the sole initiator of the service", ESMA's release states. Customer initiation is

known as "reverse solicitation", a concept also present in other restrictive financial laws in the EU, which put pressure on foreign firms to open a branch or subsidiary in the EU bloc. "Currently, the solicitation of cryptocurrency business in the EU by a company from a third country, which would include marketing actions in the EU bloc, is prohibited. Therefore, a non-EU firm cannot rely on the exception in the law to provide additional services, if it is not carried out in the same context as the original transaction", says ESMA.

On March 19, 2024, the European Parliament approved a ban on crypto-currency transactions of any value carried out through crypto-hosted wallets. This comes as the European Council and Parliament temporarily agreed to extend parts of EU anti-money laundering and financing of terrorism legislation, to also cover transactions made on the cryptocurrency market.

European Union - Limiting Cryptocurrency Transactions

Companies in the crypto industry outside the EU can directly serve their customers from the EU bloc under extremely limited conditions, to avoid unfair competition, the European Securities and Markets Authority (ESMA) has proposed. In 2023, the EU established a regulatory framework applicable to crypto assets, crypto asset issuers and crypto asset service providers, and the European Council adopted a Regulation on Markets in Crypto assets (MiCA), establishing for the first time an EU-wide legal framework for this sector . MiCA protects investors by increasing transparence and by establishing a comprehensive framework for issuers and service providers, including in terms of compliance with anti-money laundering rules. ESMA's new rules target issuers of utility tokens, asset backed tokens and so-called "stable cryptocurrencies". These also apply to service providers, such as trading venues and wallets where crypto assets are held.

Announced on 29 January 2024, the proposals on how crypto industry firms and regulatory authorities should apply the existing legislation relate to non-EU companies that manage crypto assets and want to offer services directly to clients in the bloc without having a physical establishment in the EU.(Griffit, 2023)

"ESMA's message is related to the fact that the provision of services in the field of crypto-assets by a firm from a third country is limited, according to the Regulation on crypto-asset markets, to cases where the client is the sole initiator of the service", ESMA's release states. Customer initiation is known as "reverse solicitation", a concept also present in other restrictive financial laws in the EU, which put pressure on foreign firms to open a branch or subsidiary in the EU bloc. "Currently, the solicitation of cryptocurrency business in the EU by a company from a third country, which would include marketing actions in the EU bloc, is prohibited. Therefore, a non-EU firm cannot rely on the exception in the law to provide additional services, if it is not carried out in the same context as the original transaction", says ESMA.

Casinos and cryptocurrencies in East and Southeast Asia

Casinos and cryptocurrencies have become essential parts of East and Southeast Asia's underground banking and money-laundering infrastructure, fueling transnational organized crime in the region, according to a new UN report released on January 15, 2023 titled "Casinos, Money Laundering, Underground Banking and Transnational Organized Crime in East and Southeast Asia: A Growing Hidden Threat ". The report highlights the link between illegal online casinos, e-junkets and cryptocurrency exchanges that have proliferated in recent years alongside the rise of cross-border crime in the region: “Casinos and related banking companies have been vehicles for underground banking and money laundering for year’s days, but the explosion of unregulated online gaming platforms and cryptocurrency exchanges has changed the game. The expansion of the illicit economy required a technological revolution in underground banking to enable faster anonymous transactions, commingling of funds and new business opportunities for organized crime. Development of digitized and scalable solutions based on casinos and cryptocurrencies has boosted the criminal business environment in Southeast Asia and in particular the Mekong region,” said Jeremy Douglas, the Regional Representative for Southeast Asia and the Pacific on the United Nations Office on Drugs and Crime (UNODC).

Online casinos are used by major organized crime groups to move and launder massive volumes of state-backed currency as well as cryptocurrencies. The report notes that in "numerous recent cases", online casinos and related businesses have been used by major organized crime groups to move and launder massive volumes of state-backed currencies as well as cryptocurrencies, effectively creating channels to integrate billions of criminal income in the financial system. At the same time, the creation and success of these underground banking schemes has helped expand the wider illicit economy of the region, in turn attracting new networks, innovators and service providers into the criminal ecosystem. (Jalan,2023)

The cases examined also highlight how illegal online casino operators have diversified their lines of business to include cyber fraud and cryptocurrency laundering, with ample evidence of the influence of organized crime in casino resorts, special economic zones and border areas, including those controlled by armed groups in Myanmar to hide illicit activities.

"Criminal groups are organized where they see vulnerabilities, and casinos and cryptocurrencies have proven to be the point of least resistance," Douglas added. He noted that "operations against syndicates in countries like Cambodia and the Philippines have caused partial displacement, and we've seen criminals move infrastructure to other places where they see opportunity – essentially where they expect to be able to benefit from it and not be held accountable, in remote areas bordering the Mekong area, and recently elsewhere. UNODC analysis estimates that there are more than 340 licensed and unlicensed land-based casinos in Southeast Asia as of early 2022, and most have moved online to offer live dealer streaming services and various proxy betting services. According to the latest available industry data, the formal online gambling market is expected to reach over 205 billion American dollars by 2030, with the Asia-Pacific region accounting for the largest market growth share between 2022 and 2026, i.e. 37% . The report describes several policy developments and enforcement measures implemented by governments in the region to combat the illegal outflows of capital from casinos, corruption and money laundering that are partly behind these trends. The mention report, also describes the mechanisms, intricacies and drivers of underground banking in the region.

The report provides a list of recommendations to strengthen knowledge and awareness, legislation and policy, and enforcement and regulatory responses in the region to help governments address the situation: “It is clear that the gap between organized crime and law enforcement is growing rapidly. If the region fails to address this crime landscape, the consequences will be felt in Southeast Asia and beyond, as criminals look to reinvest their profits and innovate their operations," said Benedikt Hofmann, Deputy Regional Representative of UNODC, for which the report "is a useful reference for deeper engagement among the countries of Southeast Asia, UNODC and international partners".

South Korea -The case of Haru Invest

Established in 2019, Haru Invest operated a cryptocurrency yield platform, marketing its services by offering investors the opportunity to earn annual interest rates of up to 12% on cryptocurrency deposits. According to the indictment, Haru Invest executives misappropriated most of the coins deposited by customers by reinvesting assets from March 2020 to June 2023. The former executives falsely represented Haru Invest as operating a stable business using "risk-free diversified investment techniques." In early February 2024, South Korean prosecutors arrested several executives of the cryptocurrency trading platform Haru Invest: among those arrested were the CEO of Haru Invest and two other executives, detained on charges of stealing 1.1 trillion won (830 million american dollars), in cryptocurrencies from 16,000 clients of Haru Invest.

Haru Invest CEO Hugo Lee commented on the arrest of his colleagues: “For now, there is no information available regarding the investigations and the general situation following the detention of Bang Jun-ho, the majority shareholder of B&S Holdings. We are continuing our efforts to recover the assets". Haru Invest suddenly suspended withdrawals on June 13, 2023. Delio, a depository and administration company that had some of its funds at Haru Invest, also stopped withdrawals the next day. Haru Invest later claimed the problems were caused by alleged fraudulent activity by operator B&S Holdings, formerly known as Aventus.

Japan - Mercari trading platform

Mercari, one of Japan's largest e-commerce platforms, will allow users to purchase their products listed on apps that sell products using Bitcoin starting June 2024; the e-commerce platform will facilitate Bitcoin transactions through its Tokyo-based crypto exchange subsidiary Melcoin, where prices of items listed on the app are displayed in Japanese yen, with the option to pay in Bitcoin. (Li, 2023)

Mercari is one of Japan's largest e-commerce marketplaces with 22 million monthly users; was launched in 2013 and within five years has become the largest community e-commerce platform in the country with a 94% usage rate. The platform posted a profit of ¥2.8 billion ($19.4 million) in the third quarter of 2023, and offering the option to pay in Bitcoin could encourage further adoption of BTC by Japanese shoppers. Mercari has adopted Bitcoin on its platform through a trading service that allows users to buy and sell BTC using the proceeds from sales on the platform. Mercari's loyalty program is also crypto-centric, allowing users to exchange their points for cryptocurrencies. (Ugolini, 2023)

UK

On March 11, 2024, the UK's financial supervision organization gave bitcoin a new boost after opening the way for digital asset derivatives trading, announcing that it was allowing recognized exchanges to trade cryptocurrency-backed products. Immediately, Bitcoin surged to a record high of $71,677 in European trading, taking the 2024 appreciation to 70%.

US -Open-end ETFs (ETFs) for trading

The US Securities and Exchange Commission (SEC) announced on January 10, 2024 that it has approved the listing and trading of 11 open-ended investment funds (ETFs) for Bitcoin, a muchanticipated move in the crypto market. The 11 Bitcoin ETFs that received approval are: Bitwise, BlackRock, BZX, Fidelity, Franklin Grayscale, Hashdex, Invesco, Valkyrie, VanEck and WisdomTree.

The 11 investments were approved in the form of Bitcoin ETPs – as spot trading products, exchange traded products that track the price of Bitcoin by holding the actual, i.e. spot, bitcoin as an underlying asset. Proponents of Bitcoin ETPs believe that they can make Bitcoin investing more accessible to the general public. ETPs do not provide direct ownership of Bitcoin and have investment and security risks (Murugappan, 2023).

Bitcoin ETFs are investment vehicles that also allow small investors to indirectly own and trade Bitcoin, as is done with gold or other precious metals, for example. The SEC Chairman Gary Gensler emphasized on this occasion that the SEC does not endorse or support Bitcoin and warned investors to remain cautious of the risks associated with the crypto market: "ETP assets for metals have consumer and industrial uses, while the Bitcoin is primarily a speculative, volatile asset that is also used for illegal activities, including ransomware, money laundering, sanctions evasion, and terrorist financing. Although we have approved the listing and trading of certain ETP Bitcoin spot shares today, we have not support or endorsed Bitcoin. Investors should remain cautious about the myriad risks associated with Bitcoin and products whose value is tied to crypto," SEC Chairman Gary Gensler said. He also stated that the approval given by the SEC also comes with certain protection measures for investors:

1. The sponsors (fund managers) of ETP Bitcoin must make public complete, correct and truthful data about the products, which will be listed and traded on the registered national stock exchanges. Such regulated exchanges must have rules designed to prevent fraud and manipulation, and the SEC will monitor them closely to ensure that they enforce those rules. In addition, the SEC will fully investigate any fraud or manipulation on exchanges, including schemes using social media. Such regulated exchanges also have rules designed to address certain conflicts of interest and protect investors and the public interest.

2. Existing rules and standards of conduct will apply to the purchase and sale of approved Bitcoin ETPs.

The SEC's approval of the Bitcoin ETF follows a decision by the Washington Court of Appeals in favor of the investment firm Grayscale: starting in 2018, the SEC opposed the investment firm's attempt to convert its investment vehicle, Grayscale Bitcoin Trust, in a Bitcoin ETP. (Sapovadia, 2024) In 2024, the SEC ran out of options and had to revise its position following the ruling of the US judges, who found that the SEC did not provide an adequate explanation for its initial decision to reject the Grayscale ETF. As a result of the SEC decision, on January 10, 2024, the price of Bitcoin was quoted around 46,500 american dollars, reaching at one point close to 48,000 american dollar, but for a very short time.

The Spectacular and Unreal Comeback of Bitcoin

On February 14, 2024, Bitcoin, the world's most famous cryptocurrency, traded again around 50,000 US dollar per unit, and on February 27, the price of a single Bitcoin was 56,000 US dollar, and on February 28, 2024, it reached the cap of 60,000 US dollar. The spectacular increase, again, was supported by the unresolved expectations of investors regarding the reduction of bank interest rates and the agreement of the US authorities on the launch of investment funds open for trading (ETFs) (see above).Bitcoin reached a new record high of over 71,000 US dollar on March 11, 2024.

Cryptocurrency income

According to an analysis carried out by China analysis, Romanian investors earned 170 million US dollars from crypto in 2023, our country ranking last, at a similar level to countries such as Kazakhstan, Malaysia, Belgium and Sweden.

The most money earned from buying/selling cryptocurrencies went to American investors, who earned 9.36 billion US dollar, followed by the British, Vietnamese and Chinese. In total, investors worldwide gained 37.6 billion US dollar in 2023, which is a significant improvement over 2022, when 127.7 billion US dollar was lost.

Conclusions

In the year 2024, cryptocurrencies after all have proven to be digital assets with a pronounced economic potential, many cryptocurrencies have experienced rapid growth and rapid declines, some countries have banned cryptocurrencies, others have allowed their citizens to trade them. The US Securities and Exchange Commission (SEC) announced on January 10, 2024 that it has approved the listing and trading of 11 open-end Bitcoin investment funds, a much-anticipated move in the crypto market. The European Central Bank (ECB) still does not approve the activity of cryptocurrency trading platforms, and several countries, including India, Romania and Turkey, have banned the circulation of cryptocurrencies on their territory.

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ANALYSIS OF SAVINGS AND INVESTMENT FLOWS BETWEEN THE PRIVATE SECTOR, THE PUBLIC SECTOR AND THE LABOUR MARKET IN THE CONTEXT OF MACROECONOMIC EQUILIBRIUM

Monica Florica DUTCAȘ [5]

Abstract:

The paper identifies and discusses the maximum thresholds for savings-investment balances, providing a methodological basis for formulating effective public policies. One of the key objectives is to transform the quaternary macroeconomic identity into an equation that allows for the establishment of the maximum deficit ceiling in the labour market sector. This is done through calculation relationships that use transfer coefficients between sectors and previously established maximum values for the private, public and foreign sectors.

Thus, the paper not only provides a theoretical perspective on economic flows between sectors, but also proposes a practical framework for evaluating and managing macroeconomic balance, considering savings and investment transfers. This approach is essential for establishing sustainable economic policies and maintaining long-term stability.

Keywords: economic policies, labour market, saving and investment flows

JEL classification: *E24, E61, J08*

Introduction

The research explores the integration of the labour market into an Quaternary macroeconomic identity, extending the traditional model of disequilibrium. It proposes a comprehensive analysis of the labour market from the perspective of economic transactions, using the concepts of saving and investment to restore labour surpluses and deficits. By examining the labour market as a derivative but indispensable component of economic phenomena, the paper introduces quantitative and qualitative relations that establish the equilibrium between the factors involved. The results suggest that the integration of the labour market into the macroeconomic identity offers a unifying perspective, supporting a more rigorous approach to public policies to correct macroeconomic disequilibrium.

Macroeconomic equilibrium is an essential objective for the economic sustainability of a national economy. One of the critical aspects of this equilibrium is the interaction between saving and investing, especially in relation to the labour market. This paper analyses the savings and investment flows between the private sector, the public sector and the labour market, establishing the transfer mechanisms between them and the impact on the macroeconomic equilibrium.

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The economic literature on saving and investment highlights the role of these variables in determining macroeconomic equilibrium. Keynes (1936) emphasized the importance of saving and investing according to future expectations. Keynes (2009) revolutionizes macroeconomic theory by introducing the concept of aggregate demand as the primary determinant of employment and output. Keynes points out that macroeconomic disequilibrium, such as high unemployment and recessions, require government intervention to correct. Keynesianism is later deepened by economists such as Galbraith (1982), who emphasizes state intervention in the economy to correct market failures and reduce inequalities.

The issue of unemployment is extensively addressed in the economic literature, being an essential aspect of macroeconomic disequilibrium. Pissarides (2000, 2009) develops the theory of equilibrium unemployment and analyses its volatility according to wage rigidity, highlighting how disequilibrium between labour demand and supply can lead to persistent unemployment. Shapiro and Stiglitz (1984) introduce the theory of unemployment as a disciplinary mechanism, explaining the existence of a structural level of unemployment as a result of the strategic behaviour of firms, which contributes to the maintenance of disequilibrium in the labour market. In addition, Starr (1993) examines the mechanisms for setting the minimum wage and their implications for employment, showing that social protection policies can have a direct impact on stabilizing the economy and reducing structural disequilibrium.

Krugman (2009, 2021) provides insight into economic crises and their impact on the labour market, highlighting the role of fiscal and monetary policies in combating unemployment and correcting macroeconomic disequilibrium. Ramboll (2019) also assesses European policies for the integration of the long-term unemployed into the labour market as a measure to reduce social and economic disequilibrium.

Mankiw (2009) proposes a modern approach to macroeconomics, highlighting the role of market expectations and rigidities in explaining economic fluctuations. Macroeconomic disequilibrium, such as budget deficits and persistent inflation, are also analysed in ESA 2010, which provides an essential European statistical framework for assessing economic performance and comparability of data between Member States.

Stiglitz (2016) makes significant contributions to the analysis of economic inequalities and the impact of information asymmetries on the labour and capital markets, highlighting how these asymmetries can accentuate macroeconomic disequilibrium.

A series of works from Romanian research analyse macroeconomic dynamics and the impact of economic policies on economic cycles and macroeconomic disequilibrium. Dinga (2016) provides a detailed perspective on economic cyclicality, showing how economic fluctuations can generate long-term disequilibrium. Dobrescu (2006) builds macroeconomic models for the Romanian economy, highlighting the factors that influence economic growth and structural disequilibrium of the national economy.

This approach, of including the labour market in the equilibrium model, it remains original and quite daring, not being found as such in literature.

Description of the problem

Saving and investing are two fundamental components of any economy. The private sector contributes to savings through individual and corporate income, and the public sector through tax collection and social spending. The labour market is directly affected by these flows

through job creation and social protection policies. The essential problem analysed is how these flows adjust so as to maintain macroeconomic balance, avoiding disequilibrium such as budgetary overload or major imbalance of the labour market, unemployment.

The purpose of building a quaternary identity is, of course, to include the labour market, along with the other three sectors (private sector, public sector– as internal sectors – also the external sector) in an identity that has theoretical validity, respectively methodological coherence for the macroeconomic system of a national economy.

Some principled theoretical considerations for the labour market are useful:

- *Saving* represents the surplus supply of labour (expressed monetarily, e.g. by means of the equilibrium wage or the average salary in the economy) manifested at the level of the national economy,
- *Investment* represents the surplus demand for labour (expressed monetarily in the same way as in the case of savings) manifested at the level of the national economy;
- *Labour market* it is an open market, i.e. it is permanently subject to the impact of labour flows, both as inflows (immigration) and as outflows (emigration) from/to the international labour market. In this matter, we consider the following:
  - in the labour supply of course, the part of the supply that comes from labour immigration also enters the national market;
  - in terms of labour demand, it is obvious that it manifests itself only in the national economic area, i.e. it is 'exercised' exclusively by employer's resident (legally) in the national economic area, so it also reflects the part of demand manifested abroad and which, once it receives a response (e.g. through emigration), extracts that quantity from the national labour market;
  - therefore, regardless of the net migration of the labour force, the supply of labour force, respectively the demand for labour force is formed, from the perspective of the present research, exclusively in the national economic framework; moreover, it is relevant in itself, because it is "cleaned" of the impact of supply, respectively external demand (Things happen, moreover, perfectly symmetrically as in the case of supply, respectively the demand for goods and services on the homonymous market)

The standard, three-variable identity of macroeconomic disequilibrium covers, quantitatively, macroeconomic disequilibrium, in the sense of the logical phrase sufficient and necessary. This means that nothing is missing and nothing is redundant in that identity ternary. It follows, therefore, that the introduction of a fourth term in the ternary identity, in order to obtain the quaternary identity, will have the impact of introducing a distortion factor.

Methodology and data

The study uses a logical approach for theoretical conceptualization, and based on this a mathematical formalization for modelling saving-investment flows in the private and public sectors, as well as their impact on the labour market.

The logical foundations of Quaternary identity

At the logical level of substantiating the Quaternary identity macroeconomic disequilibrium, the following are proposed:

(i) as a result of the fact that the labour market is a market derived from the market for goods and services it follows that, in part, part of the supposed impact of the latter market is manifested from the perspective of the labour market, both in terms of labour supply and labour demand; It follows that, both from the perspective of specific savings on the labour market (the surplus of labour supply) and that of the specific investment on the labour market (the surplus demand for labour), which "delivers" the labour market in its presumed identity quaternary of macroeconomic disequilibrium is "extracted" from the market for goods and services, through the well-known channels of the macroeconomic process;

(ii) as a result of the same fact (the derivative character of the market for goods and services), the labour market intermediates part of the impact that the public sector has it within the presumed Quaternary identity. Indeed, saving in the labour market (i.e. the surplus supply of labour) means, from the perspective of the public sector, a reduction in savings (of the receipts to the public budget of direct levies – in the form of income/salary tax, respectively of social contributions – and indirect levies – in particular of value added tax, respectively of excise duty). At the same time, labour market investment (excess labour demand) involves the payment of unemployment benefits as well as other inclusion-specific public expenditure, etc., which means a reduction in public sector investment;

(iii) overall, the idea is outlined that the introduction of a fourth term (additive) in the ternary identity in order to obtain an identity macroeconomic disequilibrium – namely the binomial saving-investment on the labour market – is not likely to have a disruptive effect on the presumed Quaternary identity, but, so to speak, only an effect of redistribution of the "volumes" of savings, respectively investment at the integrated macroeconomic level;

(iv) being a quantitative redistribution relation of the saving relationship-investment between two sectors of the internal/national economy (private sector and the public sector), it follows that the fourth term that generates the quaternary identity will have to be placed in the left member of the ternary identity, so as to preserve the identity between the left and right members (external sector) of the identity in question;

(v) for analytical quantitative calculations, the question of the quantity of redistribution, both of saving, as well as investments, from the private sector (producer of goods and services), respectively from the public sector, to the 'sector' called the labour market.

Figure no.1 shows an image of these reasonings (with $T_{\delta}^{pr\to m}$ the transfer of savings balance-investment from the private sector to the labour sector was noted ; with $T_{\delta}^{p\to m}$the transfer of the savings-investment balance from the public sector to the labour sector).

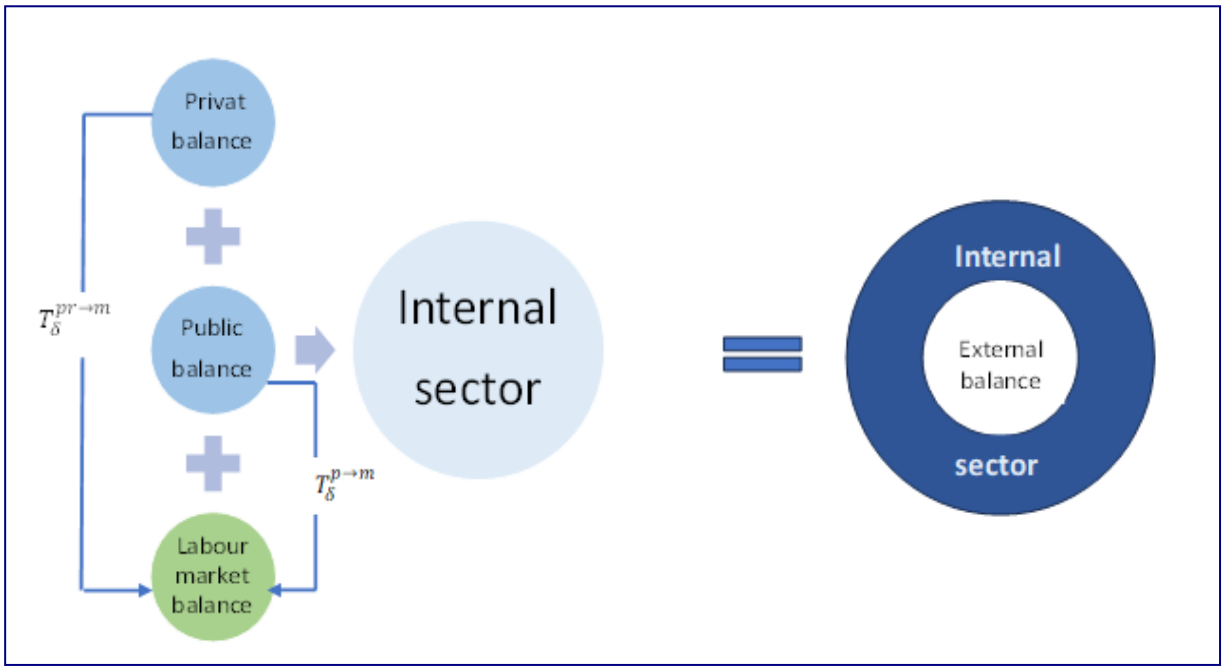

Figure 1. Relationship of savings balances-investment from the perspective of Quaternary identity macroeconomic disequilibrium

Source: own conception & design

From Figure 1 the following can be revealed:

- in *first* that, at the macroeconomic level, the aggregate domestic balance remains, or must remain, 'equal' (in the sense of identical) to the external balance, regardless of how many sub-sectors are identified within the domestic sector. This is an invariant condition of the equilibrium (or general identity) of any open economy;
- in the *second* introduction of the labour market sub-sector aims to increase the degree of analyticity of the aggregate balance of the domestic sector from the perspective of taking into account this important economic market that is the labour market;
- in the *third* labour market balance is a derived balance, just like the labour market it is itself a derivative market; The derivation is made through the two balance transfer flows, from the private sector, respectively from the public sector;
- in the *fourth*, a certain artificial separation of the labour market must be recognised within the internal sector of the relationship between savings and investments. This beneficial and useful fact consists of the following:

➢ Labour market balance it is also preserved in the case of the ternary identity, but there it is dissipated both in the private sector, as well as in the public sector. This means that, in the case of Quaternary identity, the reverse operation must be carried out: the separation, from the balances of the two internal sectors from the ternary identity, of the balance specific to the labour market;

➢ Labour market balance, as interpreted above, has, in a way, a virtual/possible character [1]. This virtual/possible character consists of the following:

– *Saving* – which consists of the surplus supply of labour power – resides, in fact, in unemployment, as it is registered according to legal procedures, and with the verification of the conditions, also legal, for the qualification of a person as unemployed. Turning

unemployment into employment [2] is characterized by uncertainty. Of course, with some modelling efforts, it is possible to arrive at a pattern of unemployment behaviour that, through the associated probability distributions, leads to the reduction of this uncertainty or, at least, associates probabilities (of an objective type) to it, but the virtual/possible nature of the saving character of the sector called the labour market remains indisputable;

- *Investment* – which consists of the surplus demand for labour – resides, in fact, in job vacancies. Understanding by job vacancies both the jobs that have become available as a result of the ending of employment relationships for various reasons, as well as the newly created jobs, there is no certainty that these vacancies will also be filled (frictional unemployment, respectively the natural unemployment rate [3] barriers to this). Therefore, also from the perspective of the investment related to the labour market, the virtual character is obvious and, as in the case of saving, in principle irreducible.

➢ In this way, we arrive at the situation of building an identity macroeconomic (quaternary identity) which will inevitably contain a virtual component – the savings balance-investment of the labour market. But, paradoxically, this component, precisely because of its virtuality, has a great impact both in terms of the predictability of the Quaternary identity, as well as in terms of its controllability, through public policies.

According to figure no. 1 within the internal framework of the national economy there are flows of transfer of savings, respectively investment from the two sectors, public and private, and the question arises of their quantitative determination, so as to maintain the initial identity on the entire economy.

Mathematical transcription of logical reasoning

Mathematically, the reasoning will be expressed: *i) as a formula of quaternary identity, ii) as transfers,* and *iii) as thresholds*

i) ***Quantitative formula of quaternary identity***

The known ternary identity of macroeconomic disequilibrium is as follows:

$$\left(E_i^{pr} - I_i^{pr}\right) + \left(V_i^B - C_i^B\right) = \left(I_i^{ex} - O_i^{ex}\right) \qquad (1)$$

Where:

E_i^{pr} *= saving in the private sector,*

I_i^{pr} *= investment in the private sector,*

V_i^B *= saving in the public sector,*

C_i^B *= investing in the public sector,*

I_i^{ex} *= saving in the foreign sector,*

O_i^{ex} *= the investment in the foreign sector.*

The condition is maintained that the internal (national) balance must remain equal to the external balance, i.e.:

$$\delta_i^N = \delta_i^{ex} \qquad (2)$$

Where:

δ_i^N=*the internal (national) balance,*

δ_i^{ex}= *the external balance.*

For reasons of methodological unity at the level of Quaternary identity, both saving and investing in the labour market will be expressed in terms of value, more precisely monetary.

(δ_i^M)*Savings balance-investment on the labour market, will be calculated as follows:*

$$\delta_i^M = S_i^M - D_i^M \quad (3)$$

Where:

S_i^M *- saving on the labour market, i.e. the excess supply of labour,*

D_i^M *- Investing in the labour market, i.e. the excess demand for labour.*

$$\left(E_i^{pr} - I_i^{pr}\right) + (V_i^B - C_i^B) + (S_i^M - D_i^M) = (I_i^{ex} - O_i^{ex}) \quad (4)$$

from whence:

$$\delta_i^{N^*} = \delta_i^N + \delta_i^M \quad (5)$$

and the general identity, associated with the national economic system, is preserved:

$$\delta_i^{N^*} = \delta_i^{ex} \quad (6)$$

ii) Transfers

For the private sector, savings are estimated by the product of the number of unemployed and the average wage, adjusted by a coefficient that transforms the surplus supply of labour into virtual supply. The transfer of investment is assessed by the ratio of job vacancies to the average salary, also adjusted by a specific coefficient.

- on the private sector:

– Savings transfer ($\widehat{U}_i^M$), in monetary expression:

$$\widehat{U}_i^M = \overline{w}_i \cdot U_i^M \quad (7)$$

Where:

U_i^M= number of unemployed,

$\overline{w}$= average salary in the economy.

– Investment transfer ($\widehat{V}_i^M$):

$$\widehat{V}_i^M = \overline{w}_i \cdot V_i^M \quad (8)$$

Where:

$\overline{w}$= average salary in the economy,

V_i^M = number of job vacancies.

In view of the previous logical reasoning, the transferability of these two quantities must be adjusted by a coefficient (force$\alpha \in [0,1]\mathbb{R}$) that transforms the potential of the numerical excess supply/demand of the labour in a virtual nature of this offer/excess request and we will write:

$$\begin{aligned}\widetilde{U}_i^M &= \alpha_E^{pr} \cdot \widehat{U}_i^M = \alpha_E^{pr} \cdot \overline{w}_i \cdot U_i^M = \alpha_E^{pr} \cdot \overline{w}_i \cdot \alpha_E^{pr} \cdot S_i^M \\ &= \left(\alpha_E^{pr}\right)^2 \cdot \overline{w}_i \cdot S_i^M\end{aligned} \quad (9)$$

$$\tilde{V}_i^M = \alpha_I^{pr} \cdot \hat{V}_i^M = \alpha_I^{pr} \cdot \overline{w}_i \cdot V_i^M = \alpha_I^{pr} \cdot \overline{w}_i \cdot \alpha_I^{pr} \cdot D_i^M = \left(\alpha_I^{pr}\right)^2 \cdot \overline{w}_i \cdot D_i^M \quad (10)$$

Where:

$\widetilde{U}_i^M$= Saving Amount (virtual) that is transferred from the private sector to the labour market sector,

$\tilde{V}_i^M$ = Investment Amount (virtual/possible) that is transferred from the private sector in the labour market sector.

results:

$$\tilde{\delta}_i^{pr \to m} = \overline{w}_i \cdot \left[\left(\alpha_E^{pr}\right)^2 \cdot S_i^M - \left(\alpha_I^{pr}\right)^2 \cdot D_i^M\right] \quad (11)$$

Where:

$\tilde{\delta}_i^{pr \to m}$ = transfer of savings balance-investment from the private sector to the labour sector (expressed in monetary terms).

- on the public sector:

For the public sector, the transferred savings are determined by the tax revenues collected from income tax and social contributions related to the unemployed. The transfer of public investment is estimated by government spending on unemployment benefits and other active employment policies.

Reasoning similarly, the transfer of savings balance-investment from the public sector to the labour sector, ($\tilde{\delta}_i^{p \to m}$expressed monetarily), is calculated by the formula:

$$\begin{aligned}\tilde{\delta}_i^{p \to m} &= \tilde{V}_i^p - \tilde{C}_i^p \\ &= \left(\alpha_I^{pr}\right)^2 \cdot \overline{w}_i \cdot \left[\lambda_E^p + \left(1 - \lambda_E^p\right) \cdot \beta_E^p\right] \cdot D_i^M - \beta_I^p \cdot \left(1 + \lambda_I^p\right) \cdot S_i^M\end{aligned} \quad (12)$$

(iii) The issue of thresholds

As in the case of ternary identity, thresholds are necessary, in particular, for the design of public policy measures regarding the management of the quaternary equation Quaternary identity.

Starting from the situation of the thresholds in the case of the classical, ternary equation:

$$\bar{\bar{p}}_i^d = \lambda \cdot \bar{\bar{d}}_i^{ex} - \bar{\bar{b}}_i^d \quad (13)$$

Where:

$\bar{\bar{p}}_i^d$= the maximum equilibrium balance, relative to private sector GDP,

$\bar{\bar{d}}_i^{ex}$= the mandatory maximum balance (Maastricht Treaty) in relation to GDP, total external public debt,

$\bar{\bar{b}}_i^d$ = the mandatory maximum balance (Maastricht Treaty) relative to GDP of the consolidated general budget,

$$\lambda = \frac{1}{\beta \cdot (1-\alpha) \cdot i},\ \beta \in [0,1]\mathbb{R}, \alpha \in [0,1]\ \mathbb{R} \qquad (14)$$

Where:

β = the coefficient of incurring the contracting of external public debt, as a result of the current account deficit, is considered constant during the analysis period,

α = the coefficient for reducing the trade deficit through non-trade flows from the current account, is considered constant during the analysis period.

For the purpose of setting a maximum ceiling on the savings balance-investment in the labour market sector, the qualitative reasoning already known or used in the case of the ternary equation is used and the quaternary identity of macroeconomic disequilibrium is resumed:

$$\delta_i^{pr} + \delta_i^p + \delta_i^M = \delta_i^{ex} \qquad (15)$$

As the maximum relative values (to GDP) for the private sector are already established from the ternary equation, the public sector and the external sector, it remains to determine, as the only unknown, the maximum value (relative to GDP) of the deficit of the labour market sector. This cannot be done, however, simply by separating the deficit of the labour market sector from the quaternary equation of deficits, because the (more general) deficit of the labour market sector balance is a virtual balance constituted by balance transfers from the private and public sectors, respectively. It is therefore correct to determine the maximum deficit of the labour market sector using these transfers, as they have been established above.

(i) Definition relationships:

$\varphi_i^{pr} = \frac{\tilde{\delta}_i^{pr \to m}}{\delta_i^{pr}}$	(16)
$\varphi_i^{p} = \frac{\tilde{\delta}_i^{p \to m}}{\delta_i^{p}}$	(17)

Where:

φ_i^{pr}= the coefficient of the balance transfer from the private sector to the labour market sector;

φ_i^{p}= the coefficient of the balance transfer from the public sector to the labour market sector;

(ii) Calculation relationships:

Thus, **the macroeconomic deficit equation** will be written, successively:

$$\left(\delta_i^{pr} - \tilde{\delta}_i^{pr\to m}\right) + \left(\delta_i^{p} - \tilde{\delta}_i^{p\to m}\right) + \tilde{\delta}_i^{pr\to m} + \tilde{\delta}_i^{p\to m} = \delta_i^{ex} \quad (20)$$

$$\tilde{\delta}_i^{pr\to m} = \varphi_i^{pr} \cdot \delta_i^{pr} \quad (18)$$

$$\tilde{\delta}_i^{p\to m} = \varphi_i^{p} \cdot \delta_i^{p} \quad (19)$$

$$\left(\delta_i^{pr} - \varphi_i^{pr} \cdot \delta_i^{pr}\right) + \left(\delta_i^{p} - \varphi_i^{p} \cdot \delta_i^{p}\right) + \tilde{\delta}_i^{pr\to m} + \tilde{\delta}_i^{p\to m} = \delta_i^{ex} \quad (21)$$

$$\delta_i^{pr} \cdot \left(1 - \varphi_i^{pr}\right) + \delta_i^{p} \cdot \left(1 - \varphi_i^{p}\right) + \tilde{\delta}_i^{pr\to m} + \tilde{\delta}_i^{p\to m} = \delta_i^{ex} \quad (22)$$

Where: $\delta_i^M = \tilde{\delta}_i^{pr\to m} + \tilde{\delta}_i^{p\to m}$

Substituting the maximum values established in the case of the ternary equation, we obtain:

$$\left(\bar{\bar{p}}_i^d\right)_{aj} + \left(\bar{\bar{b}}_i^d\right)_{aj} + a_i^m = \lambda \cdot \bar{\bar{d}}_i^{ex} \quad (23)$$

Where:

a_i^m = the current deficit of the labour sector,

aj = means value adjusted with the mentioned balance transfers.

It follows: the maximum limit of the relative deficit (to GDP) of the labour sector:

$\bar{\bar{a}}_i^m = \lambda \cdot \bar{\bar{d}}_i^{ex} - \left(\bar{\bar{p}}_i^d\right)_{aj} - \left(\bar{\bar{b}}_i^d\right)_{aj}$	(24)

For an illustration of the application of this methodological proposal, we continued the empirical study on the case of Romania.

The time series that were constructed for the empirical study on the identity and quaternary equation of macroeconomic disequilibrium refer to the period 2012-2022.

The data of the statistical yearbooks used for data collection include data two years ago compared to the year of publication of the yearbook, so this period was imposed.

As for the limitation of the series to 2012, this is explained by the fact that, methodologically, the statistical data from the recent period did not correspond to the data older than those related to 2012.

As we are not talking about statistical tests, which would have required a number of records to verify the conditions of statistical representativeness, the limitation of the time series does not affect the validity of the reasoning and empirical evaluations.

Results

According to its own methodology, the analysis carried out is examined at the level of the net balance (savings minus investment) at the level of each of the sectors, as shown in Table 1.

Table 1

Influence of the 3 sectors on the formation of the internal balance – (RON)

Year	Internal balance	Contributions					
		Private sector		Public sector		Labour sector	
		abs. – thousand.	%	abs. – thousand.	%	abs. – thousand.	%
(0)	(1)	(2)	(3)=(2)/(1)	(4)	(5)=(4)/(1)	(6)	(7)=(6)/(1)
2012	-28432.2	6908.2	-24.3	-22263.3	78.3	-13077.1	46.0
2013	-1041.6	25787.2	-2475.7	-13173.1	1264.7	-13655.7	1311.0
2014	4886.6	25107.9	513.8	-7122.4	-145.8	-13098.9	-268.1
2015	4248	19807.8	466.3	-3432.7	-80.8	-12127.1	-285.5
2016	-16949.9	14030.1	-82.8	-18896.9	111.5	-12083.1	71.3
2017	-30382.7	2276.2	-7.5	-21539.6	70.9	-11119.3	36.6
2018	-55383.4	-16533.5	29.9	-26521.9	47.9	-12328	22.3
2019	-62798.2	-4764.8	7.6	-38723.2	61.7	-19310.2	30.7
2020	-66683.2	47952.7	-71.9	-95801.5	143.7	-18834.4	28.2
2021	-83230.2	14627.7	-17.6	-84103.5	101.0	-13754.4	16.5
2022	-114627	-11713	10.2	-64471.7	56.2	-38442.6	33.5
Total	**-450394.1**	**123486.5**	**-27.4**	**-396050**	**87.9**	**-177831**	**39.5**
Annual average	**-40944.9**	**11226.05**	**-27.4**	**-36004.5**	**87.9**	**-16166.4**	**39.5**

Source: own calculations based on the Statistical Yearbook of Romania, NBR.

The analysis of the table reveals:

•At the level of the entire analysed period, the private sector had a higher saving than investment, while the other two sectors had higher investments than savings (the negative percentage contribution of the private sector, respectively the positive percentage contribution of the other two sectors is explained methodologically: the discrepancies summed internally over the analysed period give a negative magnitude (total investments higher than total savings);

•The negative balance of the public sector, over the analysed period, indicates that the expenditure on unemployment benefits exceeded the savings generated by job vacancies (in the private sector), respectively by the potential of budget revenues from the taxation of personal income (in the public sector). This is an important signal for economic policy decisions (in particular, fiscal-budgetary policy) for the period following the one taken into account in this draft;

•atypical situations occurred at the following moments during the analysis period:

-(2013): all three domestic sectors have very large "leaps" in the kinematics of saving and investment, respectively: enormous net savings in the private sector, enormous

net investment in the public sector, and enormous net investment in the labour sector respectively (note: the public sector and the labour sector have approximately equal net investment);

-(2014): the magnitude of the disequilibrium is about eight times lower than in the previous year, but their algebraic sign remains: very high net savings in the private sector, high net investment in the public sector, respectively very high net investment (but half compared to the private sector) in the labour sector. From a qualitative point of view, the year 2014 replicates, on a smaller scale, the phenomenology of 2013. It should be noted that the labour sector remains, quantitatively, at a net investment comparable to that of the previous year;

-(2015): from a qualitative point of view, we have the same situation as in 2014, only on a slightly smaller scale (not much smaller, however); Interestingly, the net investment in the labour sector remains, this year as well, very close to the value recorded in the previous two years.

Several other opinions formed in this matter are formulated below:

–the existence, concomitant (although, of course, in a frictional way, as shown above) of the unemployed, respectively of the vacancies, by means of appropriate and deterministic forecasting models, to identify appropriate economic policy measures, as an opportunity in time and space, in intensity, as a means of implementation, etc., in such a way as to achieve the meeting between the surplus supply of labour and the surplus of labour demand;

–structure, kinematics and volume of jobs are subtle predictors of investment intention or economic business development, both in the private sector, as well as in terms of the private domain of the state. On these bases, through appropriate models of information processing, public policy can constitute a realistic basis for intervention in the market, both as a reactive function and, especially, as a projective (or pro-active) function;

–in general, on a broader epistemological level, it must be accepted that virtuality (possibly also associated with adequate probability distributions) constitutes, in itself, a predictive field from which directions and ways of intervening in the market can be extracted, in accordance with the economic ideology of the State, respectively with the Government's governing program;

–predictability (this time, potential), which subsists in the virtual character of the savings balance-investment on the labour market, represents an ontological datum that greatly reduces uncertainty [4] on the kinematics of the labour market, on the one hand, respectively the functioning of the quaternary identity themselves, on the other hand;

–difficulties in transferring parts of savings and investment from the private sector, respectively from the public sector, to the labour market sector represents a considerably lower cost compared to the advantages, both theoretical and methodological, brought by the construction of a quaternary identity macroeconomic disequilibrium.

The results indicate that the macroeconomic balance depends on the correct adjustment of the flows between savings and investment according to the dynamics of the labour market, thus avoiding the emergence of structural disequilibrium. Application of the Quaternary equation for data from Romania highlighted discrepancies average annual income of approximately 0.3 billion (in RON). This approach can support economic policies directly aimed at redressing these discrepancies, reducing economic polarisation.

Conclusions

The study demonstrates that the efficient management of savings-investment flows is essential for maintaining macroeconomic balance. The private and public sectors contribute to the stability of the labour market through transfer mechanisms that need to be properly calibrated.

Transforming the Quaternary macroeconomic identity into an operational equation provides a useful tool for setting the maximum ceiling of the labour market deficit. This approach is essential for the development of sustainable public policies, including the adjustment of taxes and public expenditure according to labour market dynamics.

The findings suggest that fiscal and monetary policies should be coordinated more closely with labour market policies in order to effectively address macroeconomic disequilibrium.

The paper demonstrates the usefulness of including the labour sector in the analysis of macroeconomic disequilibrium, by identifying complex and circular causal relationships between it and the other three classic sectors (private, public, external).

The analysed literature provides a solid basis for understanding the fundamental economic mechanisms, focusing on business cycles, labour market and economic policies, but also on their impact on macroeconomic disequilibrium. Studies show that government interventions and appropriate macroeconomic policies can mitigate the negative effects of these disequilibrium and contribute to long-term economic stability. The integration of these perspectives allows the development of econometric models capable of explaining and predicting future economic developments, providing an analytical framework for identifying and correcting macroeconomic disequilibrium.

Developing the logical-mathematical construction regarding the economic growth model, the major risks of disequilibrium macroeconomic problems faced by the national economy, the paper proposes an additional contribution through the equation Quaternary macroeconomic disequilibrium and an analysis of the case of Romania from the perspective of the quaternary equation.

Future Directions

In the future, the analysis can be extended by integrating additional variables, such as the impact of technological innovation on saving-investment flows or the influence of demographic factors on the labour market.

The application of forecasting models can also help to better anticipate macroeconomic disequilibrium and formulate proactive policies to correct them.

Text notes

[1] The conceptual error of being considered a potential balance, which, under certain conditions, can be updated, should not be made. It has a virtual character in the sense that the introduction of the labour market in the domestic sector of the savings balance-investment it is required by methodological (analytical) reasons rather than conceptual (constitutive) reasons.

[2] Conceptually, it represents a change in the structure of the workforce (i.e. the working population).

[3] One could also study the symmetrical problem of a natural rate of jobs by identifying an analogue of the short-term Phillips curve in the case, this time, of "unemployment" of jobs.

[4] According to Knight, uncertainty cannot be associated with any probability distribution.

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ABOUT INSTITUTIONALVIABILITY

Gratiela-Denisa IORDACHE [6]

Abstract:

The present paper aims to define, in terms of logical analysis, the concepts of the institutional viability and its mathematical model for a complex organization.

In the context of the strong debates on the model of the future development of the European Union, from institutional point of view, in the actual context of economic and social turbulences, the fully understanding of the concept of institutional viability is a helpful tool for designing the future of the European Union Institutional System. In defining the concept, I choose to use method of sufficiency predicates (logical analysis).

The results of the paper will be useful in finding ways for increasing the efficiency of the European Union's institutions and their viability.

Keywords: *Institutional viability, European Union, sustainability*

JEL Classification: *E50, E60, E70*

Introduction

The concept of viability has gathered increasing attention across disciplines, from economics to organizational theory and systems science.

Viability is not a static state; it involves an ongoing process of adaptation and regulation. For example, in economic systems, viability could mean a balance between growth and resource consumption that ensures the system can sustain itself in the long run. In ecological terms, it may refer to the ability of an ecosystem to maintain biodiversity and resilience in the face of environmental stresses.

At its core, viability refers to the capacity of a system to maintain its essential functions and adapt to changing conditions while ensuring long-term sustainability. In the context of complex systems—be they economic or social—the viability of the system is crucial for its survival and growth. This article will explore the concept of viability in systems, focusing on its definition, applications, methodologies for analysis, and implications for the future.

Description of the Problem

The key issue of the article lies in defining and modelling the viability in a way that applies to different types of systems/organizations.

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Moreover, understanding the conditions that impact the viability of complex systems, including internal dynamics, external forces, and feedback mechanisms, is essential for making informed decisions in policy, management, and design.

Methodology and Data

1. To analyze the viability of a system, we can use various systems theory and cybernetic approaches that incorporate feedback loops, adaptation strategies, and performance indicators. In this paper, I proposed the use of *Stafford Beer's Viable System Model* (VSM) (Beer, S., 1979) that offers a mathematical and conceptual framework for evaluating the viability of organizations and institutions, considering their structures, communication channels, and decision-making processes.
2. Another method I used in defining the viability concept is the *method of sufficiency predicates* introduced by Prof. Univ. Dr. Ene Dinga [1] (Dinga, E., 2009) based on the "Treatise on Logic" by Enescu, G.(Enescu, G., 1997)[2]. This method is a tool used with predilection in logic and philosophy to define a concept by identifying a set of conditions or predicate attributes that are sufficient to attribute the concept in question to an object or entity.

Method of sufficiency predicates

Due to its innovative character, I will describe the fundamental concepts of the method. So, a sufficiency attribute is a property or attribute that, once fulfilled by an object or entity, implies that that object or entity is part of the category defined by the respective concept.

The method of logical analysis of sufficiency attributes is used to describe a concept N as the result of its sufficiency attributes/attributes.

So, we can describe an abstract notion by the equation:

N = {A1, A2, ..An},

where N is the abstract concept(notion) and A1, A2, ..., An are the identified sufficiency attributes(properties).

Defining concepts by the sufficiency attribute method involves several steps, namely:

a. Identifying the sufficiency attributes that completely define the abstract notion N;

b. Qualitative analysis of the identified sufficiency attributes which involves the following steps:

- Verifying the requirements that must be met by the pairs of sufficiency attributes identified as necessary for defining the notion, namely:

  i. independence (no sufficiency attribute is the logical result of another);

  ii. consistency (no sufficiency attribute is contradictory to another).

c. Checking the completeness of the sufficiency attributes so that they can generate a notion.

Institutional Viability Concept

a. Identifying the sufficiency attributes that completely define the abstract notion Viability-L:

- Self-duplication (D) - the ability of a phenomenon / process / system to duplicate itself, in response to external shocks, without the intervention of an external device
- Adjustability (A) - the ability of a phenomenon / process / system to adjust or modify itself to maintain its state parameters, in response to external shocks, without the intervention of an external device

- Continuity (C) - the ability of a phenomenon / process / system to maintain its state parameters uninterrupted in space and time, in response to external shocks, without the intervention of an external device

So, from a logical point of view, it is defined by the following equation:

$$L=(D)\wedge(A)\wedge(C)$$

Consequently, I will define *Viability as the ability of a phenomenon / process / system to replicate its structure, adapting to the external environment to preserve the value of its state parameter and to maintain its state parameters uninterrupted in space and time, in response to external shocks, without the intervention of an external device.*

The following step of the process of defining the Viability concept is the Completeness Analysis:

- Analyzing the list of identified sufficiency attributes:

• Self-Duplication (D) - The ability of a phenomenon / process / system to replicate itself, in response to external shocks, without the intervention of an external device

• Adjustability (A) - the ability of a phenomenon / process / system to adjust or modify itself to maintain its state parameters, in response to external shocks, without the intervention of an external device

• Continuity (C) - the ability of a phenomenon / process / system to maintain its state parameters uninterrupted in space and time, in response to external shocks, without the intervention of an external device

We conclude that this completely defines the concept of Viability.

The next step is Independence Analysis:

Independence analysis assumes that none of the attributes is the logical result of another. Therefore, we have the following:

- D does not imply A and vice versa: the ability of a phenomenon/process/system to replicate itself does not imply that the system/process/phenomenon has the ability to adjust or modify itself to maintain its state parameters, in response to external shocks, without the intervention of an external device and vice versa- to adjust or modify itself to maintain its state parameters, in response to external shocks, without the intervention of an external device does not imply that the phenomenon/process/system has the ability to replicate itself.
- D does not imply C and vice versa: the ability of a phenomenon/process/system to replicate itself does not imply that the system/process/phenomenon has the ability to maintain its state parameters uninterrupted in space and time, in response to external shocks, without the intervention of an external device and vice versa - the ability of a phenomenon/process/system to maintain its state parameters uninterrupted in space and time, in response to external shocks, without the intervention of an external device does not imply that the phenomenon/process/system has the ability to replicate itself, in response to external shocks, without the intervention of an external device
- C does not imply A and vice versa: the ability of a phenomenon/process/system to maintain its state parameters uninterrupted in space and time, in response to external shocks, without the intervention of an external device does not imply that the system/process/phenomenon has the ability to replicate itself, in response to external shocks, without the intervention of an external device and vice versa - the ability of a phenomenon/process/system to replicate itself, in response to external shocks,

without the intervention of an external device does not implies the ability of a phenomenon/process/system to maintain its state parameters uninterruptedly in space and time, in response to external shocks, without the intervention of an external device.

The next paragraph is about Consistency Analysis :

Consistency analysis assumes that none of the attributes is contradictory to another. Therefore, we have the following:

• D does not contradict A: the ability of a phenomenon/process/system to replicate does not contradict the fact that the system/process/phenomenon has the ability of a phenomenon/process/system to adjust or modify itself to maintain its state parameters, in response to external shocks, without the intervention of an external device

• D does not contradict C: the ability of a phenomenon/process/system to replicate does not contradict the fact that the system/process/phenomenon has the ability to adjust or modify itself to maintain its state parameters, in response to external shocks, without the intervention of an external device

• C does not contradict A: the ability of a phenomenon/process/system to maintain its state parameters uninterrupted in space and time, in response to external shocks, without the intervention of an external device does not contradict the fact that the system/process/phenomenon has the ability to replicate, with or without the help of an external device.

As a species of the genus Viability, Institutional Viability can be defined as *the ability of an institutional system to duplicate its structure, adjusting to the external environment to preserve the value of its state parameter and to maintain its state parameters uninterrupted, in space and time, in response to external shocks, without the intervention of an external device*

Proposal for a mathematical model applied to institutions described as viable systems

The Viable System Model (VSM), developed by Stafford Beer (Beer, S.,1995), is a systems theory framework that describes how complex systems (like organizations or institutions) maintain their viability by performing essential functions and interacting with their environment.

The VSM suggests that to remain viable, a system must have the following components:

- System 1: Operational units that perform the day-to-day functions of the organization.
- System 2: Coordination mechanisms to ensure stability between operational units.
- System 3: Control systems that provide operational oversight and resource management.
- System 4: Intelligence systems that provide foresight and adaptability to external challenges.
- System 5: Policy-making mechanisms that set the strategic direction of the system.

In our attempt to elaborate a model for a complex institution using Viability System Model model, we will develop a set of equations that describe each of the system's five components, their interactions and the overall viability of the system. Thus:
1. *Subsystem 1 (Operational)* – Daily activities of the organizations

Mathematical formalization:

Let there be a variable Z_t that represents the state of subsystem 1 at time t. This variable can be in the form of economic indicators (or in the form of implemented policies

The following system of differential equations can describe the evolution of these indicators over time [3].((Strogatz, 2018)

$$dZ_t/dt = f(Z_t, D_t)$$

Where:

- Z_t is the state vector of subsystem 1 at time t,

- D_t represents the decisions taken by the management subsystems (subsystems 2 and 3),

- f(Z_t, D_t) is a function that describes how operational actions interact with the organization's policies.

2. *Subsystem 2 (Coordination)* – Organization's Governance

The coordination subsystem refers to the organization's structural units, which are responsible for decision-making and coordination of actions between the organization's elements

Mathematical formalization:

Given the attributions of this subsystem, I consider that an optimal modeling option is the decision function [4] H_t, which represents the actions and decisions taken by the units of the organization at a given time:

$$H_t = l(Z_t, E_t)$$

Where:

- Z_t is the operational state of the organization,

- E_t represents the external environment

- l(Z_t, E_t) is a decision function based on the interaction between the state of the operational subsystem and external factors.

3. *Subsystem 3 (Control)* - Supervision and Regulation

This includes the development of rules and regulations, as well as monitoring their compliance.

Mathematical formalization:

I propose that this subsystem be described by a feedback function [5] because it represents a mechanism by which the outputs of a system are reintroduced as inputs to influence future states of the system, and can therefore describe the functions of supervision and regulation. Thus:

$$S_t = r(Z_t, H_t)$$

Where:

- S_t is the control vector of the organization

- Z_t is the state of the operational subsystem at time t

- H_t are the decisions taken by the bodies of subsystem 2,

- r(Z_t, H_t) is the control function that regulates actions depending on the state of subsystem 1 and the decisions of the institutions of subsystem 2.

4. *Subsystem 4 (Analysis)* - Strategic Planning

Subsystem 4 is responsible for developing strategies based on the analyses made in order to adapt to external changes.

Mathematical formalization:

Mathematically, this subsystem can be represented by a forecasting and planning model that determines the strategic directions of the EU:

$$A_t = w(Z_t, S_t)$$

Where:

- A_t is the strategic plan of the organization
- Z_t is the state of subsystem 1,
- S_t is the control established by subsystem 3 (regulations and interventions),
- $w(Z_t, S_t)$ is the strategic planning function that adapts the organization's actions in the long term.

5. *Subsystem 5 (Political)* - regulates how decisions are made and how policies are implemented.

Mathematical formalization:

I propose the use of a normative function [6] P_t, which imposes regulations on the entire system:

$$P_t = u(A_t, H_t)$$

Where:

- P_t is the political vector that regulates the fundamental values and principles of the organization,
- A_t is the strategy,
- H_t are the decisions,
- $u(A_t, H_t)$ is the normative function that imposes constraints and defines how decisions are made.

The complete mathematical model of the organization as a viable system, consisting of the five subsystems mentioned, is described by the following equations that reflect how the subsystems interact with each other and how they self-regulate to ensure the viability of the organization in a dynamic environment:

$$dZ_t/dt = f(Z_t, D_t)$$

$$H_t = l(Z_t, E_t)$$

$$S_t = r(Z_t, H_t)$$

$$A_t = w(Z_t, S_t)$$

$$P_t = u(A_t, H_t)$$

Results

- The use of method of sufficiency attributes contributes to a clear understanding of complex concepts
- The above model may be used to understand:

a. Threshold Effects: Certain thresholds of governance, legitimacy, adaptability, or collaboration may trigger significant changes in institutional viability.

b. Resilience to External Shocks: The model can identify which factors are most susceptible to external shocks and how the institution can improve its resilience to these shocks. For instance, an institution with high adjustability A(t) may be more capable of surviving environmental or economic crises.

c. Optimal Policy Interventions: The model can suggest which areas require intervention (e.g., improving collaboration, increasing legitimacy) to boost institutional viability. It can also help identify policies or practices that increase the overall resilience of the institution.

Conclusions

The concept of viability provides valuable insights into the dynamics of complex systems. Whether applied to ecosystems, economies, or social organizations, understanding and assessing viability enables us to make better decisions about resource management, policy development, and system design.

For systems to remain viable, they must be capable of adapting to both internal and external changes while maintaining their core functions. This requires fostering resilience, sustainability, and flexibility across different sectors, whether it involves financial institutions, environmental policies, or social structures. The future of institutional viability depends on the ability of institutions to remain responsive to changing conditions, while ensuring that they continue to fulfill their essential functions and maintain legitimacy in the eyes of their stakeholders.

The proposed simplified mathematical model captures the dynamic interrelationships between the key subsystems of the organization, as outlined by the Viable System Model (VSM). The model highlights how each subsystem (operations, coordination, control, intelligence, and policy) influences and is influenced by the others. By using these equations, we can study how the complex institutions adapt over time to various internal and external pressures and identify strategies to maintain its viability in a complex, ever-changing global environment.

Future Directions

Future research on viability should focus on developing integrated models that account for the interconnectedness of different types of systems/organizations.

Additionally, advancing data collection techniques and computational models will improve our ability to predict the viability of systems under various scenarios. This will allow policymakers, managers, and stakeholders to make more informed decisions that balance short-term goals with long-term sustainability.

Finally, addressing social and cultural factors in the viability of systems—such as values, behaviors, and institutional trust—will be crucial for creating sustainable societies and organizations in the future.

Further research can focus on refining the model by adding more specific factors, such as social capital or political stability, and expanding its application to different types of institutions (e.g., national governments, corporations, international organizations). Ultimately, a deeper understanding of institutional viability will help ensure that institutions remain resilient in an increasingly uncertain and complex world.

Text notes

[1] Dinga E., Studii de economie. Contribuții de analiză logică, epistemologică și metodologică, Editura Economică 2009, București, pag.79-84.

[2] Enescu Gh., - Tratat de logică, Editura Lider, București, pag. 71-77 ISBN/Cod: 973-97836-5-1, 1997.

[3] Strogatz, S.H., 2018. Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering. 2nd ed. CRC Press.

[4] A decision function is a function that associates each possible state or set of conditions with a specific outcome or choice. It can be viewed as a function that describes how decisions are made in a given context, based on predefined factors or criteria. Formalization:

Suppose we have a set of possible options and a set of decision criteria or information that influences the choice. The decision function can be formalized as follows:

- Let X be a set of options (actions or strategies).

- Let S be a set of states or conditions that can influence the decision (the current state of a system).

- The decision function H: $S \rightarrow X$ is a function that associates each state $s \in S$ with an option $x \in X$, such that $H(s) = x$.

This means that, for each state s in the set S, the function H chooses an element $x \in X$, which represents the decision made in that state. (Espejo, R., Harnden, J.R., and Bichler, R., 2019.)

[5] A feedback function can be described as a mathematical relationship that defines how an output variable (or the result of a process) is used to modify the inputs of a system, in order to regulate its behavior. Formally, a feedback function can be described as:

$x(t+1) = f(x(t), u(t))$,

where:

- x(t) is the state of the system at time t,

- u(t) is the input to the system at time t (which may be influenced by previous outputs),

- f is the feedback function that determines how the inputs and outputs interact and influence the future evolution of the system.

[6] A normative function can be described as a function that defines what is considered "correct" or "optimal" in a given context, guiding the decision-making process to achieve a goal. This may involve setting a goal or a set of rules that must be followed to achieve a desired outcome.

Mathematically, a normative function can be viewed as an objective function in an optimization process, which determines what should be maximized or minimized in a given system. Thus, the normative function f(x) can be used to evaluate a solution, and the optimal solution will be that value of x that minimizes or maximizes f(x), depending on the established objectives.

f(x) = the objective to be optimized, where x represents the decision variables of the system. (March & Simon, 1958).

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PERSPECTIVES IN CAPITAL TAXATION IN THE CURRENT ECONOMIC CONTEXT AT EUROPEAN LEVEL

Nicoleta MIHĂILĂ[7]

Abstract:

The main purpose of the paper is the analysis of capital taxation in the European Union in 2018-2022, the methodology used being descriptive, by appealing to various bibliographic sources, mainly from foreign literature, and empirical, by processing and analyzing the data taken from international databases (Eurostat). We consider the analysis of corporate and individual taxation at the level of EU member states during the mentioned period, as well as the proposal of some measures in order to increase the economic efficiency and revenues of the EU member state.

Keywords*: corporate income taxation, personal income taxation, global minimum tax, tax administration*

JEL Classification: *F23, H24, H25*

1. Introduction

Capital taxation is a widely debated topic in the literature, with the main themes ranging from the complex nature of capital to different assessments of inequality, the theoretical validity of optimal tax outcomes and how to address restrictions imposed by capital mobility (Mirrlees et al., 2011, Piketty 2014, Straub și Werning 2020, Jacobsen et al. 2020).

Countries differ substantially in the way and the level at which they tax capital income. These differences originate in historical developments in economic, legal and social structures, different political traditions, country size, the desirable size of the public sector, and the acceptability and feasibility of various taxes. In this paper, we analyze the evolution of capital taxation revenues in the European Union during the period 2018-2022, in Romania and the European Union, the main objectives being the analysis of household taxation revenues in EU states in 2018-2022, respectively the analysis of corporate taxation revenues in EU states in the period 2018-2022 and the role of the tax administration in increasing these revenues to the budget of the respective states. The methodology used is of a descriptive and empirical type, by referring to bibliographic references from the international specialized literature, as well as statistical data of different bodies/fiscal entities (Eurostat, OECD).

2. Analysis of capital tax revenues in EU countries in the period 2018-2022

Capital taxes include taxes on capital income from corporations, households and the self-employed, as well as taxes on capital shares/stocks (e.g., periodic/ recurring property taxes, inheritance taxes) or their transactions. Analyzing the breakdown by economic function, income from capital taxes increased by 12,5%, amid rising corporate profits. Consumption

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tax revenues grew by 6,9%, supported by rising private consumption spending and rampant inflation. Finally, labor tax revenues grew by 6,8%, supported by continued employment growth.

In 2022, revenues from labor taxes (including social security contributions) constituted 50,6% of total tax revenues, revenues from consumption taxes reached 27,3% of the tax mix, and the remaining 22,1% was obtained from capital taxes. Developments in recent years suggest a small shift from labor and consumption taxes to capital taxes.

We note that in the paper we use the revenues obtained from capital taxation (households and companies) in the period 2018-2022, expressed as a share in GDP, data taken from the Eurostat database.

During 2018-2022, capital tax revenues (% GDP) had an oscillating trajectory, in some developed countries they decreased, in others they increased. They increased significantly in the Czech Republic (+3,1 pp), Romania (+1,7 pp), Austria (+ 1,4 pp) or the Netherlands (+ 1,5 pp). A significant decrease was recorded in Luxembourg and Malta (-1,7 pp), Belgium (- 0,7 pp), Latvia (-0,5 pp). Compared to 2020, the first year of the pandemic, capital tax revenues decreased substantially in some states - Denmark (-2,0 pp), then resumed their upward trend. They increased in Romania (+ 2,1 pp), Bulgaria (+2,9 pp), the Czech Republic (+1,7 pp), the Netherlands or Austria.

Table 1

Taxation of capital revenues in the period 2018- 2022 in EU, % GDP

	2018	2019	2020	2021	2022
EU-27	8.2	8.1	8.0	8.6	8.9
EA-19	8.5	8.3	8.2	8.8	9.2
Belgium	11.3	10.5	9.9	10.5	10.6
Bulgaria	4.7	5.0	5.0	5.6	7.8
Czechia	5.4	5.2	4.4	5.5	6.2
Denmark	7.4	10.1	9.3	10.5	7.3
Germany	7.1	7.0	6.8	7.7	7.8
Estonia	2.8	2.6	2.6	3.2	2.7
Ireland	5.9	5.7	5.4	6.1	6.7
Greece	8.4	7.9	7.6	7.9	8.0
Spain	8.4	7.8	7.9	9.0	8.9
France	10.4	10.6	10.7	10.5	11.2
Croatia[1]	5.3	5.3	5.2	4.8	5.8
Italy	9.5	9.4	9.6	9.8	10.8
Cyprus	8.4	8.2	8.1	8.7	9.5
Latvia	3.0	2.4	2.4	2.6	2.6
Lithuania	3.4	3.5	3.7	4.1	4.3
Luxembourg	12.8	12.4	11.1	11.6	11.1
Hungary	6.0	5.9	5.9	5.6	6.6
Malta	8.2	8.2	6.9	7.5	6.6
Netherlands	7.6	7.9	7.5	8.3	9.1
Austria	7.5	7.6	6.9	8.0	8.8
Poland	8.5	8.6	8.9	9.0	8.8
Portugal	7.2	7.0	6.7	6.5	7.4
Romania	3.7	3.8	3.3	4.0	5.4
Slovenia	4.9	5.1	5.1	5.4	5.3
Slovakia	4.6	4.3	4.3	4.8	5.2
Finland	7.2	7.2	7.3	8.5	8.5
Sweden	6.0	6.0	5.8	6.8	6.6

Source: European Commission, DG Taxation and Customs Union, based on Eurostat data

2.1.Analysis of household tax revenues in EU countries in the period 2018-2022

Household tax revenues, as a share of GDP, fluctuated between 2018 and 2022. They decreased slightly in Denmark, Latvia, Greece (-0,2 pp), increased slowly in other countries, Czech Republic +0,4pp, Finland +0,5 pp. Compared to 2020, they decreased sharply in Denmark (-1,7pp), but generally remained relatively constant (anemic increases).

Table 2

Household tax revenues in EU countries in the period 2018-2022, % GDP

	2018	2019	2020	2021	2022
EU-27	0.9	0.9	0.9	1.0	1.0
EA-19	0.9	0.9	0.9	1.0	1.0
Belgium	0.5	0.4	0.3	0.4	0.4
Bulgaria	0.4	0.4	0.4	0.4	0.4
Czechia	0.1	0.1	0.1	0.2	0.5
Denmark	1.0	3.1	2.5	2.9	0.8
Germany	0.6	0.7	0.7	0.7	0.7
Estonia	0.1	0.2	0.3	1.0	0.5
Ireland	0.6	0.6	0.6	0.7	0.6
Greece	1.4	1.2	1.3	1.3	1.2
Spain	1.0	1.0	1.0	1.0	1.1
France	1.5	1.5	1.5	1.6	1.8
Croatia[1]	0.7	0.7	0.7	0.6	0.7
Italy	1.1	1.3	1.3	1.5	1.2
Cyprus	0.6	0.5	0.4	0.5	0.6
Latvia	0.4	0.7	0.1	0.2	0.2
Lithuania	0.8	0.9	0.8	0.9	0.8
Luxembourg	1.7	1.5	1.4	2.0	1.8
Hungary	0.5	0.6	0.6	0.5	0.7
Malta	0.2	0.1	0.1	0.1	0.1
Netherlands	-0.5	-0.3	-0.2	-0.3	-0.2
Austria	0.8	0.8	0.7	1.0	1.0
Poland	0.3	0.3	0.3	0.3	0.2
Portugal	0.6	0.6	0.6	0.6	0.6
Romania	0.7	0.8	0.6	0.9	1.1
Slovenia	0.5	0.6	0.4	0.5	0.4
Slovakia	0.1	0.1	0.1	0.1	0.1
Finland	1.4	1.3	1.6	2.0	1.9
Sweden	1.3	1.3	1.2	1.7	1.4

Source: European Commission, DG Taxation and Customs Union, based on Eurostat data

The share of revenues from household income taxation reveals a synchronization between the level of the tax rate and the level of budget revenues; thus in countries where the tax rate is high (Denmark, Austria, Finland), the related tax revenues are high. In most EU countries, an upward trend is recorded.

In 2022, at the level of the countries in the region, compared to 2021, a lower level of these tax revenues was recorded, only Romania has a relatively constant value (2,4% of GDP in 2021 vs 2,5% of GDP in 2022; a factor that contributed to this increase of 0,1 pp was the extension of the facility granted to employees in the agricultural and food industry sectors); Hungary is the only country in the region to register a higher level compared to 2021, namely

an increase of 1,2 pp (from 4,1% of GDP in 2021 to 5,3% of GDP in 2022); at the opposite pole, Poland stands out, with a 0,9 pp decrease compared to the previous year. Hungary and Poland also have values above the regional average (3,8% of GDP). In Romania, the level of collection is the lowest in the EU, two of the causes being the categories of taxpayers exempted from this tax, as well as the reduced tax rate.

Regarding the statutory personal income tax rates, in 2022 they varied, depending on the region. While Romania, Bulgaria, Hungary continue to apply flat-rate tax regimes (single rate), other countries, such as the Czech Republic, Austria, Germany, Slovenia, Croatia and Slovakia, use progressive tax regimes. In Austria, in 2021, the personal income tax rate for the first tax bracket was also reduced from 25% to 20%, Latvia reduced the maximum tax rate from 31,4% to 31% in 2021, and Spain increased the income tax by 2 pp for those with an annual income of more than 300.000 euros (331.485 dollars). In 2022, the statutory rate for Slovenia is reduced (from 50% to 45%); in Luxembourg, a solidarity surcharge of up to 9% applies; Austria reduced the personal income tax rate for the second tax bracket from 35% to 30%.

2.2.Analysis of corporate tax revenues in EU countries in the period 2018-2022

In the period 2018-2022, corporate tax revenues (% GDP) increased in most countries, except Malta (-1,2pp), Luxembourg (-1,9pp). Increases were in Ireland and the Netherlands (+1,3pp), Croatia, Italy (+1,0pp). Compared to 2020, these revenues increased in all countries - Ireland and Austria +1,3pp, Greece, Czech Republic (+1,1pp), Romania (+1,2pp).

In recent years, member countries have implemented numerous changes, both in terms of the profit tax rate and its tax base. Nine of the member countries have reduced their statutory corporate tax rates, the most significant being adopted in Hungary (-9,4pp), Belgium (-9 pp) and France (-6 pp) and more restricted in countries such as Croatia, Greece, Italy, Luxembourg, Slovakia and Sweden. The only countries that increased their statutory corporate tax rates were Latvia (+5 pp), Portugal (+2 pp) and Slovenia (+2 pp).

In 2022, France stands out, where the statutory rate decreased by 2,6 pp, from 28,4% in 2021, to 25,8% in 2022, and Greece, where the rate decreased by 2 pp, from 24% in 2021, to 22% the following year. The Netherlands, on the other hand, has raised its statutory corporate tax rate by 0,8 percentage points to 25,8% in 2022. Spain has approved a new minimum corporate tax rate of 15% for 2022, applied to large companies with annual revenues of more than 20 million euros (22 million dollars), while banks and energy firms must pay a minimum of 18%. Large multinational companies based in Spain will also face higher taxes, as in 2021 the government reduced tax exemptions from 100% to 95% for dividends and capital gains from foreign subsidiaries.

Table 3

Taxation of companies' income in the period 2018-2022 in the EU, % GDP

	2018	2019	2020	2021	2022
EU-27	2.8	2.8	2.5	3.0	3.4
EA-19	2.8	2.8	2.5	3.0	3.4
Belgium	4.3	3.7	3.3	3.8	4.0
Bulgaria	2.3	2.4	2.2	2.9	3.0
Czechia	3.5	3.3	3.1	3.8	4.2
Denmark	2.7	3.1	2.9	3.9	3.1
Germany	2.8	2.6	2.2	3.1	3.2
Estonia	2.0	1.8	1.6	1.5	1.7
Ireland	3.2	3.1	3.2	3.6	4.5

Greece	2.2	1.9	1.4	2.0	2.5
Spain	2.5	2.1	2.0	2.6	2.7
France	2.9	3.0	2.9	3.0	3.4
Croatia[1]	2.2	2.3	2.3	2.2	3.2
Italy	2.4	2.5	2.5	2.4	3.4
Cyprus	5.8	5.6	5.7	6.2	6.6
Latvia	1.1	0.2	0.7	0.9	1.0
Lithuania	1.5	1.6	1.7	2.1	2.3
Luxembourg	6.3	6.0	4.8	4.5	4.4
Hungary	3.1	3.1	3.0	2.9	3.0
Malta	5.5	5.6	4.6	5.1	4.3
Netherlands	3.5	3.7	3.1	3.9	4.8
Austria	2.8	2.8	2.2	2.8	3.5
Poland	2.1	2.2	2.3	2.6	2.8
Portugal	3.3	3.1	2.8	2.4	3.3
Romania	2.1	2.1	1.9	2.2	3.1
Slovenia	1.9	2.0	2.0	2.5	2.3
Slovakia	3.5	3.3	3.2	3.9	3.8
Finland	2.5	2.5	2.1	2.7	3.0
Sweden	3.0	3.1	3.0	3.5	3.6

Source: European Commission, DG Taxation and Customs Union, based on Eurostat data

Tax reforms adopted by some Member States in recent years include a combination of base-broadening and base-shrinking measures:

• Broadening the tax base through anti-avoidance/anti-evasion measures and by reducing tax exemptions and deductions, such as limiting the deductibility of losses (Latvia, the Netherlands, Sweden) or the use of expensive cars (Poland), reducing the exemption for dividend income (Spain and Belgium) or capital gains (Spain);

• New exemptions and deductions, such as the tax exemption for reinvested profits (Latvia, Portugal), increased deductibility of municipal taxes (Italy), more generous tax brackets in progressive schemes (Netherlands), extending a tax exemption previously limited to special economic zones to the whole country (Poland);

• Investment incentives such as more generous capital allowances/allowances, accelerated depreciation and incentives for research and development. In addition, some Member States have introduced preferential tax regimes for income from intellectual property and the deduction of national interest.

• At the EU 27 level, we note the trend of reducing these rates over the analyzed period and their heterogeneity among member countries.

The EU is concerned with limiting tax competition and combating tax evasion techniques. The objective is to establish a common framework for corporate taxation or, at least, to prevent the application of tax evasion techniques in member countries. An important instrument for this purpose is *the Anti-Tax Avoidance Directive* (ATAD, Directive 2016/1164 EC), mandatory for member countries as of 1 January 2019. Measures applied/initiated in recent years: restrictions on interest deduction; offshore standardization (controlled foreign company - CFC) is one of the important concerns of ATAD; introduction of a global minimum tax.

EU countries (and at regional level), which apply traditional corporate taxation, allow the carry-forward of losses acquired in previous years and the possibility of offsetting them against the positive tax base of subsequent years. This option can only be used for a certain period of time, usually between 5 and 7 years, and in some places, only between 3 and 4 years.

It should be added that countries in the region still tend to impose withholding taxes on interest, dividend and royalty payments (at the rate of 15% or 19-20%). Lithuania, Estonia and Hungary continue to not impose withholding taxes on capital gains. Starting from 2019, group taxation started to be applied in Hungary as well, previously only existing in Austria and Poland. Also, in most countries the tax system encourages research and development activities, Slovakia and Poland have recently taken measures in this regard, while in Romania, various tax incentives specific to these activities have been implemented previously.

In terms of ***international taxation***, efforts to protect corporate tax bases against corporate tax evasion continued with the adoption of significant reforms in line with the OECD/G20 Base Erosion and Profit Shifting (BEPS) project. Tax challenges arising from the increasing digitalisation of the economy are another major concern for many countries that have announced or implemented provisional measures to tax certain digital services revenues.

The European Union published in December 2022 *the Directive implementing the mechanisms for applying the 15% minimum tax*, with mandatory implementation in Member States in 2023, with the first reportable year being 2024.

The OECD's BEPS initiative has drawn attention to cross-border intra-group transactions. Transfer pricing rules have already been introduced into the tax systems of almost all countries involved (in Bulgaria, transfer pricing documentation can be prepared upon specific request of the tax authority). The documentation obligations have recently changed. The BEPS Action Plan - Action on Base Erosion and Profit Shifting has led to international collaboration of over 135 jurisdictions to put an end to abusive tax practices. In addition, the Multilateral Convention on Mutual Administrative Assistance allows for the exchange of tax information between 146 jurisdictions (including Romania).

The fundamental objective of country-by-country reporting mandated by the OECD is to *promote transparency* by providing local tax authorities with the information needed to assess tax risks. Over the past year, taxpayers in the CEE region have had to actively participate in the launch of the country-by-country reporting system.

Fiscal transparency is the fundamental objective of the Organization for Economic Cooperation and Development (OECD) and the European Union (EU), the two organizations imposing a series of measures aimed at ensuring the fulfillment of this objective (through increased regulations, as detailed as possible and real-time reporting of duties and taxes, fiscal risk analysis and targeted controls).

At EU level, an important element of tax transparency is *the Country-by-Country Reporting* (CbC), which will enter into force in June 2024. European Directive 2021/2101 has already been transposed at the Romanian level by Order 2048/2022. According to this order, multinational groups with headquarters in the EU, as well as outside the EU, with a consolidated annual turnover of more than 3,7 billion RON (equivalent to 747,5 million euros on December 21, 2021), in each of the last two consecutive financial years, will have to publicly report the information on the profit tax starting from January 1, 2023. The implementation of this directive at the level of Romania brings even higher fiscal transparency, with the aim of reducing and avoiding tax evasion.

The increase in tax transparency at EU level was also brought about by the EU Anti-Tax Avoidance Directives – ATAD, namely:

- DAC 4 on mandatory automatic exchange of information between tax authorities regarding reporting by multinational enterprises for each country.

- DAC 6 on the reporting obligation of cross-border tax optimization schemes.

- DAC 7 on new tax reporting rules for digital platforms.

- DAC 8 on reporting obligations for electronic currencies and crypto assets

The Standards on environmental, social and governance (ESG) objectives, a priority for companies and implicitly investors, also contribute to increasing transparency and sustainable economic growth; these are regulated by the existing legislative framework regarding sustainability perspectives, such as the Directives on non-financial reporting and corporate sustainability reporting, which introduce the obligation of large, public interest companies to prepare a non-financial report reflecting the relationship between the company and the environment, along with the Regulation on financial market participants and the Taxonomy, which provides a classification of sustainable activities, at the European Union level, respectively OMFP no. 1938/2016, OMFP no. 3456/2018 and the Sustainability Code, at the national level.

3.Fiscal administration - essential role in increasing income from capital taxation

Tax administrations must ensure that taxpayers meet their tax responsibilities. An effective administration achieves this primary objective by promoting voluntary compliance with tax obligations, as well as by identifying and addressing the risks associated with non-compliance.

There are two main reasons why it is vital that tax administrations function effectively. First, they are a key player in ensuring the adequate financing of public policies and public services. Tax administrations collect, on average, 62% of total government revenue in the EU and in some Member States, such as Sweden, up to 99% of total government revenue. A percentage of Member States' value added tax bases also contributes directly to the EU budget.

Second, tax administrations play an important role in protecting honest taxpayers and upholding the principles that everyone pays their fair share. By tackling tax evasion and fraud, they can also help prevent market distortions and ensure a level playing field in the single market. An efficient tax administration facilitates the timely calculation and payment of taxes. On-time filing rates can serve as a useful indicator of the efficiency of tax administrations in this respect, as they partly reflect the ease with which taxpayers can meet their tax obligations in a timely manner. For example, for the timely filing of CIT returns, Portugal, France, the Netherlands and Slovenia are among the best performing countries, while Malta, Cyprus, Ireland and Poland are among the worst performers in 2020. Regarding the timely filing rates of PIT, Spain, France, Bulgaria and Greece are in the highest positions, while Cyprus, Romania, Ireland and Slovenia have the worst results in terms of this indicator.

Tax administrations play an important role in determining the compliance costs faced by taxpayers. These reflect the time spent on complying with tax responsibilities, e.g. completing tax returns. While the size of the compliance costs a taxpayer incurs is partly determined by the rules and obligations of a tax system, it is also affected by the ability of the authorities to simplify the tax compliance process.

Electronic services play an important role in reducing compliance costs as well as the administrative burden on tax authorities. The latest data from 2020 show high levels of e-filing, i.e. the online filing of tax returns, both CIT and PIT returns, across the EU and with significant improvements between 2015 and 2020. However, while the proportion of CIT returns completed electronically is at 100% for most Member States, there is room for improvement in the share of online PIT filings. This is especially true in Luxembourg, Slovenia and the Czech Republic, where e-filing rates are below 25%.

Therefore, the tax administration has the following mission:

- Increasing the collection of taxes and duties, by improving the administrative capacity of ANAF, simplifying, clarifying and predicting tax legislation, combating the underground economy through frequent and efficient controls, supporting voluntary compliance measures, transparency, predictability and real dialogue with the business environment.

- Optimizing the digitalization of the tax system, through the complete and efficient implementation of digital systems (SAF-T, RO e-Invoice, RO e-Transport, SPV, e-cash registers, e-seal), optimizing, and in the absence of this possibility, eliminating e-VAT reporting, eliminating redundant tax returns, interoperability and high-performance IT infrastructure at the ANAF level, training program for ANAF staff to acquire digital skills, stimulating research-development-innovation activities, initiating a public information campaign, along with organizing seminars for industry and consultants, focused on representative case studies and good practices, simplifying the practical implementation of the tax facilities system by clarifying the application method, Correlating these facilities with the global minimum tax, An easier, less bureaucratic documentation system, in order to maintain the competitiveness of research centers.

For Romania, it is necessary to improve the administrative capacity of ANAF (by investing in more and better trained human resources); simplify and clarify tax legislation (by reducing bureaucracy, simplifying tax procedures, clear and easy-to-apply legal texts); assume a transparent attitude regarding legislative intentions and have a real dialogue with the business environment, whose expertise can help find better methods of implementation on the ground.

Some measures that can lead to an increase in capital tax revenues in Romania are:

-eliminating the transaction tax on the sale of residential property and replacing it with a 10% capital gains tax,

-the capital gains tax should only apply to properties purchased after the date of the reform announcement. The measure reduces budget revenues but eliminates the expenses of revaluation of all properties, maintaining the current 10% tax rate on capital gains obtained through an intermediary (e.g. an investment fund),

- increasing the tax rate on dividends to 10% to match the taxation of most other forms of capital income,

- reforming corporate tax incentives to improve effectiveness and transparency,

-simplifying the tax incentive for research and development: a single, increased deduction, eliminating the current exemption for newly established enterprises in research and development,

-reviewing and clarifying the definition of eligible research and development expenses,

-reassessing the efficiency of the tax exemption for reinvested profits.

4.Conclusions

Over the past two decades, the cost of capital has declined significantly and steadily, reflecting a historic decline in both interest rates and corporate tax rates. After the global financial crisis, large firms and firms that are part of multinational groups, firms that hold a high proportion of intangible assets in total fixed assets, and firms that are highly profitable have become less tax-sensitive compared to other firms. The tax sensitivity of older firms also decreases over time compared to younger firms. Changes in corporate taxation that

result in higher effective tax rates (ETRs) reduce investment less than before the global financial crisis. Tax incentives can increase investment in research and development.

Accelerated depreciation is a type of tax support used to help stimulate investment. It is important that tax incentives are well designed and regularly monitored to ensure that they are effective and cost-effective, given their fiscal impact and that they are consistent with existing policy objectives. Such regular assessment could improve the quality of tax support policies aimed at increasing competitiveness, growth and prosperity.

Greater compliance by all taxpayers - legal entities and individuals - can improve the functioning of the economy. Significant improvements have already been achieved through the OECD and EU Directives on administrative cooperation by improving coordination and information exchange between countries. Digitalisation and artificial intelligence (AI) can also help tax administrations to increase tax compliance.

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SOCIETAL OPTIMALITY AND ECONOMY OF EFFORT

Iulian ONEAȘCĂ [8]

Abstract:

The article brings forward the path to optimality, as a way to support improving society's economy of effort. The approach is pluri-methodological, based on a modified and generalised theory of social systems and focussing on Pareto optimality and Markowitz's portfolio selection. The author discusses optimality and its complementary measures and foreshadows a path to optimality in society. This originates in the constitutional amendment and the release of Buchanan's "return of increasing returns", and continues with Markowitz's quantitative method, complemented by Pareto optimality. Finally, the paper concludes, highlighting the need for a metric of socio-human energy, which would allow estimates of social wealth, well-being, and suffering.

Keywords: *economy of effort, Pareto optimality, Markowitz`s portfolio theory*

JEL classification: *D70, K10, O10*

Introduction

Efficiency is the Holy Grail of our times. It is the ultimate measure of performance, meant to reflect the highest output achieved with the least input.

In an increasingly complex world, assessing efficiency is a difficult task. The multidimensionality of society (Luhmann, 1995; Oneașcă, 2021) challenges researchers to assert its performance and seek a desired evolution of its efficiency. Monetization is ill suited to measuring most socio-human activities (see, for instance, Pareto, 1900; UNSD-AEG, 2020). At the same time, the application of the principle of minimum action (Maupertuis), as well as that of self-organization (Thelen and Smith, 2006, p 259; Mathiesen et al., 2011) or economy of effort—its adaptation to living systems—is difficult. It lacks a general metric of energy, which could cover all aspects of human and social life (Oneașcă, 2021). Therefore, a more appropriate term is employed: optimality; it expresses an ideal or desired situation. Optimality reflects a general endeavour to improve reality.

A comprehensive approach to society—according to the international standards of social sciences (Ford, in OECD, 2015), and social disciplines (ISCED-F, in UNESCO-UIS, 2014)—is preferred in this paper. Accordingly, not preference or satisfaction matters in determining the efficiency of policy measures. There are difficulties in highlighting them correctly. People themselves can be wrong when they appreciate what is good for them (Mill, 1859; G.

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Dworkin, 1971).

The objective of the article is to highlight the path to optimality, as a way to support the improvement of society's economy of effort. A pluri-methodological approach, supported by heuristics and casuistry, guides the analysis. It relies on two main pillars:

- A comprehensive framework based on the theory of social systems, which considers energy and its principles as elements of continuity, as well as the international standards of social sciences and disciplines;

- A multidimensional, polycentric approach, with an emphasis on society as a whole, centred on Pareto optimality and Markowitz's seminal work of the 1950s.

Optimality and its complementary measures Pareto - a visionary, top down approach

The Pareto-optimality concept emerged towards the end of the 19th century. Not long after, it became a standard definition of efficiency in economics: when no one can be better off without someone being worse off (Pareto, 1894; Hausman and MacPherson, 1996; Budd, 2004). Thus, social change acquires a relative measure of progress. The value of the principle rests on its social considerations. Its famous applications are confined to welfare economics (Ingham, 2022). One should mention that Pareto delivered his work at a time when the welfare state was at its beginnings and more than a half-century before the adoption of the Universal Declaration of Human Rights in 1948.

Pareto`s method has a macroeconomic perspective, with a top-down approach. Its absolute view derives from its principled nature. In society, only by comparing a change in welfare a Pareto improvement can be observed. Traditionally, efficiency implies a voluntary limitation of resources in public policies; they are thus not conceived by any free market game, even under the threat of bankruptcy, much less in a socio-political environment devoid of such threats. As a result, efficiency can only aim at maximizing certain benefits. To this extent, it seeks to satisfy a limited number of criteria. Pareto optimality is, therefore, a concept that can be used to reduce complexity.

In real world conditions, evaluation and optimality are politically arbitrated. This results from the social decision-making nature, which cumulates judgments on time horizon and funding or change opportunity, as well as resource constraints, including loans. An optimal Pareto situation cannot exist here-and-now. The idea of the optimal is judged in the context of the existence of differentiated values, with different objectives and time horizons; distributional impact and predictability are affected by the time horizon. Therefore, agreement on status changes, and timelines—operational or short-term—, is difficult to achieve and requires imposition, not consensus; accordingly, what is best or acceptable to one person or community is not necessarily similar to others. To formulate a judgment, the mechanistic aggregation brings these values to the level of a fictitious average. Such conditions go beyond the Pareto optimality.

Reality is furthermore complicated. Modern societies have several levels of government and corresponding decision-making centres; what is considered optimal on one level may be a suboptimal entry on another—higher level—or a particular case for another entity at the same level.

Kaldor-Hicks - a step closer to practicality

Pareto optimality has considerable potential, which makes it useful in any dimension of society, not just welfare (e.g., politics, justice). As society is multi-dimensional, Pareto

became the main instrument in multi-objective optimization (Rentsen and Ganlkhagva, 2022).

A more recent measure of efficiency or optimality—the Kaldor-Hicks criterion—loosens the Pareto one: the net gains surpass the losses and the people made worse off can, in principle, be compensated. A theoretical application of such a principle favours the accumulation and centralization of capital, respectively wealth. Thus, the main beneficiaries in society are the entrepreneurs / social structures with a wider potential cost-benefit range. The main reason is that the criterion maximizes the net benefit, not its distribution. Those who have control over non-human/physical assets are likely to control human assets as well (Hart and More, 1990). This could explain why politics tilts heavily in favour of the better off (Elsässer et al., 2018).

Most of the time, a specific distribution strategy is at stake: this stems from the recommendations of political economy and decision-makers choices. The separation between efficiency and distribution cannot be achieved (Hicks 1939, pp. 711–712; Kaldor 1939, pp. 550). At the same time, distributions involve choices and values that are not necessarily specific to society. As a result, they reflect a particular form of efficiency, the allocative one.

The benefits of applying the Kaldor-Hicks criterion are dependent on wealth and power; those who benefit the most will be the wealthiest and most powerful. On the one hand, entrepreneurs and social structures or firms will be able to reap more benefits from policy measures, as, through the variety and diversity of their businesses, they face more opportunities to guide and maximize profits. On the other hand, the wealth of companies (derived from the size and diversity of operations, the relative size of resource flows, etc.) offers wider ranges between costs and potential benefits, favouring the achievement of greater net benefits. Through repeated iterations, the polarization of social structures would increase. Similarly, with each period passing on social inequality would increase (Hackinen, 2012). In the absence of transfers, the benefits and costs will tend to be counted as an average, distributed according to the specifics of the society's organization. Hicks's (1941) hypothesis, though not empirically supported, according to which it is very likely that in the long run everyone will become richer, seems thus contradicted. This is because rich is a relative term. The key to better lives lies in the principles of society's organization and the fair distribution of wealth. The Pareto and Kaldor-Hicks optimality are ahead of their time. Their poor utilisation is related to a conventional and limited understanding (e.g., applied welfare economics), which induced critics (Ellerman, 2014). However, the efficiency-equity analyses disregard the production of public goods and benefits other than welfare ones. Therefore, the principles stand.

Markowitz - a bottom-up approach

A pragmatic way of addressing optimality, though in microeconomics, is portfolio construction. The diverse possibilities of selecting the assets among which an investor can divide its capital define a portfolio. The assets are identifiable resources, monetary or non-monetary, with or without substance (whether physical or biological), controlled by the entity as a result of past events (such as acquisition or self-creation) and from which future benefits are expected (cash inflows or other assets). This definition capitalizes on international standards that it broadens to ensure the inclusion of non-monetized socio-human assets. [9]

[9] International Financial Reporting Standards (online at https://www.ifrs.org/issued-standards/list-of-standards), or International Accounting Standards (online at https://www.iasplus.com).

Portfolio selection is an optimization process, establishing a trade-off between high return and low risk. The first systematic treatment (Steinbach, 2001), belongs to Markowitz. Harry Markowitz received the 1990 Nobel Prize in Economics for „a rigorously formulated, operational theory for portfolio selection under uncertainty." His quantitative method dominates portfolio construction in practice (Boyd et al., 2024).

Using mathematical optimization, portfolio selection responds to the specific needs of microeconomic capital markets. As such, the procedure is mostly available to large investors, those who can afford the selection costs.

Optimality in society

A developed and predictable society, or a flourishing one in the Aristotelian understanding, is a sustainable and resilient society, based on democracy, the rule of law and human rights. Optimising its course involves a continuous dynamic initiated by at least two iterative, comprehensive processes and complemented by others, according to the dimensions of social life and existing levels of governance.

The optimisation process considers principles (e.g., economy of effort), societal dimensions and their markets (e.g., political, legal) that condition societal efficiency. In this endeavour, economics can provide the main tools. This social science addresses basic human needs. Their satisfaction with success has allowed humanity to reproduce itself for millennia. Thus, the study of the production of goods and services led to the incorporation of nature`s principles into economics.

First, the constitution is the foundation of any society and its development engine. Therefore, the starting point in optimising the evolution of society is the amendment of:

- The culture and societal values that need to be promoted,

- Constitutional checks and balances and their progress,

- Benchmarks on the direction of progress, the level of ambition and the setting of reasonable expectations.

Improving constitutional rules with all their incentives expresses the same process coined as "the return of increasing returns" by Buchanan (Buchanan and Yoon, 1994). These multiplying returns can be seen as resulting elements of a broader fiscal policy perspective, stimulating a favourable balance between social energy spending and harvesting.

Second, the public spending is a multi-dimensional portfolio that needs optimisation on its various levels of government. Two main types of portfolios can be distinguished. They aim at the acquisition of specific assets.

i. Assets such as investments in physical (e.g., power, transport, construction), digital infrastructure, and capital markets and

ii. Social assets such as education, training, health, employment and good governance.

Markowitz optimisation intervenes in these processes to select the most profitable portfolios.

Third, Pareto optimality is required. Particular attention is needed to verify respect for the rule of law and human rights, so that selected investments do not undermine them in the pursuit of maximizing economic profit. The aggregation of results provides us with information about the average. The well-being of each individual is susceptible to unpredictable and multidimensional variations. Therefore, in real life, the measure of coverage with goods and services or personal satisfaction, combined with trends in dynamics, can provide a comparative picture of overall societal optimality or efficiency.

Conclusions

Society, as a whole, offers optimality measures a full scope. Subsidizing or increasing the costs of various doings encourages or discourages certain types of activities or behaviours. The approach has proven to be very powerful. It shapes human behaviour through informed choices: individuals are offered as much information and incentives as possible for consideration. In turn, societies can benefit from it in all their dimensions, improving the economy of effort. Unfortunately, the use of economics and its focus on efficiency are limited to the economic dimension—only part of it—and society in general is disregarded. Thus, non-monetized economic gains and losses are barely noticeable, let alone taken into account for an overall assessment of optimality. A new standard of measurement of socio-human energy and capital—such as energy currency—would allow an estimate of social wealth, well-being and suffering. All costs and benefits are thus translated from current currencies into energy harvesting and reproduction units, specific to societal needs. National statistics could thus include monetized measures of socio-human capital, unemployment, physical disability, and income, including an index of suffering in society (see the anticipation of such an index, Kahneman, 2011).

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IDENTIFICATION AND USE OF SUSTAINABILITY AND RESILIENCE INDICATORS WITHIN BANKING INSTITUTIONS

Viorica POPA [10]

Abstract:

Organizational assessment and reporting on sustainability, a tool developed and conceptualized in the middle of the 20th century in the context of cooperative activity, is expanding and becoming an important tool for measuring and communicating organizational performance in order to achieve the objective of sustainable development, accountability for this performance to internal and external stakeholders. A sustainability report also presents the organization's values and governance model and demonstrates the link between its strategy and its commitment to a sustainable global economy." Increasingly, corporate sustainability reports take the SDGs into account. Through Directive 2014/95, the EU introduced, for certain large companies, the obligation of non-financial reporting in relation to certain minimum sustainability information. The reporting methods applied differ depending on the entity's management requests, the nature and usefulness of the non-financial information presented. The article was developed within the framework of Subprogram 030101 „Strengthening the resilience, competitiveness, and sustainability of the economy of the Republic of Moldova in the context of the accession process to the European Union", institutional funding.

Keywords: *Sustainable indicators, organization, research, sustainable, development, resilience.*

JEL classification: *J24, O15, I23*

Introduction

The Republic of Moldova's commitment to sustainable development is based on the commitment to comply with the 2030 Agenda, as well as on the country's European path, stemming from the reflection of sustainable development in the EU treaties. Organizational sustainability assessment and reporting, a tool developed and conceptualized in the mid-20th century in the context of cooperative activity, is expanding and becoming an important tool for measuring and communicating organizational performance in order to achieve the goal of sustainable development, accountability for this performance to internal and external stakeholders.

The Global Reporting Initiative, a major player supporting this development by proposing the most commonly used standards, considered as a reference by the European Commission bodies when developing recommendations, defines sustainability reporting as "a report published by a company or organization on the economic, social and environmental impact caused by its daily activities. A sustainability report also presents the values of the organization and its governance model and demonstrates the link between its strategy and its commitment to a sustainable global economy". Increasingly, companies' sustainability

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reports take into account the SDGs. Through Directive 2014/95, the EU introduced, for certain large companies, the obligation of non-financial reporting in relation to certain minimum sustainability information. The reporting methods applied differ depending on the requests of the entity's management, the nature and usefulness of the non-financial information presented. In this context, the application of a specific grid for group reporting is at the forefront, but international standards are also applied, such as, for example, the Global Reporting Initiative, UN Global Compact, AA1000, SA8000, ISAE3000, etc. (Chorafas, D. N et al., 2021).

Sustainability reporting within banking institutions is a new tool in the case of the Republic of Moldova, being present only sequentially. Some local entities develop reports requested by the non-resident parent entity or voluntarily advocate for the application of European regulations, which allows them to align with international data reporting requirements. The US Agency for International Development (USAID), in partnership with FHI 360 and the International Center for Not-for-Profit Law (ICNL), and the local partner - the Center for Organizational Training and Consulting (CICO), is implementing the Civil Society Organizations Sustainability Index. This index, applied for a quarter of a century, although focused on the analysis of seven key dimensions (legal framework, organizational capacity, financial viability, advocacy, service delivery, sectoral infrastructure and public image), represents not only an assessment tool but also a basis for developing support measures for these organizations (European Central Bank et al., 2020).

The importance of expanding the application of the sustainability assessment of organizations is particularly relevant at the national level, given the continuous increase in the interest of stakeholders and organizations in non-financial information. Making the implementation process more efficient depends on the capacity to develop national expertise, adopt and adjust sets of indicators, including the evaluation methodology based on indicators, based on the specific needs of different types of organizations at the national level and the European experience. Achieving sustainability and the multiplier effect of the action is ensured by involving young people and integrating capacities from the research and education system (Gintz, D., & Miazga, M. et al., 2020).

The activity is to respond to the evaluation and reporting needs of organizations and stakeholders, considering the contribution of this exercise to democratization and transparency, to the development of adjustment and development strategies, to the completion of the SDG implementation tools. The implementation of the exercise at the national level, through an integration of the functional assessment needs of the organizations and the information of significant importance for the stakeholders, will allow to ensure the implementation of an exercise adapted to the local specifics, with the construction of a vision of implementation in stages, of training the necessary expertise and on the regulatory framework and existing practices at the national level. The implementation of the Project will contribute to reducing the costs of the model extension by considering the possibilities of automating the data collection process in order to increase their efficiency and comparability, selecting the most optimal models and methods based on international practice, identifying the information of significant importance to be considered in the first stages of implementation, ensuring the contributory basis for the training of specialists. The prior identification of the implementation challenges will represent a basis for facilitating the expansion of the practices (Grewal, J., & Serafeim, G. et al., 2019).

Sustainability assessment is the basis for extending complex approaches with a broad scope from the analysis of an organization's impact on the environment to a more comprehensive analysis of sustainability in its operational processes as a whole, examining the interdependence between the organization's impact on the environment and environmental changes on the organization's activity.

Literature Review

Banks and other financial institutions are intensely engaged in channelling financial resources toward sustainable activities (Cerqueti et al., 2023) through investment strategies (Xia et al., 2023). The SRP has become the core of the business strategy irrespective of the type of business operations (Ghosh, 2017). The stakeholder theory emphasises the importance of corporate disclosure in advancing the interests of stakeholders and society. According to the theory, firms must report all sustainability issues to maintain long-term stakeholder relationships (Freeman, 1994). Contemporary empirical literature noted the relevance of SRP in the banking industry considering the significant impact on society through investment and lending operations (Nobanee & Ellili, 2016; Islam & Kokubu, 2018). Bank strategies must undergo a paradigm shift to integrate ESG considerations into banking activities and advance sustainable development. Several national and international standard-setting bodies, including the United Nations Global Compact (UNGC) principles, have proposed environmental reporting frameworks, which organisations have widely embraced to improve ESG enactment. Consequently, to keep the stakeholders well-informed on business affairs and communicate ESG-based performance, sustainability reporting has become more popular and important over the past couple of years through BRR, SRP, CSR reports, and similar formats (Khan et al., 2009). In fact, any firm has explicit costs and implicit costs. The firm that attempts to decrease its implicit costs by being socially irresponsible will certainly incur additional explicit costs. Therefore, managers should satisfy the needs of all stakeholders, not just investors or shareholders (Melé, 2008) whereas sustainability reporting satisfy stakeholders' needs.

According to the trade-off hypothesis or traditionalist view (Friedman, 2007), there is a negative relationship between sustainability and financial performance. Spending resources to accomplish social and environmental goals (such as investment in pollution reduction, higher employee wages and benefits, donations, and sponsorships for the community) increase costs, harm profitability and impair competitive advantage (Galant & Cadez, 2017). Thus, firms should not be engaged in sustainability activities unless they have excess returns. Manchiraju and Rajgopal (2017) showed that forcing firms to invest in sustainability activities leads to a drop in their returns. The trade-off theory suggests that sustainability practices create additional expenses that reduce profitability (Aupperle et al., 1985). Firms that spend on sustainability activities will have lower profits (Balabanis et al., 1998; Friedman, 2007).

The results of research and discussions

Sustainability reporting in the banking system refers to the process by which banks present their economic, social and environmental impact on society and the environment, in order to demonstrate their responsibility towards sustainability. In the financial context, this type of reporting has become increasingly important due to strict regulations, customer and investor requirements and the need to support a transition to greener and fairer economies. In this sense, sustainability reporting for banks in the European Union (and beyond) has been regulated by directives such as the EU Corporate Sustainability Reporting Directive (CSRD), which replaced the old NFRD (Non-Financial Reporting Directive).

The banking financial system functions as a relay in the orientation of funds in the economy, so, in the context of ESG priorities, it has an increasingly defined and regulated mission to monitor and direct capital towards sustainable development according to the 2030 Agenda and the objectives of the transition to a low-carbon economy. In this regard, in recent years,

over 10 new regulations have emerged (many of them from the European Commission, the European Central Bank and the European Banking Authority) with numerous requirements that also target the financial banking system in the Republic of Moldova.

In this context, the ESG (Environmental, Social, and Governance) strategy in the banking sector refers to the integration of environmental, social and governance factors into banking activities and decisions. Banks are subject to an increasingly rigorous regulatory framework, and the implementation of ESG strategies has become a priority not only for compliance with regulations, but also for building a solid reputation and responding to market demands.

Table 1

ESG strategy in the banking sector

Aspects of ESG strategy in the banking sector	
Environmental (E)	**Reducing carbon footprint:** *Banks can invest in green energy projects or adopt sustainable internal practices (e.g., using renewable energy in their offices).*
	Managing climate risk: Assessing and integrating climate risk into the lending process. For example, banks can refuse to finance polluting or climate-risk industries.
	***Financing environmental projects**: Banks can support companies that focus on developing green solutions or reducing their environmental impact, such as renewable energy solutions, sustainable transportation, or efficient resource management.*
Social (S)	***Social impact of financial decisions:** Banks can implement policies that promote financial inclusion, by providing affordable credit or by supporting small and medium-sized enterprises.*
	***Responsibility to employees:** Creating a safe and inclusive work environment, promoting diversity and equal opportunities*
	Measures against discrimination: Banks should adopt clear policies to prevent discrimination based on gender, age, race or other protected categories.
Governance (G)	***Transparency in decision-making**: Adopting corporate governance practices that ensure transparency to shareholders and other stakeholders, for example, by publishing annual ESG reports.*
	***Governance and compliance committees:** Creating committees dedicated to ESG responsibilities and aligning with international governance standards, such as OECD regulations or local legislation.*
	***Prevention of corruption:** Banks should apply rigorous control over corruption risks, including through compliance policies, internal audit and ongoing monitoring.*

Source: elaborated by the author.

Society and governments attach great importance to the growth of these aspects, so that the rating of companies is influenced by their ESG profile - therefore, the ESG policy begins to influence the market value and cost of financing of any entity.

In the context of the rapid expansion of new technologies and constantly changing market requirements, the banking community in the Republic of Moldova promotes projects of national and international scope and communicates to the market the role of the banking system in contributing to consumer welfare and economic development by increasing financial inclusion, increasing financial intermediation on a sustainable basis and reducing risks/barriers. The banking community has a key role in supporting companies in the transition to a green economy and supports the transition to climate transition financing through the development of green products. It is also considered that the implementation of the Action Plan on Sustainable Finance must reflect developments in the real economy.

Banking institutions in the Republic of Moldova are involved in promoting and implementing ESG strategy in the banking sector, with important steps being taken in this regard:

- ✓ *Clear internal policies and strategies:* Each bank must have specific internal ESG policies that apply to all its activities, including at the level of the loan portfolio, investments and customer relationships.
- ✓ *ESG risk assessment:* Banks can implement ESG risk assessment systems to help identify and manage environmental, social and governance risks.
- ✓ *Training and education for employees:* Bank staff must be trained to understand the importance of ESG and how to apply these principles in customer interactions and internal decisions.
- ✓ *Collaboration with other financial institutions:* Banks can collaborate internationally to establish common standards and share best practices regarding the implementation of ESG strategies (OECD et al., 2020).

To this end, we encourage companies to pay increased attention to these data, and if they already have a sustainability strategy or if ESG aspects are embedded in the business strategy, to make their long/medium and short-term objectives known to their banking partners. For each of the ESG components – environmental/social/governance, it is recommended that the objectives set be adapted to the specifics of the industry and the positive or negative impact of the company in the ESG areas. For example, such objectives may target actions such as 100% energy consumption from renewable sources, reducing or eliminating plastic from packaging, energy efficiency in company operations, adapting services to serve vulnerable categories. Each commercial bank will analyze within the internal lending process the information collected from companies, which may include, without being limited to those from the perspective of environmental, social and corporate governance principles, those usual in lending analysis in compliance with the regulations in force (Pereira, C. S., & Pereira, J. M. et al., 2020).

In the Republic of Moldova, ESG (Environmental, Social, Governance) regulations for the banking sector are still in their early stages, but there are important steps towards implementing international and European standards. Although local legislation is not yet as mature as in the European Union, there are regulations aimed at encouraging a transition to a more sustainable and responsible financial sector. Although Moldova is not part of the European Union, European regulations significantly influence national legislation, especially in the context of association agreements and economic integration. The main European regulations relevant to the banking sector in Moldova include:

a. Sustainable Finance Disclosure Regulation (SFDR): The Sustainable Finance Disclosure Regulation (SFDR) is a European regulation that requires financial institutions, including banks, to disclose how they take ESG factors into account in the management of their assets. It is part of a broader package of regulations aimed at integrating sustainability criteria into the financial sector. Although Moldova is not part of the EU, many international banks operating in the Moldovan market follow these regulations, and the Moldovan authorities are starting to implement similar regulations as part of the financial sector reform process.

b. European Taxonomy - The EU Taxonomy provides a common system for classifying economic activities that can be considered environmentally sustainable. Even if Moldova has not yet directly adopted this taxonomy, local financial institutions are likely to be influenced by this regulation in the context of their investment and lending activities, especially given the economic ties with the European Union.

c. NFRD and CSRD Directives - The Non-Financial Reporting Directive (NFRD) and the new CSRD Directive require large companies to report information on their ESG performance. Similarly, Moldovan banks that are subsidiaries of European groups will be influenced by these regulations, and the tendency is for local authorities to adopt similar measures in the near future.

Local ESG regulations for the banking sector in the Republic of Moldova - local regulations are less developed in the field of ESG compared to the European Union, but there are some initiatives that reflect concerns about sustainability and governance:

a. Law on Environmental Protection and Ecological Policy - While there are no specific regulations requiring banks to adopt detailed ESG policies, there are general laws regulating environmental protection, to which banks can contribute through their financing and investment policies. Banks are encouraged to support green projects, such as renewable energy or energy efficiency, by providing loans or financing in these areas.

b. Civil Code and governance regulations - Existing regulations regarding corporate governance in Moldova include requirements for transparency, financial reporting and accountability. Although not always focused on ESG principles, they are considered fundamentals of good governance, and financial institutions are subject to these rules. In addition, the Moldovan authorities are focusing on improving corporate governance standards.

c. National Bank of Moldova (NBM) regulations - The National Bank of Moldova has adopted regulations requiring financial institutions to have a risk management system, including environmental and social risks, which may affect long-term financial stability. In this regard, the NBM promotes responsible risk management, and Moldovan banks are encouraged to take into account climate change risks and the social impact of their activities. The NBM has also adopted regulations for the transparency of financial institutions and for consumer protection, which may be related to social aspects of ESG.

d. International initiatives and partnership agreements - Several Moldovan banks are part of international financial groups that promote ESG principles. For example, banks that are part of large groups will apply the ESG regulations and standards imposed by the parent group. Association and cooperation agreements with international organizations, such as the World Bank or the International Monetary Fund, may also indirectly influence the adoption of ESG policies and practices in the Moldovan banking sector (Ernst & Young (EY). et al., 2020).

Increasing ESG transparency and reporting: Moldovan authorities may implement stricter ESG reporting regulations in the future, especially for banks and large financial institutions. Such regulation could include reporting obligations on the social and environmental impact of financial and investment activities.

Sustainable finance: There is a growing trend in financing sustainable projects, including in the field of green energy and energy efficiency. Moldovan banks may be encouraged to adopt financial policies that support these areas.

Regulatory infrastructure challenges: One of the major challenges remains the lack of a clearly defined legislative and regulatory framework in the field of ESG. Currently, there is a growing need to create a more detailed legal framework that supports the implementation of good ESG practices in the banking sector.

To obtain a green loan, companies must meet the bank’s requirements in terms of sustainability, demonstrate positive environmental impact, and ensure transparency and compliance with environmental regulations. It is also essential that the project is well documented, assessed, and certifiable, and that the company demonstrates a clear strategy

for its implementation. This type of financing can represent a valuable opportunity for companies that want to contribute to environmental protection and access favorable financial conditions.

Table 2

Principles of obtaining a "green" loan from banks	
Defining a "green" project	*Eligible projects: First, the company must define a project that meets the "green" criteria set by the bank or sustainable finance rules (such as the EU Taxonomy or international regulations). These may include investments in renewable energy technologies (solar, wind, hydropower), energy-efficient infrastructure, carbon reduction projects, or waste and water management projects. Environmental impact assessment: Projects must demonstrate a significant contribution to environmental protection, such as reducing greenhouse gas emissions, saving natural resources, or improving energy efficiency.*
	Eligible projects: First, the company must define a project that meets the "green" criteria set by the bank or sustainable finance rules (such as the EU Taxonomy or international regulations). These may include investments in renewable energy technologies (solar, wind, hydropower), energy-efficient infrastructure, carbon reduction projects, or waste and water management projects. Environmental impact assessment: Projects must demonstrate a significant contribution to environmental protection, such as reducing greenhouse gas emissions, saving natural resources, or improving energy efficiency.
Developing a sustainability plan	*Companies must submit a sustainability plan that details the project's objectives, activities and expected environmental outcomes. This plan should include clear information on:* ✓ *Carbon footprint* ✓ *Use of renewable energy sources* ✓ *Environmental impact* ✓ *Any environmental or ecological certifications the company holds, if applicable (e.g. ISO 14001 for environmental management).*
Risk assessment and regulatory compliance	*Environmental due diligence: Banks will conduct a detailed assessment of the project to ensure that it complies with environmental standards. This process may include environmental risk analysis, assessment of the impact on local ecosystems, and verification of compliance with national and international environmental regulations.*
	Compliance with European taxonomy (for banks applying EU standards): If the bank follows European regulations (such as the EU Taxonomy for Sustainable Activities), the company must demonstrate that its project complies with these regulations, demonstrating that the economic activity in which it invests can be considered "green" or sustainable.
Submitting a Complete File to the Bank	*The company must prepare a complete dossier containing details about the green project, the expected environmental impact, the implementation strategy and the financial projections. It is also important to include information about environmental risks and their management plans.*
	If the project includes investments in innovative technology or infrastructure (for example, carbon capture technologies or renewable energy), a detailed feasibility assessment may also be required.
Getting Green Certification	*Some banks may require that green projects have external certification, issued by recognized organizations that validate that the project complies with environmental standards. Certifications may also include independent verifications of the project's environmental impact.*
The Benefits of Getting a Green Loan	*Favorable financial conditions: Banks often offer more advantageous loan terms for green projects, such as lower interest rates or longer repayment periods, as they are considered safer in the long term and contribute to achieving global sustainability goals*
	Access to European or international funds: In some cases, banks can facilitate access to additional funds from European or international sources for green

	projects. For example, through EU cohesion funds or other international financial institutions that support sustainable development.
Monitoring and Reporting Progress	*Ongoing monitoring: After granting the loan, banks will track the progress of the project, ensuring that the environmental objectives are met. This may include regular reporting on the project's environmental performance.*
	Reporting according to ESG standards: If the company is large or operates in international markets, it may be required to report according to relevant ESG standards, such as CSRD standards or other European or international regulations.
Partnerships and Collaborations	*Some banks collaborate with international organizations and environmental agencies to financially support sustainable projects. Companies can benefit from such partnerships to access funds and demonstrate their commitment to sustainability.*

Source: elaborated by the author

Companies wishing to obtain "green" loans (financing for environmentally sustainable projects) from banks must meet certain conditions and follow a specific process. These loans are granted to support projects that have a positive impact on the environment, such as investments in renewable energy, energy efficiency, CO2 emission reduction, sustainable management of natural resources or biodiversity protection.

In this context, the Moldovan banking sector is in the process of integrating ESG principles, but there are still challenges related to the implementation of a complete and coherent regulatory framework. European regulations will continue to influence the local banking sector, and gradually, the Moldovan authorities will adopt measures to support the transition to more sustainable and responsible financing.

Conclusions

The identification and use of sustainability performance indicators by banking institutions will lead to better communication with external stakeholders on the achievement of sustainable development objectives and the positioning of banks in a sustainable environment and in step with current realities. The potential of these indicators is manifested, including, by promoting sound and sustainable investment decisions by companies.

Sustainability assessment and reporting is a response to the demand of investors, markets, civil society and consumers. Although the public and private sectors are based on different driving forces, stakeholder satisfaction is essential for both sectors, the motivations and benefits of reporting, both in the private and public sectors, being in some respects similar based on the two fundamental purposes, as a management tool and as a reporting tool at the management or organizational level. The implementation of the ESG strategy in the banking sector is not just a trend, but a necessity in the context in which banks must respond to the increasing demands of the market and international regulations. By integrating these principles, banks can contribute to the development of a sustainable and responsible economy, and at the same time, they can protect and improve their position in the market.

The implementation of the organizational sustainability assessment represents an action to facilitate, at the micro and macro level, sustainable development approaches, to establish conditions for increasing the country's investment attractiveness, to democratize processes and to promote sustainable management practices. The action will contribute to facilitating the European integration process, by contributing at the micro and macro level to the adoption of practices and approaches established at the European level. From the point of view of the obligations assumed by the Republic of Moldova, it is related to facilitating the achievement of the SDGs and the process of adopting the European acquis.

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THE POLICY OF PROFESSIONAL DEVELOPMENT OF HUMAN RESOURCES IN RESEARCH INSTITUTIONS IN THE CONTEXT OF A RESILIENT DEVELOPMENT

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Abstract:

The paper examines the importance of resilient human resource (HR) practices in research institutions, essential to fulfilling the Lisbon Strategy's vision of a competitive, knowledge-based economy. It highlights the unique HR challenges these institutions face, such as attracting top talent, continuous training, and retention, which demand adaptable recruitment and development strategies. Through a mixed-methods approach that integrates theoretical frameworks with empirical data from European research institutions, the study explores effective HR strategies, such as competency-based recruitment, targeted training programs, flexible career development opportunities, and multi-dimensional performance evaluation. By fostering an environment that supports professional growth, innovation, and institutional adaptability, resilient HR practices play a critical role in sustaining research excellence and maintaining competitiveness in the dynamic global scientific landscape.

Keywords: *human resources, research institutions, professional development, resilient development, knowledge-based economy*

JEL classification: *J24, O15, I23*

Introduction

The European Union's Lisbon Strategy, launched in 2000, outlined a bold vision for Europe to become "the most competitive and dynamic knowledge-based society in the world" (European Commission, 2000). At the heart of this vision is the pivotal role of universities and research institutions, which serve as engines of innovation, scientific progress, and economic growth. These institutions contribute approximately 80% of fundamental research in Europe and employ around 34% of active researchers (European Science Foundation, 2009). Positioned at the intersection of research, education, and innovation, these institutions drive advancements in science and technology while supporting the economic goals of the region.

However, realizing the full potential of this vision requires more than mere investment in infrastructure or resources. The human capital within these institutions—researchers, educators, and administrative staff—is essential to achieving Europe's competitive edge. Unlike in other fields, human resources (HR) in research institutions are subject to unique pressures and challenges due to the highly specialized, interdisciplinary, and rapidly evolving nature of the scientific field. This dynamic environment places demands on HR policies and

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practices that go beyond standard organizational frameworks, necessitating adaptive and resilient HR approaches tailored to the distinctive needs of research personnel.

The challenges faced by research institutions in effectively managing their human resources are multi-faceted. The high degree of mobility among researchers, intense competition for top talent globally, and the growing requirement for interdisciplinary skills and adaptability highlight the complexities in recruitment and retention. Further compounding these issues are evolving global research demands and heightened competition between institutions to attract leading scholars and innovators. Additionally, the focus on producing high-impact research and fostering innovation requires that researchers receive ongoing professional development opportunities to keep pace with advancements and contribute meaningfully to their fields.

This paper delves into the HR policies and practices essential for fostering resilience within research institutions, focusing on recruitment, motivation, training, and performance evaluation as key components of a robust HR strategy. Resilience in HR practices is not only about responding to challenges but also about creating an environment in which researchers can thrive, innovate, and grow. Such resilience enables institutions to meet both current and future demands, preparing them for shifts in research priorities, technological advancements, and emerging interdisciplinary fields. By examining adaptive strategies for professional growth, this study emphasizes the necessity of resilient HR practices that align with the overarching goals of the European Union's knowledge-based economy.

The study draws on both theoretical frameworks and empirical insights from existing literature, institutional reports. By analyzing these data, we aim to highlight the best practices and challenges associated with fostering resilience in HR management within the unique context of research institutions. This paper offers a comprehensive overview of strategies to build and sustain a workforce capable of adapting to the fast-paced and competitive nature of global research environments, contributing to the sustainable development of Europe's knowledge economy.

Literature review

The professional development of human resources in research institutions, particularly through the lens of resilient development, has garnered substantial attention in recent years. As organizations navigate an increasingly volatile world, fostering resilience within their workforce has emerged as a crucial strategy.

Research by Lee and Wang (2017) underscores the importance of entrepreneurial resilience, particularly for leaders who face unpredictable challenges. They found that human resource professionals can play a pivotal role by designing interventions that strengthen resilience among leaders. Such interventions can help leaders develop adaptability, ensuring that institutions are well-prepared to navigate the unexpected (Lee & Wang, 2017).

Luthans and colleagues (2006) took a different angle, exploring the concept of psychological resilience as a core component of "psychological capital." They advocated for a combination of proactive and reactive human resource development (HRD) strategies to help employees build inner resources, like self-efficacy and optimism. By increasing employees' psychological assets and managing stressors, HR professionals can contribute to a more resilient workforce that withstands challenges with a constructive mindset (Luthans et al., 2006).

Health workers, who are at the core of healthcare resilience, also benefit from robust HR practices, as noted by George, Campbell, and Ghaffar (2018). Their research highlights the

unique role of health personnel as pillars of resilient health systems, emphasizing the need for HR policies that prioritize engagement, retention, and motivation. This ensures that health workers, crucial to resilient development, remain committed to their roles, ultimately supporting sustainable progress in healthcare settings (George et al., 2018).

Organizational resilience is similarly supported by strategic HR initiatives, as shown in Lengnick-Hall's (2011) research. By fostering resilience-oriented practices within HR, institutions can cultivate individual behaviors that, when combined, contribute to an organization's overall capacity to adapt. This strategic approach enables organizations to respond flexibly to adverse conditions, which is crucial in fast-evolving sectors (Lengnick-Hall et al., 2011).

In the industrial sector, Blanco and Montes-Botella (2017) found that human capital and research and development (R&D) are key to resilience in manufacturing companies. Their study of Spanish firms suggests that investments in HR and R&D create a stronger foundation for resilience, enabling companies to handle global economic shifts with greater ease. This indicates that resilience is not just about individual employee capabilities but also the structural support of human resources and innovation (Blanco & Montes-Botella, 2017).

Finally, the education sector also requires resilience-based HR policies, especially during crises. Slatvinskyi and Tsymbal-Slatvinska (2023) examined HR strategies in higher education amid current crises and found that adapting HR policies to prioritize safe work environments, continuous professional development, and strategic use of financial resources significantly benefits institutions. Their findings highlight the need for educational institutions to support faculty resilience, ensuring that educators can fulfill their roles even under pressure, thus enhancing the institution's overall stability (Slatvinskyi & Tsymbal-Slatvinska, 2023).

Thus, the development of human resources with a focus on resilience can fortify research institutions and organizations across sectors. Strategic HR practices enable employees not only to cope but to thrive, contributing to institutions that are better prepared for the unpredictable demands of a dynamic world.

Description of the problem

The rapid advancement of knowledge, and the demands of a globalized scientific community, present unique HR challenges for research institutions. Studies indicate that human resource management (HRM) within research settings is perceived as more complex and anxiety-inducing than financial or administrative management. As the competition for skilled researchers intensifies, institutions must continuously adapt their HR policies to meet evolving demands.

Recruiting qualified research personnel is particularly challenging in a competitive global environment. Research institutions require highly specialized expertise that often crosses disciplinary boundaries. To address this need, institutions frequently expand their recruitment efforts to include international candidates. Top institutions such as the University of Cambridge and Oxford University recruit over 30% of their researchers from international talent pools, emphasizing the importance of a global approach to recruitment (Φραγκούλης, 2005). This strategy allows institutions to access diverse perspectives and foster collaboration across geographic boundaries.

However, international recruitment alone is insufficient to meet the complex needs of research institutions. Many institutions have implemented structured recruitment processes that include job analysis, role-specific criteria, and performance predictors to identify

candidates most likely to succeed. Given the complexity of research roles, this structured approach helps institutions select candidates who possess both the technical skills and adaptability required for success. However, the recruitment process in research settings is often time-consuming and resource-intensive, underscoring the need for efficient yet rigorous selection methods.

Retention of skilled researchers is a critical challenge for research institutions, as high turnover can disrupt research continuity and institutional productivity. Researchers are often driven by factors such as intellectual challenge, recognition, and career development opportunities. Studies indicate that fostering an environment that meets these needs is key to retaining researchers in the long term (Harley, 1999). Institutions can support retention by offering incentives such as flexible working conditions, sabbaticals, and funding opportunities for research projects.

In addition to these structural supports, institutions benefit from providing career advancement opportunities and professional recognition. For example, allowing researchers to participate in conference presentations, leadership roles, and collaborative projects can foster a sense of belonging and encourage long-term commitment. Financial incentives, such as performance-based bonuses, also play an important role in retention, although non-monetary rewards such as mentorship and professional development opportunities are equally valuable.

Methodology and Data

This study employs a mixed-methods approach, integrating theoretical frameworks and empirical data from existing reports, policy documents, and academic literature to analyze resilient HR practices in research institutions. The research focuses on key aspects of HR management, including recruitment, motivation, training, and performance evaluation, to understand how institutions adapt to evolving research demands and workforce challenges.

A comprehensive review of scholarly literature, institutional reports, and policy documents was conducted to identify trends, challenges, and best practices in HR management within research institutions. This review included academic journal articles, reports from European research organizations, and policy documents from institutions such as the European Commission. The selected sources provide insights into competency-based recruitment, interdisciplinary skill development, structured career pathways, and multi-dimensional performance evaluation.

Additionally, statistical data from policy briefs, education management systems, and publicly available datasets were analyzed to examine researcher employment trends, training participation, and institutional performance metrics. By synthesizing findings from these sources, the study highlights effective HR strategies that enhance resilience in research institutions and identifies common challenges across different organizational contexts.

By synthesizing insights from existing literature and empirical data from institutional sources, this study provides a comprehensive assessment of resilient HR management in research institutions. The findings contribute to a deeper understanding of how HR policies can be optimized to sustain research excellence and institutional competitiveness in a knowledge-based economy.

Results

In the Figure 1 it is illustrated a cyclical approach to human resource management within research institutions, highlighting the interconnected processes of recruitment, training and development (including motivation and retention), and performance evaluation. This continuous loop ensures that institutions can attract, develop, and retain highly skilled researchers while maintaining a structured assessment framework to support long-term resilience.

The cycle begins with recruitment, where institutions seek to attract top talent with the necessary expertise and adaptability to thrive in research environments. Once researchers are integrated into the institution, training and development initiatives, along with motivation and retention strategies, play a crucial role in fostering professional growth. These efforts help researchers stay engaged, refine their skills, and adapt to evolving scientific and institutional demands.

As researchers contribute to their fields, performance evaluation becomes essential in assessing their progress and impact. This assessment not only ensures accountability and excellence but also informs future training needs and recruitment strategies, reinforcing a continuous improvement cycle. By integrating these key HR components into a dynamic and adaptive framework, research institutions can build a resilient workforce capable of sustaining innovation and competitiveness in a rapidly evolving knowledge-based economy.

Effective recruitment is essential for building a resilient workforce in research institutions. Many institutions target international talent pools, seeking individuals with specific expertise in areas of high demand. This international recruitment strategy allows institutions to tap into a broader range of skills and experiences, particularly in emerging fields that require interdisciplinary knowledge (European Science Foundation, 2009).

Selection processes typically include job analysis, identification of role-specific skills, and criteria for professional efficiency. Structured recruitment processes help institutions identify candidates who are well-suited to the demands of their roles. However, the time and resources required for these processes can be a barrier, particularly in fast-paced research fields where positions must be filled quickly. Some institutions have begun to experiment with faster, technology-driven recruitment methods, such as virtual assessments and online interview platforms, to streamline the selection process without compromising rigor (Φραγκούλης, 2005).

Training and development programs are critical for fostering a resilient research workforce. Research institutions emphasize two primary skill sets: research expertise and management capabilities. Researchers are often provided with training in areas such as securing research funding, managing interdisciplinary collaborations, and intellectual property management. Training in these areas not only enhances individual skills but also strengthens the institution’s capacity to engage in complex research projects (Middlehurst, 2009).

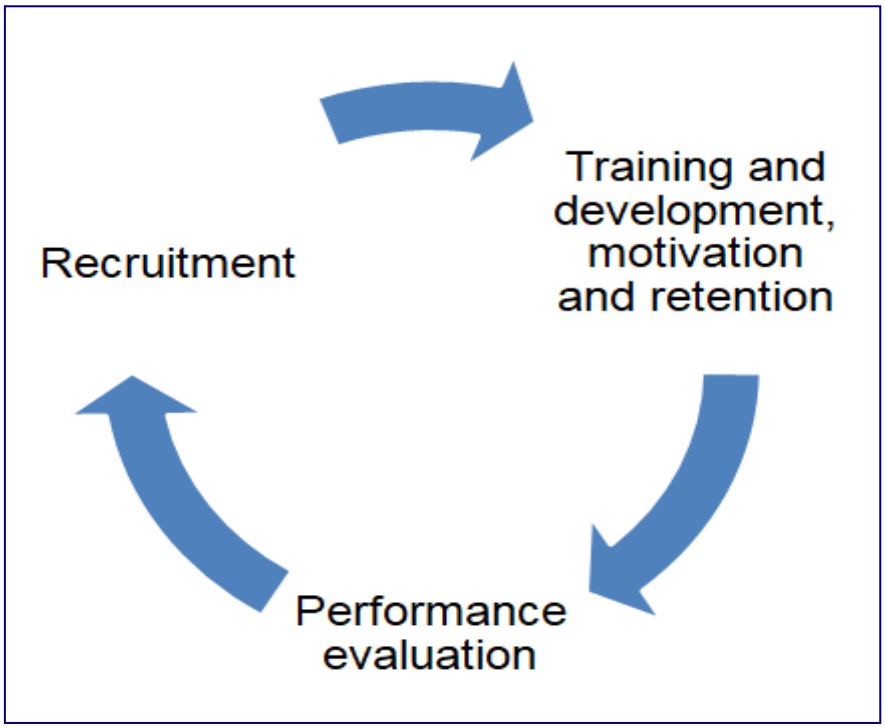

Figure 1 - Flowchart of the resilient HR approach

Source: Elaborated by the authors

Mentorship programs are another vital component of professional development in research settings. For example, over 75% of European universities report that they offer mentorship opportunities to doctoral and postdoctoral researchers, helping early-career researchers develop foundational skills and providing guidance on career progression. In addition to mentorship, institutions offer training in project management, financial management, and research methodology, equipping researchers with the tools they need to make meaningful contributions to their institutions.

The importance of flexible and targeted training is underscored by the demanding schedules of research personnel. Short-term, high-impact training sessions allow researchers to develop skills without significant disruption to their primary responsibilities. Studies suggest that targeted, practical training programs are more effective than traditional methods, as they are easier to integrate into busy work schedules and address the specific needs of researchers (Φραγκούλης, 2005).

Retention strategies in research institutions are focused on creating an environment that fosters both personal and professional growth. Research indicates that providing researchers with intellectual challenges and opportunities for professional recognition are key factors in retaining skilled personnel (Harley, 1999). Institutions can further support retention by implementing flexible work policies that allow researchers to balance their teaching and research responsibilities, thereby reducing burnout and enhancing job satisfaction.

Financial incentives, such as competitive salaries and performance-based bonuses, contribute to motivation and retention. Many institutions have developed transparent pay structures that reward high performance, helping to retain top talent. In addition to financial rewards, non-monetary incentives such as professional recognition, conference invitations, and leadership opportunities are equally important. These initiatives help researchers feel valued and motivated, which strengthens their loyalty to the institution.

A robust retention strategy also includes providing career development opportunities. Leadership training programs, for example, allow researchers to develop skills in project management, team building, and strategic planning. These programs are particularly valuable for early-career researchers, as they provide a clear pathway to advancement within the institution. By supporting the professional growth of researchers, institutions can create a more resilient workforce capable of adapting to new challenges.

Performance evaluation in research settings requires a multi-dimensional approach that goes beyond traditional metrics. While peer review remains a key component of research assessment, many institutions are adopting scientometric tools to complement peer review, allowing for a more comprehensive evaluation of research impact (Whitchurch & Gordon, 2009). These tools measure research output based on metrics such as citation counts, publication quality, and societal relevance.

The evaluation process also considers the broader impact of research, including its contributions to education, technology, and public policy. For instance, research that influences policy decisions or contributes to economic development is highly valued, as it aligns with the goals of the knowledge-based economy (Φραγκούλης, 2005). This approach ensures that research is not only productive but also relevant, providing tangible benefits to society.

Research institutions face considerable challenges in managing human resources, particularly in the context of a dynamic and competitive global research environment. Recruitment, motivation, training, and performance evaluation are all critical components of an effective HR strategy, yet each of these areas requires a resilient approach that can adapt to the changing needs of the field.

Recruitment practices, for example, must be flexible enough to attract a diverse and highly skilled workforce while ensuring that candidates possess the specific skills needed for their roles. Similarly, training and development programs must be tailored to the unique demands of research, providing researchers with targeted skills that enable them to succeed in their careers. Motivation and retention strategies must go beyond financial incentives, fostering a supportive environment that recognizes the contributions of researchers and encourages long-term commitment.

Performance evaluation is particularly complex in research settings, as it requires balancing quantitative metrics with qualitative assessments of impact. Institutions that adopt a multi-dimensional approach to evaluation can more accurately assess the contributions of their researchers, promoting a culture of excellence and accountability.

Conclusions

The development of resilient HR policies within research institutions is a foundational component for fostering a sustainable and adaptable research workforce. Resilience in HR practices is essential not only for supporting researchers' individual growth but also for enhancing the institution's capacity to adapt to the demands of a rapidly changing knowledge-based economy. By focusing on key areas such as recruitment, training, motivation, and performance evaluation, research institutions can establish a workforce capable of meeting current challenges while remaining prepared for future uncertainties.

Effective recruitment strategies are critical for attracting top talent, especially as institutions increasingly compete on a global scale. Structured, competency-based recruitment processes enable institutions to select candidates with the specific technical and interpersonal skills necessary for complex research roles. Furthermore, targeting diverse,

international talent pools allows institutions to draw from a wide range of perspectives, which can enrich interdisciplinary research and innovation.

Training and development programs form the backbone of professional growth within research institutions. These programs not only provide researchers with the technical skills and management capabilities needed to succeed but also contribute to the overall institutional resilience by preparing researchers for leadership roles. Short-term, targeted training programs that are easily integrated into researchers' busy schedules have proven to be effective, ensuring that researchers can continuously update their skills without disrupting their primary responsibilities.

Motivation and retention are equally important in fostering a committed and resilient workforce. Research institutions can retain skilled personnel by creating an environment that supports intellectual curiosity, professional recognition, and career development. Flexible work policies and incentives—both financial and non-financial—help address researchers' unique motivational drivers, such as the need for recognition and opportunities to contribute meaningfully to their fields. By cultivating a supportive work environment, institutions can reduce turnover and maintain continuity in their research agendas.

Performance evaluation presents unique challenges in research settings, where traditional metrics alone cannot fully capture the impact and relevance of a researcher's contributions. A multi-dimensional approach to evaluation, which combines quantitative metrics with qualitative assessments of broader societal and policy impacts, is essential for fostering a culture of excellence and accountability. This approach aligns individual contributions with the broader mission of advancing knowledge and innovation for societal benefit.

Ultimately, resilient HR practices in research institutions not only support the professional growth of individual researchers but also enhance the competitiveness and adaptability of the institution itself. By embedding resilience into HR policies, research institutions can position themselves to thrive in a global, knowledge-driven economy, effectively contributing to scientific advancements, technological innovation, and economic development.

The findings of this paper also underscore the broader implications of resilient HR policies in research settings. By building a robust talent pool, research institutions enhance their ability to address global challenges, drive sustainable development, and support regional economic growth. Additionally, resilient HR practices can serve as a model for other sectors that rely heavily on knowledge-based workforces, showcasing how adaptability, targeted skill development, and motivational strategies can create a dynamic and future-ready workforce.

The insights provided in this study can guide research institutions in refining their HR policies to support a resilient and engaged workforce. These practices have the potential not only to benefit researchers but also to contribute to the institution's long-term success and to the advancement of a knowledge-based economy that meets the needs of society and future generations.

Future Directions

The future of human resource management (HRM) in research institutions presents several promising directions. One area for further research is the development and identification of best HRM practices across different types of research institutions, such as public universities, private research entities, and non-profit research organizations. Comparative studies could reveal how various institutional structures, funding models, and research priorities influence HR policies and their effectiveness in enhancing productivity, innovation, and institutional reputation.

Another potential direction involves examining the long-term impact of resilient HR practices

on both researchers and institutions. Longitudinal studies could assess the correlation between adaptive HR strategies, such as flexible recruitment and performance evaluation, and indicators of institutional success, such as research output, researcher satisfaction, and talent retention. Understanding these impacts would provide valuable insights into how HR policies influence not only individual career progression but also the overall competitiveness and sustainability of research institutions.

With the digital transformation accelerating across sectors, another area of interest is the role of digital platforms in enhancing professional development, collaboration, and recruitment processes in research institutions. Virtual learning environments, online mentoring, and digital skill-building platforms offer new ways to support researcher development, making it easier for institutions to deliver training and professional resources, especially in remote or under-resourced areas. Digital tools also facilitate cross-institutional collaboration and global recruitment, creating more inclusive and diverse research environments.

Exploring the impact of artificial intelligence (AI) and machine learning on HR processes in research settings is another promising avenue. AI-powered tools can streamline recruitment by efficiently screening candidate profiles, predicting job-fit, and reducing the time required for the selection process. Additionally, AI can play a role in personalized career development by analyzing researchers' performance data and suggesting tailored training programs or professional pathways, helping institutions retain and nurture talent.

Lastly, establishing international standards for researcher evaluation would enhance transparency, competitiveness, and alignment with the goals of a global knowledge-based economy. Standardized metrics and evaluation frameworks could improve cross-border recognition of research contributions, facilitating international collaboration and researcher mobility. Such standards could also include guidelines for recognizing interdisciplinary work and societal impact, ensuring that evaluations reflect the diverse contributions of research beyond traditional publication metrics.

These future directions highlight the potential for HR practices to evolve in ways that meet the demands of a dynamic research environment. By embracing digital transformation, AI, international standards, and comparative studies, research institutions can enhance the resilience and effectiveness of their HRM strategies, ultimately strengthening their capacity to contribute to global scientific and technological advancements.

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SECTION II. FINANCIAL AND MONETARY CHALLENGES

THE TRENDS IN THE EVOLUTION OF DIGITAL BUSINESS MODELS IN THE BANKING SECTOR IN THE CONTEXT OF INDUSTRY 4.0.

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Abstract:

The transition to the digital economy and its impact on the banking sector is perceived ambiguously by both academic and business circles. The very possibility of digital transformation of the banking business model, in order to maintain its market position (let alone increase or strengthen it), requires reshaping the boundaries of accessible information for external agents, which carries numerous hidden threats and security risks to the entire architecture of the bank's business model.

The purpose of the research on the topic is to analyze and evaluate how the technological transformations brought by Industry 4.0 influence digital business models in the banking sector. This research aims to identify the main trends in the adoption of digital technologies, examine their impact on the operations and competitiveness of banks, and explore the opportunities and challenges faced by financial institutions in the process of digitalization.

Keywords: *digital economy, banking sector, digital business models, digital transformation*

JEL classification: *G21, L21*

Introduction

Today, the banking sector, like other branches of the economy, is actively advancing digitalization: artificial intelligence technologies are being deployed, robotic chatbots are being created and remote identification methods are widely used. In addition, in the banking services market, despite the tightening of central banks' policies in different countries regarding capital adequacy and liquidity of commercial banks, competition is becoming fiercer every year.

The banking system is one of the most receptive sectors of the national economy to the implementation of innovations and application of new digital solutions. This is determined by several internal and external factors. Internal factors include:

- The steady growth of cashless payments globally and in the Republic of Moldova, the use of cashless payments has seen a significant increase in recent years. According to a report in 2024, in 2023, each citizen made, on average, 54 cashless payments, compared to just 8 payments in 2017. However, over 30% of Moldovans do not use bank cards due to distrust of banks and preference for cash [22];

- Developing competition on the payment services market from non-bank organizations.

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External factors include:

- Steady growth of the global digital banking market (globally, the market for digital banking platforms is growing. Its size is projected to reach USD 11.5 billion by the end of 2024 and continue to grow to USD 31.3 billion by 2033, at a compound annual growth rate (CAGR) of 11.7% from 2024 to 2033 [23];

- A steady increase in the number of users (in terms of the number of digital banking users, it is expected to exceed 3.6 billion globally by 2024, up from 2.4 billion in 2020, representing a 54% increase [24]).

- The COVID-19 pandemic has also accelerated demand for remote financial services. According to data from Fidelity National Information Services (FIS), since April 2020, the number of new unique users of mobile banking apps has increased by 200% and traffic has increased by 85%.

These trends indicate a growing adoption of digital banking services both globally and in the Republic of Moldova, although challenges still exist related to consumer trust and cash preference.

The expansion of digitization of banking services is also being driven by the trend towards personalized banking. On the one hand, personalization is today a key competitive advantage for modern banks, which focus on meeting the unique needs of their customers. On the other hand, the personalized approach in the banking segment is an appropriate response to the economic and psychological expectations of banking consumers. These expectations are linked, firstly, to the increasing wealth of the population (according to IMF and UN data, by 2025 income is expected to increase by 3.0-10.0%, depending on the region), secondly, to the growing number of the middle class - the main driver of innovations for individuals (according to WorldDataLab, by 2030, the global number of the middle class will reach 5.3 billion people), and thirdly, to the changing personal motives for organizing financial services according to individual lifestyle and needs (life-style banking) [12, p. 14].

All this creates favorable conditions for the development of personalized digital services in the banking sector, taking into account the national characteristics of the transition to Industry 4.0.

In this context, the assessment of the banking business according to the transition to Industry 4.0 will ensure not only an increase in the number of customers served, but also in the range of digital services provided through high-performance digital models. Commercial banks are ready to implement new techniques and technologies to optimize their business, with a priority on ensuring customer satisfaction and recording increasing performance indicators.

Description of the problem

The research problem is to identify and analyze the main directions for the evolution of digital business models in the banking sector, given the challenges and opportunities generated by the technological transformations of the Industry 4.0 era. In a context characterized by accelerated digitalization, artificial intelligence, big data, block chain and other disruptive technologies, banks are under constant pressure to adapt and innovate.

Researchers in the field have analyzed both theoretically and practically how to shift to digital business models not only in banking, but also in other important areas of the economy. At the same time, the issues related to the formation and development of digital business models for banking have been little studied in the national and international literature, which was an additional motivation for the authors to investigate this scientific field in more detail.

In this context, banking services should be understood as the existing electronic customer service and support technologies available to customers, such as internet banking, mobile banking, virtual account in electronic payment systems, online banking and others.
The clarification of the categorical apparatus will focus on the analysis of the business model approach, and then the various approaches to the content of the concept of "digital banking business models" presented in the literature will be systematized (table 1).
Among the definitions of the business model concept, two groups can be distinguished:
- In the first group, the main focus is on the value created for customers, i.e. what and for whom we create and whether it is possible to realize this value for the consumer with profit for the company;
- In the second group, the focus is on internal processes: how we create value for customers (operational processes, process executors, their hierarchy and areas of responsibility).
In the first group, the definition of the business model is closely linked to the value creation chain, and the key characteristic of the model is monetization. Is the business model capable of generating significant value in the eyes of customers, does this value exceed the cost of its formation in the business and delivery to the customer?
In the second group, the definition of the business model is closely related to business processes, and the key characteristic of the model is operational efficiency. Is the company able to reduce costs through the management models and technologies developed?
Both approaches are also linked to the company's strategy: how the company's work is carried out and by what means its objectives are achieved.
The concept of business models is intended to describe the business in detail, so that the key moments of the business are clear, but without details and specifics that are specific to a concrete implementation and lack the necessary degree of generality: detailed enough to be a tool for business modeling, but not so customized that the template is difficult to use for adaptation to a concrete business idea.

Table 1.

Conceptual approach to the notion of "digital banking business model"

The author	The concept
1. Amit R., Zott C. [1, p. 43]	Maximizing the full potential of digital technologies for the implementation of banking products and services exclusively in a remote format
2. Burmeister C., Lüttgens D., Piller F. [3, p. 67]	Large-scale transformation of the architecture and infrastructure of banking business processes of product (service) provision to the client, when his communications with the bank take place in a virtual environment
3. Parker J., Van Alstine M., Choudary S. [15, p. 145]	A new organization of banking service, which allows to increase the productivity of all bank systems and personalize the product (service) taking into account the client's wishes.
4. PWC Analytical Reports [7]	Format of bank work based on the use of social, mobile and other digital technologies in order to reduce operational costs and personalize banking services to increase its own competitiveness.
5. Uddin M.H. [20]	strategy for integrating the potential of digital technologies into the bank's financial products and services to generate economic value added.
6. Ghauri F.A [9]	Fundamental reorganization of the bank's business model to ensure its competitiveness in the new conditions of market structure and business behavior paradigm.
7. Tripathi S. [19]	The process of forming a new organizational, legal and economic structure in which private and public commercial interests are realized in a seamless information space.
8. Jibril A.B. [11]	Some ‘agreement’ of market space subjects on the transfer of business processes into a virtual environment, where products and services are designed to meet the needs of a particular customer, taking into account the principles of smart manufacturing.

Source: elaborated by the authors based on the information mentioned in the table

Summarizing the material presented in table 1, we propose our own interpretation of the concept of "digital banking business model" - it represents a way of digital interaction of the bank with its customers, oriented towards the creation of new values through the use of the

latest digital technologies in a virtual mechanism of creation and promotion of personalized banking products and services.

In our opinion, this interpretation synthesizes all the modern laws and trends of digital banking development, both in the Republic of Moldova and internationally.

As Matt, Hess and Benlian note, digital transformation is best accomplished in a cross-functional way within individual structures. It's about ensuring alignment and standardization of practices within the business to streamline communication, collaboration, and support brand image and corporate cohesion. The authors identify four dimensions common to most - if not all - digital transformation strategies:

1. Technology use: The company's attitude toward new technologies and its ability to use them.

2. Changes in value creation: The impact of these digital tools on the value creation chain of the business and its core activities.

3. Structural changes: These are the foundation of the actions and processes of the business and therefore need to move towards digital transformation.

4. Financial aspects: These are the driver of digital transformation and also act as a barrier. In any case, they need to be considered as the foundation of digital transformation [13, p. 339- 343].

The authors illustrate the interplay of these dimensions as a successive transformation of the financial aspects, closely linked to value creation and business structure, which need to change to enable the digital transformation and the use of technologies.

The authors illustrate the interaction of these dimensions in the form of a successive transformation of the financial aspects, closely linked to value creation and business structure, which must change to enable the digital transformation and the use of technologies.

The content of the "Industry 4.0" concept can be represented in the following diagram (fig. 1).

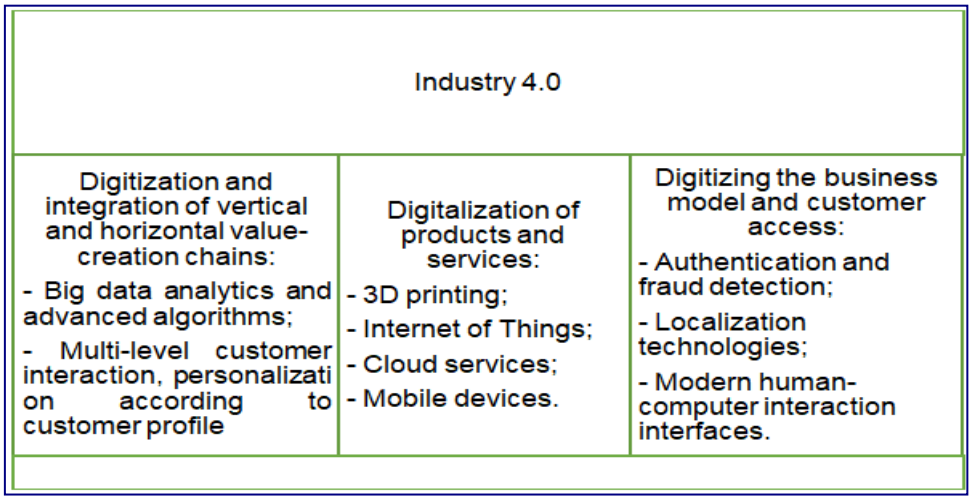

Figure 1. The content of the "Industry 4.0"

Source: elaborated by the author in according with 14

Thus, an important feature of the banking system in terms of delineating its stages of incorporation into the digital economy is the inseparability of digital technologies in banking business processes. Thus, the first mention of "Industry 4.0" as an evolutionary stage of the world economy belongs to the American computer scientist N. Negroponte, but the genesis

of digitalization must be sought much earlier [14].

According to I. A. Sedyh, the first successful example of the digitization of banking services is the creation of a functional ATM of Barclays Bank in London in 1969, which laid the foundation for the development of a new segment of the banking market - card-based banking products. In 1970 in the United States, Bank Americard was issued, which later became the international Visa International system [17].

The second stage is considered to be the period between 1980 and 2000 when the "customer-bank" remote banking methodology was formulated, which is, in fact, the foundation for contemporary digital solutions and services.

The third stage can be identified as the period between 2001 and 2010, when the previously created "client-bank" platform was actively supplemented with various services and products.

From 2011 to the present, we are witnessing the era of open banking, which gradually forms extended digital spaces, involving more and more representatives of the non-financial sector in thematic partnerships: businesses in the FMCG, HoReCa, airline, taxi (the most common examples), which come under the interest of leading banks most often.

The COVID-19 crisis of 2019-2020 has become one of the most active catalysts in the entire history of remote banking development and has rapidly spurred the development of banking services, prompting a review of traditional strategies and models of communication with customers. It is important to note that even today, the effect of a brief launch persists, and in the next 2-3 years it will be one of the main factors of smart development of digital banking in the world and in the Republic of Moldova.

The critical analysis of scientific and applied researches of the definitions presented in Table 1 allowed establishing that the attempts to methodologically order the processes of development and implementation of innovations in the business models of the banking sector originated in the 70s of the XX century. Overall, the evolution of the stages of transformation of business models in banking is presented in figure 2.

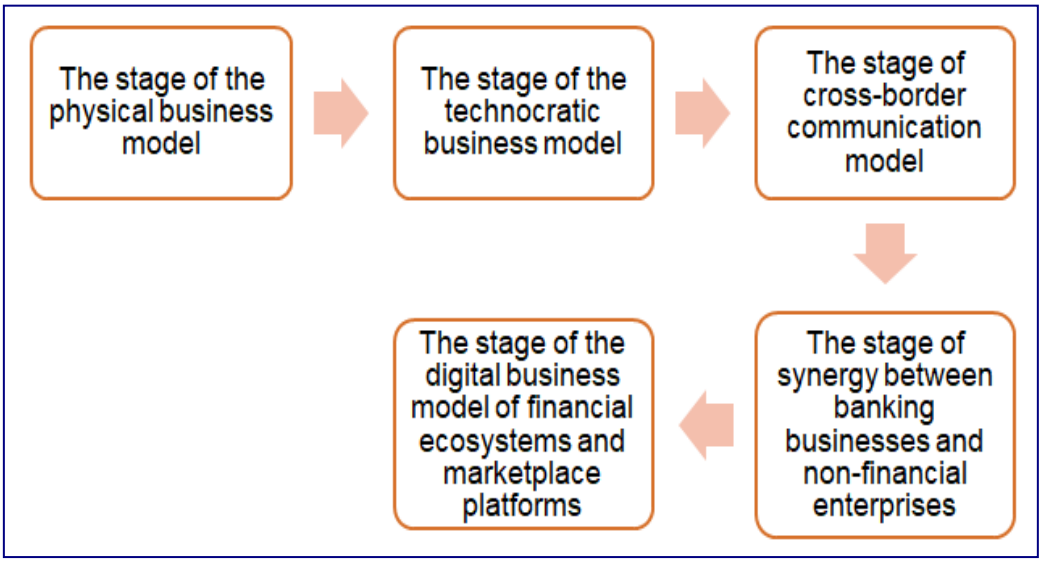

Figura 2. The evolution of the stages of transformation of business models in banking

Source: elaborated by the author in according with 10, p. 73

As can be seen from Figure 2, the shift from the physical to the digital business model has been achieved in a fairly short period of time, and the last few years demonstrate an almost phenomenal development of the banking business towards digital optimization and personalization of the virtual bank-customer interaction.

Today, the central issue for commercial banks is how banks can redefine their business models to remain competitive, respond to growing customer demands and meet changing regulations, while effectively integrating new technologies. Of course, it is not easy to deploy powerful digital technologies without a coherent legal framework, the necessary tools and customer feedback to transform habits that have been formed over years. However, both banks and customers recognize the need to change and align the spectrum of banking services and operations to the standards dictated by the ultra-fast advancing technological innovations.

The main signal for the revolutionary transformation of banks' business models in terms of organizing and promoting banking services to retail and corporate customers was the adoption in September 2015 by the UK banking regulator of the initiative to transition to the application of open API standards (developed by the Open Banking Working Group [16, p. 22]). This allowed banks to use customer data from other institutions, subject to privacy policy requirements, to improve banking services and proactively respond to changing customer needs and requirements. We emphasize that as of 13.01.2018, the implementation of the Open API standards in the UK became mandatory for the country's 9 largest banks [21, p. 80].

Separately from the UK, in January 2016, the European Union Payments Directive, PSD2, was adopted, which gave the customer the right to pass on financial transaction management rights to third parties based on the Open API standard [16, p. 23].

These two events marked the bifurcation point in the development of banking services: everything that was in place before the adoption of the Open API standard was called traditional remote banking, and everything that emerged afterwards - digital banking. The substantive and methodological differences between traditional remote banking and digital banking are presented in more detail in table 2.

Table 2.

Comparison of traditional remote banking and digital banking

Criteria	Traditional Remote Banking	Digital Banking
Chronological Stage	? – 2015 (for the EU – 2018)	2015 (2018) – present
Business Model	Rigidity (a vertically structured system created by the bank based on its portfolio of services and products)	Customer-oriented (banking is a flexible system that quickly responds to customer needs and adapts to their behavior)
Main Source of Information	Client's personal data, which constitutes banking secrecy	Open data about the client, Big Data on their transactions, information from social networks and thematic discount cards, accessible to a specific circle of people designated by the client
Service Implementation Tools	Package solutions or strict pricing plans set by the bank and offered to the client (modifying their functional composition is usually difficult)	Marketing and behavioral tools (software products are intelligent and capable of self-adaptation based on customer behavior, lifestyle, and professional preferences)
Bank's Revenue Source	Commission for performing certain transactions using the bank's infrastructure	Commission for managing the client's personal data and ensuring the cybersecurity of their online interactions
Banking Service Format	Physical orientation: Services rely on the bank's own infrastructure and specialists (the same service may vary in quality depending on the bank's specialists' expertise)	Virtual orientation: Open infrastructure solutions where the client receives an almost identical service in terms of quality and security, regardless of the bank
Competition & Customer Acquisition Tools	Price-based: Banks offer flexible tariffs, discount schemes, and loyalty programs to attract customers	Technology-based: Banks attract customers through convenient, accessible solutions and a wide range of personalized financial tools

Source: compiled by the authors based on the data [2, pp. 213–215].

The information summarized in table 2 allows the conclusion to be drawn that digital banking is a new technical and functional construct, which is, in fact, a free-builder for the formation of single financial markets, taking into account the needs of a specific retail customer or corporate business requirements.

Methodology and Data Sources

To assess the extent of digital banking development as a key product of the fintech market, we will present the dynamics of its penetration into the banking systems of the world's major geographical regions (fig. 3).

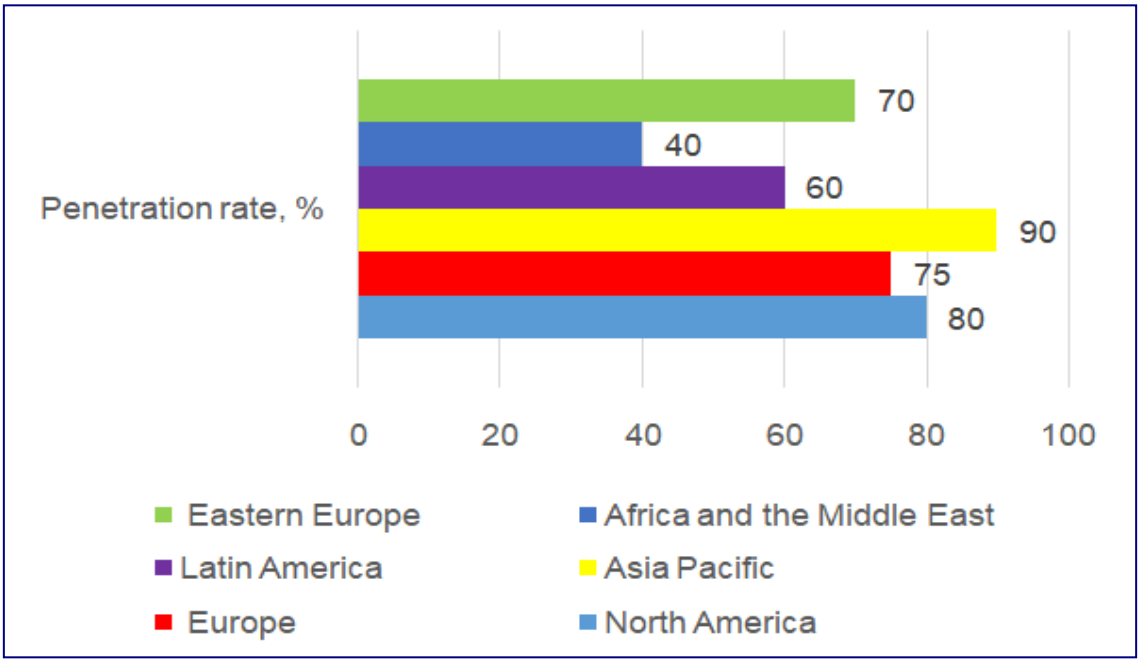

Figure 3. Evolution of the digital banking penetration rate by geographical regions

Source: author's elaboration based on data from 4, 5, 6, 8, 21

The dynamics of digital banking penetration in 2023 reflect the accelerated growth of the FinTech market, driven by the rapid digitalization of financial services and the widespread adoption of advanced technologies worldwide. Regional differences in the adaptation and integration of digital banking as a key product of the FinTech market are determined by economic, cultural, technological, and regulatory factors.

Thus, for North America [4], the penetration rate is one of the highest in the world, with over 80% of consumers using digital banking services, particularly mobile apps and online platforms. The key factors driving this evolution are:

- An advanced technological ecosystem
- Strong FinTech players such as PayPal and Stripe.
- Consumer preference for quick and easy-to-use solutions.

For Europe [21], the penetration rate ranges between 75%-80%, with variations between Western and Eastern European countries. The generating factors include:

- The implementation of PSD2 regulations and the promotion of open banking.
- A focus on instant payments and cross-border solutions, especially in the Eurozone.
- Increased use of digital wallets and mobile banking apps.

In the Asia-Pacific region [18], the penetration rate exceeds 90%. Active users include countries such as China, South Korea, and Singapore, while India is experiencing rapid growth. Key influencing factors are:

- The dominance of FinTech platforms like Alipay, WeChat Pay, and Paytm.
- Massive investments in digital infrastructure and the rapid adoption of 5G.
- Financial inclusion through mobile technologies.

In Latin America [5], the penetration rate is approximately 60%, but with accelerated growth in recent years due to investments in FinTech, driven by:

- Limited access to traditional banking services for a large portion of the population, favoring the use of digital solutions.
- Increased smartphone usage and internet connectivity.

For Africa and the Middle East, the penetration rate varies between 30%-50%, but with enormous growth potential [8], explained by:

- Mobile technologies transforming even rural areas, with solutions like M-Pesa in East Africa.
- Urban youth representing a solid base for the adoption of FinTech solutions.

Eastern Europe is also catching up, with a penetration rate of around 70%, though lower in other countries in the region. Generating factors include:

- Government programs supporting the digitalization of the banking sector.
- Development of local alternatives to international payment platforms [6].

From the above, the following trends in digital banking development under Industry 4.0 can be identified:

- Accelerated digitalization of traditional banking services.
- Integration of block chain and artificial intelligence technologies.
- Complete transformation of the banking ecosystem through super-apps integrating multiple financial services.
- Increased adoption of biometric payments.
- Expansion of mobile payment platforms like Nubank and Mercado Pago.
- Adoption of digital lending solutions.
- Development of solutions for instant payments and online banking.

In 2024, the development of digital banking continued to advance significantly across various regions of the world, influenced by technological innovations and changes in consumer behavior.

In Europe, digital banks recorded notable growth. For example, Openbank, the 100% digital bank of the Santander Group, became the largest of its kind in Europe by deposit volume and expanded its operations to the United States in 2024. This expansion reflects the strategy of European banks to increase their presence in international markets and leverage the advantages offered by digital platforms.

In the United States, traditional banks intensified their digitalization efforts to compete with new financial technology platforms. Additionally, European banks like Openbank expanded their presence in the American market, offering high-yield savings products and intuitive digital experiences for customers.

In Asia, a region known for the rapid adoption of financial technologies, digital banking continued to develop rapidly. FinTech platforms gained popularity, offering integrated and

personalized banking services to a broad consumer base.

In Latin America and Africa, digital banking made significant progress, particularly in areas with limited access to traditional banking services. The widespread use of mobile devices facilitated the adoption of digital financial services, enabling financial inclusion for larger segments of the population [25].

Thus, in 2024, digital banking continued to evolve globally, with differences in the pace and methods of adoption, depending on the specificities of each region.

Results and discussion

The comparative characterization of approaches regarding the digital transformation of banking business models allows us to conclude that the higher the level of penetration of digital technologies in a bank's business processes, the more exposed it becomes to a greater number of cyber threats. This enables a better understanding of their strengths and weaknesses in the context of ensuring security in the digital environment, as observed in the content of table 3.

Table 3.

Comparative analysis of digital transformation strategies for banking business models: global perspectives

Approach	Content	SWOT Analysis of the Approach
1. Traditional Bank with Digital Channels	**Prerequisites for Application:** Deterioration of the competitive position of banks with traditional physical business models (BM); increasing customer demand for new personalized products and services; declining profitability and business activity indicators. **Goal:** Integrating individual elements of digital banking into the traditional physical BM to maintain the competitive position and business activity of classical banks. **Mechanism:** The bank's management identifies critical areas requiring urgent modernization and rapidly digitizes the products and services within these areas. The overall BM structure and its physical paradigm remain unchanged.	**Advantages:** Relatively low transformation costs, preservation of conservative management interests, short-term satisfaction of customer expectations. **Disadvantages:** Potential conflicts between traditional and digital business process management paradigms, replication of banking products leading to increased administration and control costs, challenges in timely updating digital infrastructure due to its autonomous nature within the physical BM.
2. Digital Branch of a Traditional Bank	**Prerequisites for Application:** Growing customer demand for full migration of services to a digital environment; management's readiness to experiment with digital transformation; desire to maintain business activity in both physical and digital environments. **Goal:** Creating a subsidiary business unit within the bank's physical BM, operating as a "financial sandbox" for developing, testing, and integrating digital tools for product and service delivery in operational banking, while separating customer flows based on their preferences. **Mechanism:** The bank's management selects one or more infrastructure objects with high innovative potential. The leadership of these structures develops individual digital transformation strategies and implements the described activities. The effectiveness of their work is then evaluated in a control session, and the best practices are subsequently scaled across the parent BM.	**Advantages:** A balanced and diversified approach to transformation, creation of a dedicated infrastructure for digital transition, and the formation of professional experience in the digital paradigm. **Disadvantages:** High costs of maintaining such a branch, potential conflicts of subordination, difficulties in data exchange, and the risk of the subsidiary structure absorbing the parent organization; limited scalability of digital banking practices across the entire parent BM.
3. Digital Banking Brand	**Prerequisites for Application:** Management's declaration of readiness for fundamental digital transformation, adoption of a digital rebranding strategy for the BM, and goals for M&A deals with fully digital banks. **Goal:** Positioning the bank as one striving for change and	**Advantages:** A balanced approach to technological and process innovations, minimizing risks and errors in reform path selection; high alignment of management and customer interests, rational use of financial resources for operational

	innovation through systematic, step-by-step work on digitizing business processes. **Mechanism:** The bank's management creates a digital transition roadmap and a work schedule, defining responsibility centers and points of interest alignment. The digitization of the BM's contours and levels is carried out in stages.	infrastructure reorganization. **Disadvantages:** Lengthy digital transition (risk of losing competitive advantage); difficulty in predicting the duration of the banking brand's lifecycle stages, reactive management response to the latest technological developments, and high cyber vulnerability of the business model.
4. Fully Digital Bank	**Prerequisites for Application:** Productive inter-industry cooperation with IT companies and the fintech market; aggressive investment policy aimed at achieving technological leadership; long-term strategy for acquiring competitors with physical management paradigms. **Goal:** Creating a fully digitized business model for banking products and services, personalized and refined based on individual customer needs in exchange for monetized use of customer personal data. **Mechanism:** The bank's management abandons the physical paradigm or forms a greenfield project for fully digital products and services (in the case of a new bank). The second stage involves creating a digital landscape for product placement—a financial supermarket. The third stage involves scaling the BM by incorporating new products, including adjacent or quasi-banking ones (e.g., smart home systems with a bank customer's ID key, digital signatures, etc.).	**Advantages:** Harmonization of management interests with the digital paradigm and trends in digital economic reform; the bank as an actor is open to innovation and actively develops customer feedback; achieving informational transparency in banking and early detection of product (service) issues; seamless interbank cooperation and development of co-branded products and services. **Disadvantages:** High costs for ensuring cybersecurity of personal data and transaction infrastructure; potential agency conflicts between the bank and IT partners due to differing visions for joint business development.
5. Banking Digital Ecosystem / Financial Metaverse	**Prerequisites for Application:** Leading technological development in the IT sector in the country; accumulation of significant financial funds in non-banking sectors; regulatory liberalism and lobbying of IT business interests for incorporation into the financial sector; an oligopolistic banking market with centrist interests in reshaping the market. **Goal:** Creating a cyber space with zero competition—a financial ecosystem that allows businesses from financial and non-financial sectors to participate based on partnerships and loyalty to the ecosystem owner.	**Advantages:** Complete penetration of banks into customers' lives, essentially observing them to proactively optimize financial products and services; innovative development of all ecosystem partners and infrastructural support from the initiating bank; creation of a new digital world where societal behavior scenarios can be simulated, macroeconomic proportions analyzed, and financial violations and crimes identified.
5. Banking Digital Ecosystem / Financial Metaverse	**Mechanism:** One or a group of super-large banks conducts a large-scale investment intervention and forms a digital network platform. Based on customer requests, the platform is populated by partners offering financial (including banking) and non-financial services under exclusive conditions. Rules of conduct, data exchange standards, and interactions are regulated and controlled by the ecosystem owner. The financial metaverse represents a new level of ecosystem development, based on seamless integration of the bank and IT business into a new entity that mirrors the digital life of a specific customer, including their behavior, interests, and business activity, to create and test behavioral scenarios (the customer can also participate in their development and simulation).	**Disadvantages:** Customers' acceptance of the loss of minimal personal boundaries, negative effects of virtual replication (participants may try to transfer events from the virtual to the real world), emergence of financial and business doublethink coupled with complete informational transparency of transactions; scaling of cyber threats and rapid, explosive growth of the Darknet segment in trading personal information

Source: compiled by the authors based on the data [2, pp. 215–218]

The domestic banking sector has already formed its own strategic directions for future development, which are aligned with global trends of digital financial market expansion. The intense activity of banks in the practice of advanced banking institutions in the Republic of Moldova in the last two decades has demonstrated that banks are the locomotive of digital transformation in the national economy and the initiators of new technological initiatives. We schematically present the structure of the modern banking sector and its advantages in Figure 4.

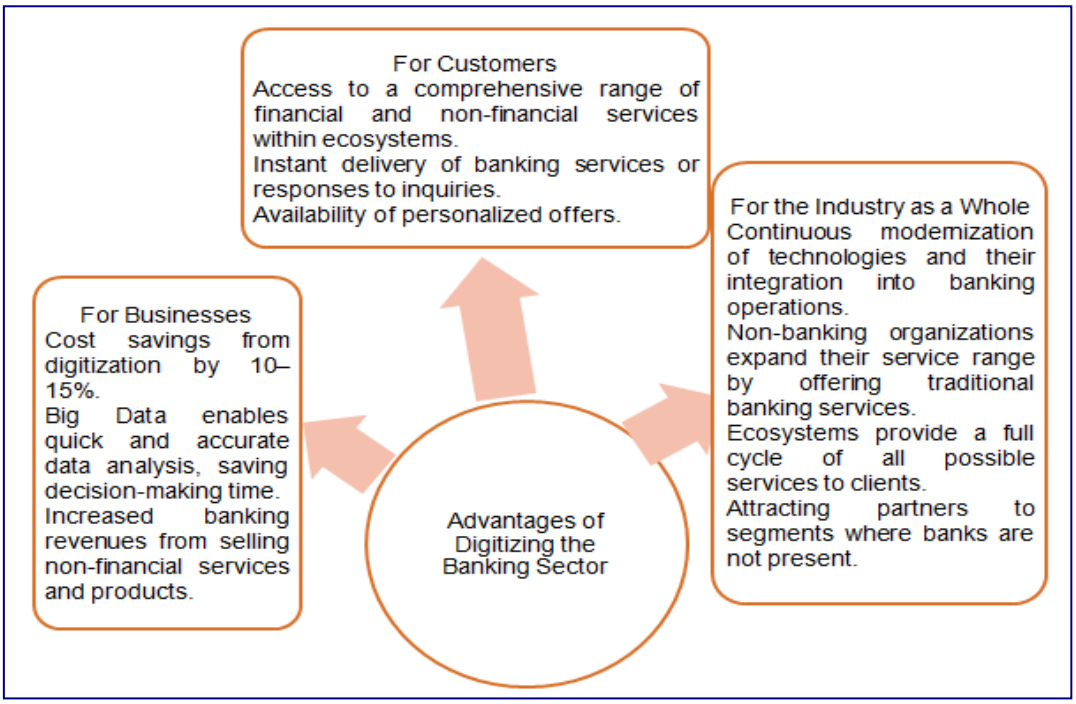

Figure 4. Key advantages of digital transformation in the banking sector

Source: compiled by the authors based on the data [2, p. 218]

Continuous digital transformations and the implementation of new solutions in traditional services and products, service delivery processes, and banking infrastructure enable the achievement of high margins and the accumulation of a vast volume of experience and customer bases. The application of artificial intelligence technologies in processing information flows allows for immediate responses to customer demands and the maximum expansion of coverage across various areas of public life [2, p. 218].

Currently, various levels of the bank's presence in the online environment can be identified, even beyond its digital platforms (fig. 5).

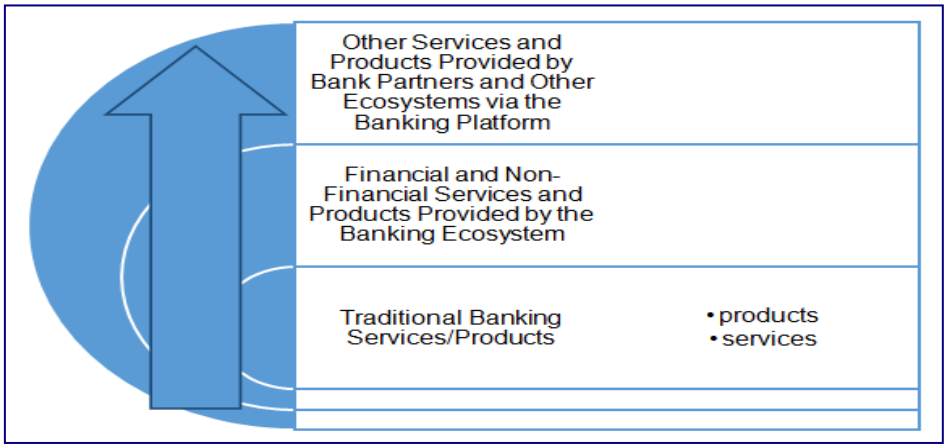

Figure 5. Range of services provided by banks in the digital economy

Source: compiled by the authors based on the data [2, p. 220]

In Figure 5, we observe that the modern bank, within the digital economy, is present across a wide range of sectors and industries in the national economy. Depending on the level of the bank's presence, three stages can be distinguished [16].

– Level 1 – represents the services and products that are traditionally considered banking services, through which banks have always generated revenue (payroll projects, payment operations, loans, deposits, etc.). These services and products are offered to customers both offline and online;

– Level 2 – represents the services and products that have been digitized and are provided through the ecosystem services of banks. These services can be both financial and non-financial in nature;

– Level 3 – represents the services and products that the bank does not offer directly but are provided by partners using banking technologies, for example, for making payments and settlements. These opportunities, created by the bank for its partners, allow them to maintain customer loyalty and expand the potential customer base.
In fact, the bank is moving into the online environment, becoming merely a payment or loan service and promoting its services not under the bank's name but under the name of a recognized brand. The bank's personnel policy is transforming – there is a reduction in the number of managers, who are being replaced by robots and online assistants that guide customers in using online banking services 24/7.

Conclusions

Today, the global banking sector is in the midst of a digital transformation, and traditional banks, wishing to remain competitive in the digital future, are working hard to discover new digital transformation technologies to become more dynamic, agile and efficient in meeting customer needs.

The efficient and secure development and functioning of the digital financial space requires the implementation of coordinated measures across all its participants, as well as timely and proportionate regulation that, on the one hand, supports the stability of the financial system and protects consumer rights, and, on the other hand, fosters the development and deployment of digital innovations.

The main problem with the transition to digital technologies is that most other financial service providers have already understood the need to adopt digital technologies and have started to develop appropriate strategies.

The spread of digital technologies in the financial sector is also associated with certain risks. In particular, technical progress creates fertile ground for the development of projects that promise investors high returns - including online P2P lending platforms. However, experience in the Chinese market shows that loopholes in government regulation can lead to fraudulent schemes and massive bankruptcies of P2P companies. This risk is also relevant for our country, where certain categories of citizens, who are not well acquainted with the particularities of the financial market, may invest in "financial pyramids" and other dubious financial schemes.

In order to improve banking activity in the digital economy, stimulate competition, increase accessibility, reduce the cost of services and reduce the risks of fraud and illegal activities on the digital technology market, it is necessary to review the current legal rules on electronic transactions, electronic signatures, electronic identification and authentication of customers, as well as the exchange of customer data and ensuring confidentiality, so that they are in line with the new conditions for banking activity.

Digital technologies in the banking business have influenced all processes of service delivery and product generation, the format of communication between banks and customers, the bank's infrastructure itself, as well as customer behavior. Virtually all transactions, except cash, can be carried out online by customers. Thanks to the development of digital ecosystems, banks have gone beyond their traditional competencies and are evolving as digital services, accompanying their customers' online activity.

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CURRENT ASPECTS OF THE DEVELOPMENT OF THE GLOBAL AVIATION INSURANCE MARKET

Ionuț LOM[15]

Iulia CAPRIAN[16]

Abstract:

Aviation insurance is a specific type of insurance intended to cover loss or damage to aircraft and cargo carried on them, to compensate for damage caused to the health (or death) of passengers traveling by air. This type of insurance provides a complex of specialized products. The conducted research was aimed at analyzing the underlying trends of the global aviation insurance market. The information base of the study is supported by the data of the reports and opinions of the experts of the companies in the field. The global aviation insurance market is experiencing significant expansion, with continued development of this process forecasted, with aircraft insurance and aerospace insurance being complementary market segments. The quantitative and qualitative advancement of the civil aviation industry has created valuable opportunities for the development of aviation insurance worldwide.

Keywords: *aviation insurance, aviation insurance market, global trends*

JEL classification: *G22, G52*

Introduction

The main objective of this research is to study the essential trends of the global aviation insurance market. The paper presents an important area of interest for both aircraft owners and travelers. The analysis period to which the information and data presented refer includes the years 2020-2032, i.e. results obtained and forecasts, respectively.

Aviation insurance provides protection to aircraft, property, and liability of participants in air transportation. It is about covering hull losses, liability for affecting the health and life of passengers, causing damage to the environment and third parties caused by aviation accidents. [13]

Aviation insurance includes coverage for damages caused by aviation risks in connection with the maintenance and operation of aircraft, including material and cargo losses, as well as personal injury. It is intended for aircraft owners and air transport operators. [9]

Specialists at Persatuan Insurans Am Malaysia (PIAM) state: "Aviation insurance, a specialized branch of insurance, is explicitly designed for activities related to aircraft operation and the inherent risks associated with aviation. ... Aviation insurance is a complex field due to the unique and potentially catastrophic risks involved. Therefore, aviation insurance plays a vital role in the aviation industry, providing financial protection against a wide range of risks." [5]

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In this context, the experts at Research Dive state: "Aviation insurance covers losses caused by risks, such as: property damage, cargo loss or personal injury. In addition, it protects against losses caused by aviation risks, such as: preservation and use of aircraft, destruction of property, confiscation of cargo or personal injury. It protects both aircraft owners and operators from unexpected losses. Many countries require aircraft owners and operators to purchase aviation liability insurance under standard laws. The development of the aviation industry in developing countries creates opportunities for the growth of the aviation insurance market." [8]

Below we present the typology of aviation insurance, which includes [1], [9]:

- ***Liability insurance***, which is intended to cover any damage caused by the aircraft's properties and typically includes: houses, vehicles, crops, airport facilities, airplanes, and more.
- ***Passenger liability insurance,*** which covers any injury that passengers transported by plane may suffer in an accident or in the event of their death.
- ***Single-limit combined insurance,*** which refers to liability insurance and passenger liability insurance combined into a single policy.
- ***Hull insurance for risk on the ground (not in motion),*** which sets out the type of insurance intended to cover damage caused to the aircraft while it is on the ground and, in particular, not in motion as a result of the following: fire, flood, wind, hail, mudslide, theft, vandalism, damage caused by animals, damage caused by vehicles or other aircraft, the collapsed hangar.
- ***Ground risk hull insurance,*** which is intended to cover damage to the aircraft while on the ground when it is taxiing or otherwise moving, but does not relate to take-off or landing.
- ***In-flight insurance***, the type of insurance that refers to the coverage of the aircraft during each stage of the flight, including: in storage, parking, taxiing, during takeoff, in flight, landing. In many cases, in-flight insurance may be able to replace both types of ground risk hull insurance.

The study carried out in this area presents the analysis of the general global trends in aviation insurance.

Research Methodology

The research was carried out with the help of the application of different methods of analysis, including graphical one. The information basis of the study served the views of experts from specialized companies, such as: Allied Market Research, Business Research Company, PRnewswire, Research Dive. As a result of the synthesis of the available information, a complex picture of the volume and structure of the global aviation insurance market was formed, as well as the trends of its evolution.

Main results

According to the results highlighted during the study, we mention a certain difference between the volume of the world insurance market and that of the global insurance market.

For example, according to the literature, for the year 2024 it was estimated that the world insurance market will be $8.02 trillion in size [10], and the global insurance market in the current year will reach the level of $4.51 billion.

Porter 's five forces, applied to the global aviation insurance market, present the following [8]:

- *Bargaining power of suppliers*: The number of global aviation insurance pressors/underwriters is large and growing, which leads to a reduction in their bargaining loss.
- *Bargaining power of buyers:* Buyers of insurance services have significant bargaining power due to the increasing demand for aviation insurance with additional benefits, which allows for the expansion of offers of types of aviation insurance with reduced premiums.
- *Threats from new entrants*: New entrants to the aviation insurance market must cope with high insurance claims costs and comply with government regulations, making the threats of new entrants relatively low.
- *Substitute Threats*: There are few substitution offers available in the market in the market, reducing the threats of substitutes.
- *The level of competition in the market.* Companies operating in the field of aviation insurance promote several business development strategies to strengthen their market position in the industry, increasing the level of competitiveness.

The data presented in Figure 1 demonstrates a growing trend in the global aviation insurance market.

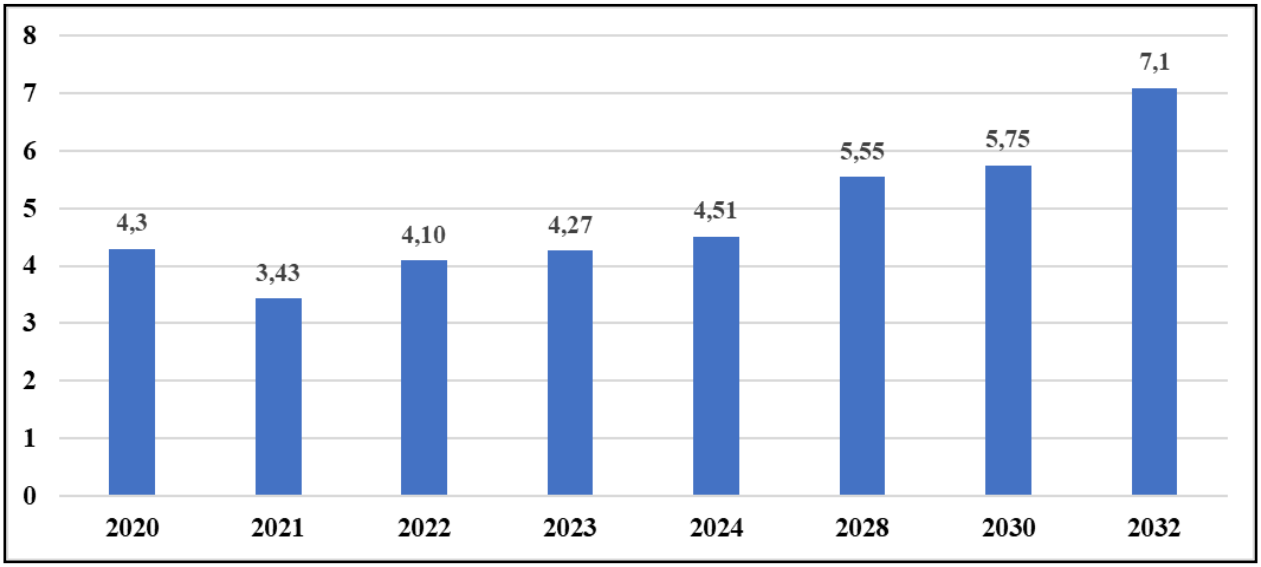

Figure 1 – Evolution of the global aviation insurance market, period 2020-2032, $ billion

Source: [6], [7], [8], [9]

Therefore, after some decline, during the years 2021-2023, the global aviation insurance market grew in 2024 from $3.43 billion to $4.51 billion, i.e. by 8 percent.

According to some experts, the volume of the mentioned market could increase to $5.55 billion in 2028 and $7.1 billion in 2032 [6], [7], [8], [9].

At the same time, we consider it essential to present the volume of the core segments of the global aviation insurance market (Figure 2).

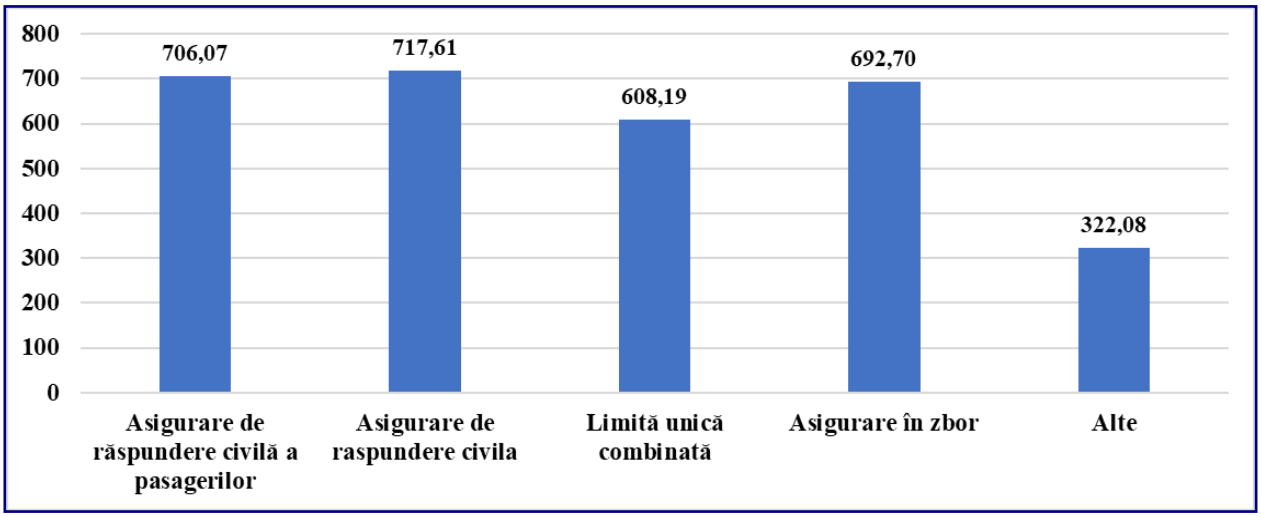

Figure 2 – Volume of core segments of the global aviation insurance market, $ billion

Source: [7]

So, the largest segment is liability insurance – $717.61 billion, followed by passenger liability insurance – $706.07 billion.

It should be noted that an important segment of the insurance market is that **of aircraft insurance**, which demonstrates an upward trend. For example, the global aircraft insurance market, in 2022, was valued at $14.51 billion, up in 2023 to $15.65 billion, and in 2024 – $16.11 billion (Figure 3).

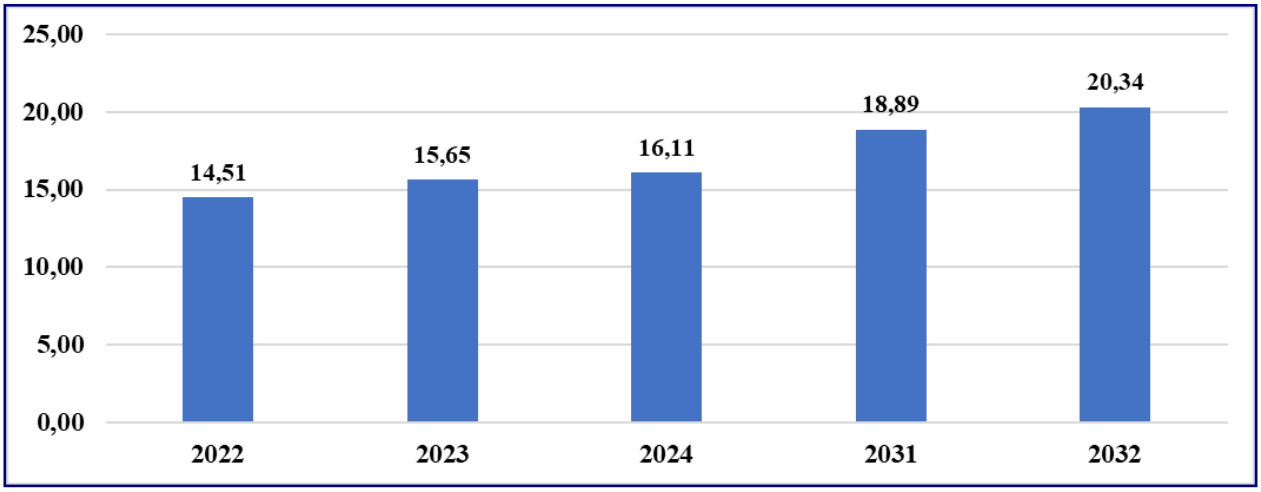

Figure 3 - Evolution of the global aircraft insurance market, $ billion

Source: [12], [14]

According to the data contained in Figure 3, an important upward trend is possible for the years 2031 and 2032, with forecasts of $18.89 billion and $20.34 billion, respectively.

Aerospace insurance is intended for aerospace manufacturers, which is an umbrella term for several types of coverage, frequently requested by companies in this industry [2]:

- Product liability insurance.
- Completed operations insurance.
- Liability insurance for hangar owners.
- Foreign military liability insurance.
- Land liability insurance.
- Spacecraft liability insurance.

Aerospace companies carry out a very wide spectrum of activities, being mostly related to aircraft manufacturers, engines, repair and maintenance service facilities, ground operators, airports and refueling. [2]

In the view of IMARC Group specialists, the size of the global aerospace insurance market is estimated at $870.4 million in 2023 and forecasts an increase to $1141.6 million by 2032. [3]

It should be noted that this market is experiencing constant growth, driven by increased demands from commercial air transport facilities, the increasing integration of artificial intelligence to improve aircraft functionalities and the growing digital transformation of various insurance procedures. [3]

The analysis of specialized reports allows to highlight the basic trends of insurance development in the field of civil aviation [3], [4], [7], [11], as well as:

- Increasing proportions of the use of drones and electric aircraft, strict government regulations, demands to ensure passenger safety, and increased government investments in several countries for the development of new airports and renovation of existing ones, being the major market factors that enhance the growth of the market.
- Flight safety has become an important issue in the last decade for airlines, due to the increase in the number of airline accidents in the recent past. Stringent government regulations on aircraft and passenger safety will drive growth in the global aviation insurance market during the forecast period.
- Over the last decade, the number of aircraft purchased by companies involved in air transport has increased, which has led to the increase of insurance services to cover various related situations, at the same time, the number of delays in aircraft deliveries has increased, which may restrict the growth of the global industry during the period under review.
- At the moment, there has been a significant reduction in the barrier to market entry and lucrative opportunities for new entrants to the global aircraft insurance industry. Unlike existing insurers, which have suffered financial losses in recent years, new insurers can develop strategies to attract customers and provide coverage for various risks associated with the aviation industry.
- Companies participating in the aviation insurance market are focusing on creating new opportunities for growth and revenue generation, giving preference to artificial intelligence and advanced machine learning algorithms, which is expected to further propel the global market growth.
- Recently, the demand for commercial air travel has increased under the influence of various factors, including economic expansion, globalization, and the growth of the middle-class population. As a result, airlines are expanding their fleets and routes to cope with this surge in demand. In the aerospace industry, there is a substantial increase in the number of passengers and the frequency of flights.

- Regulatory changes and the promotion of risk management in the aerospace industry are supporting the growth of the market. Aviation authorities around the world are perfecting safety and operational standards to ensure the highest level of passenger safety and environmental responsibility. Airlines and aerospace companies are subject to greater scrutiny to comply with regulations, which requires broader insurance coverage.

- With the advancement of the digitalization of the aerospace industry, aircraft systems and airline operations are exposed to a vulnerability to cybersecurity threats. The risk of cyberattacks, data breaches, and system vulnerabilities pose a significant challenge to the security of the industry examined. Aerospace insurers respond to this evolving threat landscape by developing specialized cyber insurance products tailored to the unique needs of the industry that are intended to cover potential losses resulting from cyber incidents, including business interruption, data breach response, and liability arising from third-party claims.

- The increasing frequency and severity of natural disasters, such as hurricanes, fires, and severe weather events, pose significant risks to the airline industry. It is about the possibility of damage to aircraft, airport facilities and aviation infrastructure. Aerospace insurers offer coverage to protect against such risks. Climate change, including more frequent and severe weather events, is leading to a greater demand for insurance solutions that address environmental and weather-related risks in the aerospace sector.

Conclusions

Aviation insurance is a particular segment of the global insurance market with a relatively modest share, but with important growth rates, which are correlated with the growth rates of the passenger transport industry. At the same time, the important development through quantitative expansion and the implementation of new technological solutions form additional opportunities to increase the aviation insurance market, so that during the last years, 2020-2024, an important upward trend has been formed in perspective until 2032.

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THE IMPACT OF SOVEREIGN CREDIT RATINGS ON INTEREST RATES IN EMERGING ECONOMIES – CASE FROM GEORGIA

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Abstract:

This study examines the impact of sovereign credit ratings on corporate loan interest rates in Georgia, focusing on the relationship between credit rating announcements and economic variables. Utilizing event study methodology and multiple linear regression with dummy variables, the research analyzes 32 Fitch credit rating announcements from July 2007 to January 2024. The study uses abnormal return analysis by Constant return and Market-adjusted models based on data of corporate loan interest rates and incorporates market rates based on U.S. Treasury bond yields. Key findings reveal a strong correlation (0.82) between Fitch's credit rating scores and corporate loan interest rates, with regression models demonstrating statistically significant results when incorporating two-month anticipation and three-month adjustment periods. Research is unique for Georgian context and provides noteworthy information for financial market participants, policy makers and academics.

Keywords: *country risk, sovereign credit ratings, event study, corporate loan interest rates, abnormal return analysis*

JEL classification: *E37; E43; G14*

Introduction

During the past decades, globalization has been the dominant theme for investors and businesses, prompting a move from local markets to exploring growth potential in foreign ones (Damodaran, 2023). Since the mid-1980s, the recent wave of financial globalization has been marked by a significant increase in capital flows, particularly between industrial and developing countries (Prasad, Rogoff, Wei, & Kose, 2003). Estimating the risks associated with globalization has become more difficult, because investing in other countries may offer higher returns, but sometimes it also comes with higher risks (Damodaran, 2023).

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All business transactions inherently involve some level of risk. However, when transactions extend across international borders, they introduce additional risks unique to the cross-border context, known as country risks. These risks arise from differences in national economic structures, government policies, socio-political institutions, geographical conditions, and currency systems. Country risk analysis (CRA) seeks to evaluate these factors to determine their potential to reduce the expected returns on international investments. By identifying and assessing these risks, CRA aids businesses and investors in making informed decisions about cross-border transactions (Meldrum, 2000).

The concept of country risk encompasses a wide range of potential challenges, including political instability, economic uncertainty, changes in government policies, and external factors that could negatively affect the countries overall economic health and investors' confidence (Bouchet, Clark,, & Groslambert, 2003). To be more specific, our research focuses on exploring whether a rise in country risk leads to higher interest rate as investors and financial institutions demand greater returns to compensate for higher risk, which implies greater uncertainty.

In today globalization era, where flow of capital across borders is very frequent, investments and especially foreign direct investment (FDI) playing a crucial role in the growth of developing countries over fifty years (Abduvaliev, 2023). Therefore, it is important to determine whether, when an investor deciding to invest in a country, they should pay attention to the country risk index, or not.

To understand correctly country risk, it must be measured and be defined in numbers. The best way to measure country risk, at least in financial markets, is through sovereign default risk (Damodaran, 2023). Sovereign risk refers to the possibility that a government may fail to meet its debt obligations, and it can be measured by sovereign credit ratings, with benchmarks provided by credit rating agencies such as Standard & Poor`s (S&P), Moody`s and Fitch (Bayar, Kılıç, & Kılınç Savrul, 2013). Credit Rating Agencies (CRAs) were created to address the problem of asymmetric information in debt securities market by offering investors an independent and reliable assessment of the default risks associated with debt issuers, thereby helping them avoid excessive risks that they might not have been able to assess on their own. However, many authors have criticized the role that CRAs have played, particularly in the lead-up to financial crises (Eijffinger, et al., 2011).

Understanding the relationship between Sovereign credit ratings, which are provided by credit rating agencies and interest rate is one of the most important measuring for investors, policymakers, financial and economic institutions for every county, but mostly for developing countries like the Georgia. To clarify the research problem, the main objectives are to analyze the impact of sovereign risk on interest rates in the Georgia; to examine how changes in sovereign credit ratings affects one of the key economic and financial variables - interest rate, and to determine whether announcement of credit rating (changed or not) have any impact on interest rates.

In its overview, the World Bank classifies the Georgia as an upper middle-income country and acknowledges that Georgia has been growing fast (The World Bank, 2023).

In 2008, Georgia faced two types of crises: one resulting from the invasion of Russia in August, and the other from the global financial crisis in October, which the International Monetary Fund (IMF) referred to as a "twin crisis". Impact of the "twin crisis" on previously growing economy was heavily negative, while Georgia`s economic growth averaged 10.5% per year between 2005 and 2007, it was only 2.3% in 2008 and dropped to -3.8% in 2009 (Otarashvili, 2013). This downturn also had a negative impact on country`s sovereign rating, resulting in the most significant rating drop in country`s history since it was included in the CRAs database. To illustrate the downgrade during the crisis, the credit rating of Georgia as assigned by Fitch (Fitch, 2024) ratings is presented in Table 1.

Table 1

Fitch long term issuer default rating for Georgia

Date	Rating	Action
12-Jan-24	BB Positive	Affirmed
14-Jul-23	BB Positive	Affirmed
27-Jan-23	BB Positive	Affirmed
29-Jul-22	BB Stable	Affirmed
4-Feb-22	BB Stable	Affirmed
6-Aug-21	BB Stable	Affirmed
12-Feb-21	BB Negative	Affirmed
14-Aug-20	BB Negative	Affirmed
24-Apr-20	BB Negative	Affirmed
14-Feb-20	BB Stable	Affirmed
16-Aug-19	BB Stable	Affirmed
22-Feb-19	BB Stable	Affirmed
24-Aug-18	BB- Positive	Affirmed
16-Mar-18	BB- Positive	Affirmed
22-Sep-17	BB- Stable	Affirmed
24-Mar-17	BB- Stable	Affirmed
30-Sep-16	BB- Stable	Affirmed
1-Apr-16	BB- Stable	Affirmed
2-Oct-15	BB- Stable	Affirmed
17-Apr-15	BB- Stable	Affirmed
17-Oct-14	BB- Positive	Affirmed
9-May-14	BB- Stable	Affirmed
20-Nov-13	BB- Stable	Affirmed
12-Dec-12	BB- Stable	Affirmed
15-Dec-11	BB- Stable	Upgrade
3-Mar-11	B+ Positive	Affirmed
25-May-10	B+ Stable	Affirmed
26-Aug-09	B+ Stable	Affirmed
7-Apr-09	B+ Stable	Rating Watch On
8-Aug-08	B+ Negative	Downgrade
28-Mar-08	BB- Stable	Affirmed
18-Jul-07	BB- Stable	New Rating

Source: Fitch

Georgia required more than three years to receive an upgrade in its Fitch rating. The downgrade occurred on August 8, 2008 (from BB- to B+), and the upgrade was on December 15, 2011 (from B+ to BB-).

Risk is an inherent concept that every entity has to face, as there is no organization or individual that operates without encountering risk in their activities (Alam, 2016). Investors in financial markets, corporations, and governments pay close attention to country risk for practical reasons, as in a globally interconnected economy, where growth is shared,

everyone faces varying degree of exposure to country risk, both on small and large scales (Damodaran, 2023).

Country risk refers to the factors that influence a country`s ability and willingness to meet its scheduled debt obligations. It specifically represents the credit risk of borrower within a country, assessed from a broader national perspective (Timurlenk & Kaptan, 2012). All business transactions inherently carry some risk, but when transactions occur across international borders, they involve additional (country) risks, which are not found in domestic deals. Some analysts separate country risk in different categories of risks, like economic risk, transfer risk, exchange rate risk, location or neighborhood risk, sovereign risk, and political risk. Best measurement for country risk is to measure individually each component, but the alternative is to use credit rating agencies information (Meldrum, 2000).

According to Pukthuanthong (2009), the purpose of a sovereign credit rating is to assess a nation`s overall risk or creditworthiness, which reflects the government`s capacity and willingness to fulfill its debt obligations as specified in the terms of the debt issuance. These ratings are provided by Credit Rating Agencies (CRAs), which are for-profit entities that offer specialized evaluations of credits for both corporate and sovereign debt (Chibamba, 2018).

In recent years, credit rating agencies like Standard & Poor`s, Moody`s, and Fitch have played a critical role in providing information that guides investor decisions, often holding more influence than governments. Following the 2008-09 financial crisis, several European Union (EU) countries, particularly within the euro area, have experienced significant increases in financial market volatility, particularly in sovereign debt and equity markets. Policymakers have considered rating agencies as potential contributors to this heightened volatility, though existing literature has yet to fully explore their impact on the fluctuations in financial variables. This volatility can intensify financial instability, as higher volatility levels are linked to increase risk perceptions among market participants. Additionally, this elevated volatility and risk perception may intensify macroeconomic uncertainty by amplifying fluctuation in output (Afonso, Gomes, & Taamouti, 2014).

Credit ratings significantly affect both access to and the cost of funding for entities, whether they are private enterprises or sovereign borrowers. Some disruptions in sovereign debt markets, such as Spanish`s downgrading in October 2011, underscore the critical influence of credit rating agencies and their sway over financial markets. Downgrade event, or even the potential for future downgrades, can quickly undermine austerity efforts (Eijffinger, et al., 2011).

Studying events of rating announcement may help to understand problem seriousness by understanding magnitude and swiftness of effect on economic measures. Event studies have a long history, widely adopted standard for analyzing the impact of firm-specific and broader economic events on firm value (Brockett, Chen, & Garven, 1994). Event studies are a fundamental tool in empirical corporate finance research, primarily used to assess semi-strong market efficiency, by evaluating how markets respond to the release of public information. They typically follow a standardized setup. Much of the corporate finance literature is concerned with the valuation of firms and the changes in firm value resulting from, for example, changes in capital structure. Although such events can be studied in many different ways, the empirical finance literature has taken a particular approach based on statistical tests of the significance of abnormal stock returns around event dates. This type of approach also plays an important role in investment analysis. For example, one can study the performance of stocks or portfolios after an initial public offering (De Jong & de Goeij, 2007).

In accounting and finance research, event studies have been applied to variety of firm specific and economy wide events. Some examples include mergers and acquisitions, earnings announcements, issues of new debt or macroeconomic variables such as the trade

deficit. However, applications in other fields are also abundant. For example, event studies are used in the field of law and economics to measure the impact on the value of a firm of a change in the regulatory environment and in legal liability cases event studies are used to assess damages. In the majority of applications, the focus is the effect of an event on the price of a particular class of securities of the firm, most often common equity. However, event studies can be applied using debt securities with little modification (MacKinlay, 1997).

In conducting event studies, as outlined by De Jong and De Gorij (2007), the process begins with identifying the event and determining its timing, which is crucial for accurate analysis. For example, in corporate takeovers, the announcement day often provides more significant insights than the actual takeover date, as market reactions tend to occur when the information first becomes public. The next step involves choosing a benchmark model to represent normal security return behavior, which is critical for calculating abnormal returns. Common approaches include mean-adjusted returns, which use the average return over a selected period, and market-adjusted returns, which account for market-wide price movements by using a market index as a benchmark. More sophisticated models, like the market model or Capital Asset Pricing Model (CAPM), adjust for factors such as a stock`s beta, providing a more precise measure of abnormal returns by considering both market trends and stock-specific characteristics. Once abnormal returns are calculated, the analysis typically focuses on these returns during the event window. Cumulative abnormal returns (CAR) are often used to capture the total impact of the event over a specified period, aggregating abnormal returns from the start to the end of event period. By averaging these cumulative returns across multiple firms, researchers can obtain cumulative average abnormal return (CAAR), which help to isolate the event`s effect from other market influences. This method enhances the reliability of the results by mitigating the impact of unrelated security price movements. Visual tools, such as graphs of CARs, are frequently employed to illustrate security performance trends before and after an event, offering a clear depiction of the event`s influence on market behavior.

Despite the increase importance of sovereign credit ratings in affecting the financial landscape of developing economies, there is a notable lack of comprehensive research in Georgia on this subject. While the global literature extensively covers the relationship between sovereign credit ratings and economic variables such as interest rates, only a limited numbers of studies have focused on the Georgian context. This gap in the research is significant, given Georgia`s economic growth trajectory and its increasing reliance on foreign investments and international credit markets. The lack of existing studies not only limits academic discourse but also restricts the availability of data-driven insights for country`s financial stakeholders, creating a critical need for further investigation.

In particular, the absence of detailed empirical analysis on how sovereign credit rating influence key economic factors, such as interest rates and borrowing costs, underscores a crucial area of concern for both policymakers and financial institutions in Georgia. The limited research on this topic means that many decisions related to financial risk management, investment, and economic policy are made without a solid understanding of the implications that fluctuations in credit ratings might have on the country`s financial stability.

This research holds significant importance for several reasons. Firstly, as developing country, Georgia`s economic trajectory is closely tied to its ability to attract foreign direct investment (FDI) and maintain favorable borrowing condition. Sovereign credit ratings, assigned by agencies such as Fitch, Moody`s, and Standard & Poor`s, play a pivotal role in shaping investor perceptions of a country`s creditworthiness. These ratings influence the cost of borrowing, access to international capital markets, and overall economic stability. Understanding how credit rating affect interest rates is crucial for both policymakers and investors. This understanding is essential for developing effective strategies to manage financial risk, improve creditworthiness, and foster sustainable economic growth in Georgia.

The findings of this research will have significant implications for a range of stakeholders, including policymakers, who can use the insights to craft informed economic strategies; investors, who rely on understanding the risk and return associated with their investments in Georgia; financial institutions, which must navigate the impact of rating changes on borrowing cost and lending practices; and academic researchers, who can build upon these findings their future exploration of the interactions between sovereign credit ratings and economic variables in emerging markets.

Methodology and Data

The methodology leverages event study analysis, particularly utilizing multiple linear regression with dummy variables. Using event study analysis this work would test how Georgian`s loans interest rates react on the announcement of credit rating agencies.

There were treated information about Georgia`s sovereign credit ratings from major credit rating agencies, such as Moody`s, S&P, and Fitch. Based on the fact that data on Georgia from Fitch was the most accessible and consistent among the three major credit rating agencies, Fitch was chosen as the primary source. The first step is to select the time period for Georgia`s sovereign credit ratings from the rating agencies. The starting point was set as July 2007, when Fitch ratings monthly data on Georgia first became available, and extends until January 2024. Since Fitch data was the principal determinant for the data period, data from other sources also spans from July 2007 to January 2024. Data on interest rates were obtained from the National Bank of Georgia (NBG) (National Bank of Georgia, 2024), specifically the volume and interest rates of commercial bank loans granted in foreign currency to resident legal entities during the reporting period, categorized by total activity type. For market interest rate, which is needed to determine Market-adjusted data, the weighted average of United States 1, 2, 3, 5, and 10-year bond yields was used. The market-adjusted rate was calculated by subtracting the weighted average U.S. bond yields from the Georgian loan interest rate for each month of the data.

Event is identified as each credit rating announcement from Fitch regarding Georgia. In total, there were 32 announcement dates during the research period.

The next step is to determine the anticipation and adjustment periods. Various options were considered, ranging from one to five months for both periods. Ultimately, the best (considering costs and benefits) option was chosen: a two-month anticipation period and a three-month adjustment period. In detail, the anticipation period spans two months before each event month, and adjustment period - three months after event month.

The next step is to design the testing framework for abnormal returns. Dummy variables were used to code the event, anticipation, and adjustment periods. These dummy variables are helpful in identifying the specific dates of interest; thus, the event, anticipation, and adjustment periods are coded as 1, while all other dates are coded as 0. More specifically, two regression models were employed.

In the models below following variables and symbols are used:

- R_t – loan interest rate for the month t
- $event_t$, $anticipation_t$, and $adjustment_t$ are respective dummy variables for event month, anticipation and adjustment months
- Rm_t - market return for month t
- e_t - error term for month t.
- β_0 – intercept coefficient of regression
- β_n – respective slope coefficients of regression

Model 1 - The Constant Return Model. :

$$R_t = \beta_0 + \beta_1 \text{ x anticipation}_t + \beta_2 \text{ x event}_t + \beta_3 \text{ x adjustment}_t + e_t;$$

Model 2 - Market-Adjusted Model:

$$R_t - Rm_t = \beta_0 + \beta_1 \text{ x anticipation}_t + \beta_2 \text{ x event}_t + \beta_3 \text{ x adjustment}_t + e_t.$$

p-value was used to assess coefficients. p-values below 5% were considered as satisfactory to indicate that the relationship between the interest rate and event variables is statistically significant.

Best combination of anticipation and adjustment periods for models was selected based on normalized Akaike Information Criterion (AIC). AIC of models were compared among each other. Model with lower AIC was considered as better. Equation below was used for calculation, where

- n is the number of observations
- RSS is the residual sum of squares
- k is the number of estimated parameters (including the intercept)

$$AIC_{Normalized} = \frac{2k}{n} + \ln\left(\frac{RSS}{n}\right)$$

In addition, country credit ratings were assigned scores and correlation between interest rates and scores were calculated.

Effect of sovereign credit rating announcements on the interest rates in Georgia were studied for the period between July 2007 and January 2024. The dataset for this research is obtained from two main sources: sovereign credit ratings provided by Fitch and interest rates in Georgia from the National Bank of Georgia.

The credit ratings are categorized by rating level (e.g., AAA, AA, A, etc.) and outlook (Positive, Stable, Negative), with each combination assigned a unique numeric identifier (score). Credit rating AAA with a positive outlook is identified as 1, AAA with a stable outlook is identified as 2, and so forth, progressing until the credit rating D with a negative outlook is identified as 66.

The sovereign credit rating data focuses on the announcements from Fitch ratings for Georgia, from July 2007 till January 2024, which includes upgrades, downgrades and unchanged ratings. There are a total of 32 Fitch credit rating announcements within the research period. In this study, each announcement is treated as an event.

To define of the principal variable for the study – interest rate, a comprehensive analysis of datasets from the National Bank of Georgia was conducted. The NBG offers an extensive array of financial and economic indicators, including data on loans, deposits, and various financial market metrics.

There are three main datasets regarding loans available from the NBG:

- IR_LE_FC – "Interest Rates on Loans to Legal Entities in Foreign Currency"
- TIR_LE_FC – "Total Interest Rates on Loans to Legal Entities in Foreign Currency"
- AMIR_LE_FC – "Annual Market Interest Rates on Loans to Legal Entities in Foreign Currency"
-

The interest rates of all three sets are very highly correlated (Table 2).

Table 2

Correlation Matrix of Loan datasets from NBG

	IR_LE_FC	TIR_LE_FC	AMIR_LE_FC
IR_LE_FC	1.0000	0.9941	0.9993
TIR_LE_FC	0.9993	1.0000	0.9934
AMIR_LE_FC	0.9993	0.9934	1.0000

Source: authors' findings

After simulating different variations, and observing the high correlation among the interest rates, the final choice was made to use the total interest rates on loans to legal entities in foreign currency (TIR_LE_FC). Since the Fitch credit rating dataset begins in July 2007, corresponding interest rate data period was used.

To adjust the interest rate percentage, a reference variable of market rate is required. For this purpose, the weighted average of several U.S. Treasury bond yields was used: Market Yield on U.S. Treasury Securities at 1-Year Constant Maturity, United States 2-Year Bond Yield Historical Data, Market Yield on U.S. Treasury Securities at 3-Year Constant Maturity, United States 5-Year Bond Yield Historical Data, and United States 10-Year Bond Yield Historical Data. The same period was used for these yields as for the NBG and Fitch datasets.

Results

Relationship between Fitch credit rating numeric scores and loan interest rate was tested by correlation analysis. Georgia's rating scores fluctuate between B+ (negative), identified as 42, and BB (positive), identified as 34, over various periods. Percentage values of interest rates were used for calculations. Correlation appeared to be significantly high at 0.8228.

Effect of credit rating announcement on interest rates was assessed using event study analysis, particularly through multiple linear regression with dummy variables, various regression variations were tested to determine the best model for this research. First, the constant return model was applied in various combinations, including: anticipation periods from one to two and adjustment periods from one to three. Same periods were tested for the market-adjusted model.

P-values for one anticipation and one adjustment, one anticipation and two adjustment, two anticipation and one adjustment periods for both models appear to be higher than 5% for all or the most of the coefficients (Table 3), and therefore coefficients of regression are not statistically significant, and models cannot be considered acceptable.

Table 3

p-values of coefficients of some insignificant regression models

	Coefficient p-values			
Model	Constant	Anticipation	Event	Adjustment
Constant Return Model				
1 anticipation and 1 adjustment periods	0.00%	16.56%	14.90%	16.67%
1 anticipation and 2 adjustment periods	0.00%	6.83%	6.51%	2.18%
2 anticipation and 1 adjustment periods	0.00%	3.27%	7.32%	7.71%
Market-adjusted Model				
1 anticipation and 1 adjustment periods	0.00%	24.46%	21.21%	21.02%
1 anticipation and 2 adjustment periods	0.00%	11.57%	10.46%	2.18%
2 anticipation and 1 adjustment periods	0.00%	6.51%	12.01%	11.23%

Source: authors' findings

The introduction of combinations such as two anticipation periods with two adjustment periods yielded more promising results as well as one anticipation and three adjustment periods. The regression outputs from this phase indicated significant results (Table 4). This was a notable improvement compared to earlier models, where statistical significance was weak or absent.

Table 4

p-values of coefficients of some significant regression models

Model	Coefficient p-values			
	Constant	Anticipation	Event	Adjustment
Constant Return Model				
2 anticipation and 2 adjustment periods	0.00%	0.43%	1.54%	0.32%
1 anticipation and 3 adjustment periods	0.00%	1.59%	1.11%	0.10%
2 anticipation and 3 adjustment period	0.00%	0.03%	0.08%	0.00%
Market-adjusted Model				
2 anticipation and 2 adjustment periods	0.00%	1.19%	3.26%	0.71%
1 anticipation and 3 adjustment periods	0.00%	3.23%	2.18%	0.19%
2 anticipation and 3 adjustment period	0.00%	0.11%	0.26%	0.01%

Source: authors' findings

Ultimately, the strongest impact was observed in the both models incorporating two anticipation and three adjustment periods. This combination produced statistically significant results across all phases, highlighting a clear relationship between credit rating announcements and interest rates.

According to p-values of regression coefficients, models with anticipation and adjustment periods with 1 and 1, 1 and 2, 2 and 1, are not statistically significant. Models that have more than 6 periods of any type, including event period itself (like, 2 anticipations, 1 event period and 4 adjustment periods) have substantial flow. Rating is announced every six months on average. If number of periods is more than 6, we have overlaps of adjustment periods of previous event and anticipation periods of following event, decreasing reliability of obtained data.

To choose the best model out of three acceptable variations of number of periods in both models Akike Information Criterion was employed. Lowest AIC has model 2-3 for both Constant return and Market Adjusted approach. Number of observations (n) is 203 for all models, number of parameters (k) is 4 – intercept and three dummy variables. Calculated AIC values are given in the Table 5.

Table 5

Akaike Information Criterion for various regression models

Number of periods in model (anticipation – adjustment)	Constant Return Model	Market Adjusted Model
2-2	-6.64	-6.52
1-3	-6.64	-6.53
2-3	-6.68	-6.56

Source: authors' findings

Regression results for the models showing the most profound results are given in the Table 6.

Table 6

Regression Results for 2 anticipation and 3 adjustment periods for constant return and market-adjusted models

	Constant	Anticipation	Event	Adjustment
Constant Return Model				
β_n coefficient	13.41%	-2.42%	-2.80%	-2.63%
Std Error	0.56%	0.65%	0.83%	0.63%
t-stat	2382%	-3.71	-3	-4.21
p-value	0.00%	0.03%	0.08%	0.00%
Market-adjusted Model				
β_n coefficient	11.69%	-2.30%	-2.67%	-2.59%
Std Error	0.60%	0.69%	0.87%	0.66%
t-stat	1960%	-3.32	-3.0	-3.9
p-value	0.00%	0.11%	0.26%	0.01%

Source: authors' findings

Negative sign in β_n coefficient may be explained by the fact, that credit rating for Georgia continuously increases since August 2008.

Conclusions

This study has explored the relationship between sovereign credit ratings and corporate loan interest rates in Georgia.

Firstly, a strong correlation was identified between Fitch's credit rating identifiers and corporate loan interest rates in Georgia. In addition, clear connection between sovereign credit rating announcements by Fitch and corporate loan interest rates was identified by using an event study methodology, particularly linear regression with dummy variables.

Several variations of two models - the Constant Return Model and the Market-Adjusted Model - across different anticipation and adjustment periods were tested. The models incorporating two anticipation periods and three adjustment periods yielded the most statistically significant p-values and Akaike information criteria.

The findings suggest that Fitch's credit rating announcements may influence loan interest rates in Georgia. However, given the extended anticipation and adjustment periods, it is reasonable to assume that credit rating announcements as such do not have a direct impact on loan interest rates, but rather fundamental economic events drive both indicators.

Future research could expand on this by looking at other financial or macroeconomic effects of sovereign ratings. This would provide a more complete picture of how sovereign creditworthiness affects emerging economies.

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THE ROLE OF CRYPTOCURRENCIES IN MODERN BANKING

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Abstract:

Cryptocurrency is a digital currency that uses cryptography. Most cryptocurrencies are not issued and regulated by a central authority and use blockchain technology in the decentralized system. For the purpose of developing this article, existing statistics, reports of international institutions, and the opinions of experts were examined. Since 2009, the global cryptocurrency market has shown significant growth in terms of number and capitalization, with the main focus being on Bitcoin. International practice demonstrates the growing popularity of cryptocurrencies as a means of payment in e-commerce systems. All of the above created important opportunities for banking development by offering services for carrying out cryptocurrency transactions. The activity of crypto banks, cryptocurrency-friendly banks and neobanks is also remarkable. New related regulations have been approved for this in many countries. Banks must also take into account the need to manage security systems and related risks in the cryptocurrency market.

Keywords: *cryptocurrency; blockchain; payment instrument; money laundering*

JEL classification: *B17, E42, F31*

Introduction

Cryptocurrency (also called "crypto") is a digital (or virtual) currency, the implementation of which takes place within decentralized networks based on blockchain technology. The security of cryptocurrency transactions is ensured by verifying and maintaining records by a decentralized system using cryptography. Cryptocurrency can be used to purchase goods and services or can be traded to obtain profit from investment or speculative operations. (*Cryptocurrency*, n.d.) (Investopedia,2024), (Oswego), (Rosen, 2024)

Currently, four types of cryptocurrencies are known (CFI), (Investopedia, 2024), (Kraken, 2024):

➢*Payment cryptocurrency* is a digital currency intended to be used as a medium of exchange and performs the function of electronic cash in a purely peer-to-peer version based on a dedicated blockchain. The most popular currency of this type is Bitcoin. Based on data provided by CoinMarketCap, the main cryptocurrency on this market is Bitcoin whose market capitalization increased from $14.8 billion on 12/24/2016 to $2.1 trillion on 12/17/2024. And the market price of this cryptocurrency increased from $463.55 on 12/19/2016 to

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$106,030.69 on 12/17/2024. (CoinMarketCap, 2024)

➢*Utility Token* is a form of cryptocurrency intended to provide access to a specific function or service within a blockchain ecosystem. That is, it is a cryptographic asset that runs on top of another blockchain. (Barchat, 2024), (Trust Machines) The most eloquent cryptocurrency of this kind is Ethereum, whose market capitalization increased from $133.13 billion on 07/11/2022 to $443.46 billion on 12/18/2024. (Ycharts) The market price of Ethereum increased from $142.11 on 04/03/2020 to $3886,88 on 12/18/2024. (CoinMarketCap, 2024)

➢*Stablecoin* is a type of cryptocurrency whose value is tied to another asset (fiat currency, commodity, financial instrument) to maintain a stable price. (Coinbase),

The main forms of stablecoins are:

- Fiat-backed stablecoin is tied to a fiat currency (most commonly the US dollar or euro);
- Commodity-backed stablecoin is a cryptocurrency tied to the market value of commodities such as gold, silver, or oil.
- Crypto-collateralized stablecoin is backed by other cryptocurrencies.
- Algorithmic stablecoin may or may not hold a reserve asset, the stability of which is maintained by controlling its supply through an algorithm, essentially a computer program.

The most representative stablecoin is Tether (USDT), which is pegged to the US dollar.

The Tether's market capitalization increased from $0.01 billion on August 2016 to $118.1 billion on August 2024. (Statista, 2024)

•*Central Bank Digital Currency (CBDC)* is a form of cryptocurrency issued by a central bank based on blockchain technology, maintaining full authority and regulation over it. CBDC is issued in the form of a token or with an electronic record associated with the currency and linked to the national currency of the issuing country or region. Currently, CBDCs have been launched in 9 countries, and they are being explored in 78 countries. (IBM)

In the opinion of Josh Howarth, the global number of cryptocurrencies has increased from 50 in the year 2013 to 13217 in March 2024. (Howarth, 2024)

Powered by CoinGecko, in the period 01.01.2014-17.12.2024 the level of capitalization of the global cryptocurrency market increased from $10.6 billion to $3908.2 billion. (CoinGecko, 2024)

The information published by Dorothy Neufeld and Christina Kostandi (2024) demonstrated that in 2024 an estimated 562 million people worldwide (up 142 million by 2023 (Triple A, 2024)). It is an equivalent of 6.8% of the global population. Of which 326.8 million live in Asia, 72.2 million - in North America, 55.2 million - South America, 49.2 million - Europe, 43.5 million - Africa.

The purpose of this work is to highlight the specific aspects of the activity of banks on the cryptocurrency market.

Also, the conducted research set the following tasks:

- Determining the areas of banking activity of the application of cryptocurrencies.
- Highlighting the necessary conditions and risks of such activities.

Description of the Problem

Over the past eight years, a new segment has been dynamically forming on the global financial market, which offers banks certain opportunities for activity.

After examining the reports of specialized companies, the existence of a global cryptocurrency banking market can be noted.

In 2021, Data Bridge Market Research valued the cryptocurrency banking market at $1.49 billion and forecasted this value to grow to $2.52 billion in 2029, achieving a CAGR of 6.80%. (Bridge Market Research, 2022)

In 2022, Market Research Future estimated the size of the cryptocurrency banking market at $2.52 billion and forecasted the growth of that market to $3.23 billion in 2023, $4.14 billion in 2024, and up to $30.0 billion by 2032. And during the forecast period, the CAGR will be approximately 28.1%. (Market Research Future, 2025)

Market Research Future also presented the structure of the cryptocurrency banking market in current and prospective view (Table 1).

Among the products offered by banks in the examined market are Cryptocurrency Wallets whose market value may increase from $1 billion in 2023 to $9.0 billion in 2032.

And from a geographical point of view, North America has an important value, which is set to grow from $1.5 billion in 2023 to $14.0 billion in 2032.

The development of banking activities in the cryptocurrency market is linked to a complex of specific aspects, which will be examined further.

Methodology and Data

The object of the research is the use of cryptocurrencies in banking activity. The information base of the research was formed from the data provided by specialized companies and the views of experts in the field published in various articles on the Internet.

Table 1

Cryptocurrency banking market structure ($billion)

Basic segments	2023	2032	Geographic distribution	2023	2032
Cryptocurrency Wallets	1.0	9.0	North America	1.5	14.0
Crypto Lending	0.8	7.0	Europe	0.9	8.5
Crypto Merchant Services	0.6	5.0	APAC	0.7	5.5
Payment Processing	0.5	4.0	South America	0.07	1,0
Investment Services	0.3	5.0	MEA	0.06	1.0

Source: (Market Research Future, 2025)

After analyzing the accumulated information, its synthesis was carried out to present a general picture of the opportunities for banking activities on the global cryptocurrency market.

Results

The development of banking activity on the cryptocurrency market has been influenced by certain factors:

Increasing acceptance of digital currencies: As previously mentioned, the number of cryptocurrency users globally has recently shown significant growth as an attractive alternative to traditional banking solutions. It is also worth mentioning certain benefits of these currencies Yasar Kinza (2023):

Decentralization: Cryptocurrency is not issued by a single financial or governmental entity and its value is not dictated by a central bank or authority.

Lower transaction fees: Cryptocurrency transacting fees are either very low or zero due to the elimination of intermediaries from the process. They are also faster due to the lack of foreign exchange procedures, thus increasing the efficiency of operations and reducing costs.

Inflation protection: Cryptocurrencies have limited supply, which makes them considered as a hedge against inflation.

Potential for high returns: While cryptocurrencies come with significant potential risks, most cryptocurrency investments at the moment are seen as having a high rate of return. According to data presented by Allied Market Research (2024), the global cryptocurrency market value was $2.3 billion in 2023 and was estimated to grow to $5.5 billion in 2033, thus allowing a CAGR of 7.5% over the forecast period.

Accessibility: Cryptocurrencies, due to the operation of decentralized networks, can be accessed with an internet connection and a crypto wallet, and opening a crypto wallet does not require identity verification, background checks, or credit checks.

Transparency: Cryptocurrency transactions are anonymous, but data recorded in a public blockchain ledger is available for viewing by the holder using a public key used for identification.

Requesting cryptocurrencies in e-commerce: As the cryptocurrency market expands, they are increasingly accepted in various sectors, including e-commerce. In 2022, the value of consumer (B2C) cryptocurrency transactions in global e-commerce amounted to $11.6 billion, with an increase forecast to $39.0 billion in 2026. At the same time, the share of these transactions in global e-commerce, respectively, increased from 0.19% to 0.5%. (Statista, 2025)

Cryptocurrency infrastructure development: The crypto infrastructure constitutes a complex of hardware, software and network components designed to ensure the smooth functioning of cryptocurrency applications and blockchain networks. (Williams, 2023) The recent growth in the number of cryptocurrency exchanges and platforms that simplify the buying, selling, and storing of digital assets is remarkable.

Technological advances in Blockchain: Innovations in the application of blockchain technology have increased the security, speed, and transparency of cryptocurrency transactions. As blockchain technology matures, new protocols and frameworks are being applied, enabling more efficient transactions and improved scalability. One effect of advances in the application of blockchain technology has been the development of decentralized finance (DeFi) and non-fungible tokens (NFTs). DeFi is an emerging digital ecosystem designed to enable people to send, buy, and exchange financial assets without using the services of banks, brokers, or exchanges. (Montevirgen) NFTs are certain assets that have been tokenized through a blockchain, represent unique identification codes created from metadata through an encryption function, and can be traded for money,

cryptocurrencies, or other NFTs. (Sharma, 2024) In this regard, the authors Lennart Ante and Ingo Fiedler (2024) state: ”The evolution of DeFi and NFTs highlights a shift towards more decentralized and community-driven models of finance and ownership. DeFi, by enabling a permissionless and transparent ecosystem, allows for financial products and services to be accessed without centralized control. Similarly, NFTs are redefining digital property rights, offering a pathway for creators to directly manage, monetize, and transfer their work in a manner that bypasses traditional gatekeepers.”

Growing regulatory clarity and government support: Authorities in many countries have recognized the potential benefits of cryptocurrencies and blockchain technology, leading to the creation of supportive regulatory frameworks. As these regulations are improved, the uncertainties and risks associated with cryptocurrency transactions are reduced, encouraging both traditional financial institutions and new players to participate in the market. These regulations also encourage innovation and increase consumer confidence. For example, in the United Kingdom, the regulation of digital assets is carried out through the Financial Services and Markets Act, which granted the government the ability to designate crypto-asset activities and establish reporting and operational requirements, as well as in relation to consumer protection. (Bajpai, 2024) In Switzerland, a law on distributed ledger technologies (DLT) was approved in 2020, introducing the concept of “DLT securities” and allowing tokenization for rights, claims, and financial instruments. (Garnett, 2025) In the European Union, this includes the Markets in Crypto-Assets Regulation (MiCA) and privacy laws such as the General Data Protection Regulation (GDPR). (Alpha Point, 2024) Likewise, the statement of expert Dave McKenzie (2024) can be remembered: ”…introducing comprehensive frameworks like the EU’s MiCA regulations has provided greater clarity, encouraging traditional banks to enter the crypto space. The SEC’s approval of Bitcoin and Ethereum ETFs in the US has signaled growing institutional acceptance.”

At the same time, some experts draw attention to the following aspects related to the acceptance of cryptocurrencies by banks (McKenzie, 2024), (One Safe):

High Volatility: Major cryptocurrencies, such as Bitcoin, exhibit a significant level of volatility. During the period 11.11.2021-10.11.2022, the market price of Bitcoin decreased from $64978.89 to $15883.15, and then increased through oscillations to $104293.57 on 16.12.2024. (CoinMarketCap, 2024)

Reputational concerns: Banks are advised to beware of associations with potential scams, market manipulation, or criminal activity. Given that cryptocurrencies are not officially controllable and the exchange rate varies widely, according to banking standards, many institutions prefer to avoid the risk.

Compliance challenges: Cryptocurrency flows and transactions can often be opaque or too complex to satisfy banks involved in crypto exchanges.

Regulatory hurdles: In some countries, navigating the various regulations regarding cryptocurrencies can be very complicated and daunting. It is also important to keep in mind that in some countries (such as Algeria, Bangladesh, Egypt, Qatar, etc.) the use of Bitcoin is considered illegal.

KYC difficulties: Promoting the Know Your Customer principle is more complicated when anonymity is one of the selling points of crypto.

Investment in related technologies: in order to effectively monitor transactions (and identify suspicious ones), banks need advanced technologies, the implementation of which imposes significant costs.

The development of the global cryptocurrency market has led to the emergence of two new types of banking institutions: crypto friendly banks and crypto banks.

Crypto friendly bank is a financial institution that has adopted policies and practices to support cryptocurrency transactions and related activities. (Rotkiewicz, 2025)

A crypto friendly bank is a banking institution that accepts cryptocurrencies. This means that they have integrated cryptocurrencies and blockchain technology into their core services. (*What is…*, n.d.)

The service offering of these banks is related to meeting the needs of cryptocurrency users and includes (Rotkiewicz, 2025):

- Secure custody solutions for digital assets;
- Lending products;
- Conversion of fiat currencies into cryptocurrencies and vice versa.

Crypto bank is a financial institution that offers the same financial services as traditional banks, but with a preference for cryptocurrencies. Essentially, a crypto bank is a platform designed to conduct traditional banking operations with cryptocurrencies. It can be organized in various forms, from traditional banks with crypto licenses to digital asset platforms with crypto bank functionality. (Petraschuk, 2023)

Crypto bank's activity is based on advanced technologies, such as Blockchain, Database, Artificial Intelligence, Machine Learning and WEB 3.0.

Unlike a traditional bank, a crypto bank adds decentralized financial services, offering blockchain transactions, crypto investments, wallets, loans, and more. In this way, a crypto bank bridges the gap between centralized and decentralized economies, combining crypto and fiat services into a single entity. (Alhalabi, 2023)

Expert Hazem Alhalabi (2023) mentions the following special offers from crypto banks:

- *Crypto accounts:* It is about opening accounts and managing digital assets through crypto wallets. Based on Web 3.0 technology, account owners can send and receive virtual money and allocate funds for various investments. It can also be about currency exchange operations.
- *Crypto investments*: Users are turning to crypto investment opportunities such as staking, yield farming, liquidity pools, and other DeFi projects. It is also possible to invest in cryptocurrencies by simply trading virtual currencies or by holding digital assets for the long term.
- *Security:* Banks are dedicating significant resources to securely adapt to the specific environment for storing cryptocurrencies and transacting with fiat and digital money, given the process of increasing cyber threats on decentralized platforms, where various breaches and hacks have occurred. This involves applying the most advanced security technologies and authentication measures.
- *Fiat-to-crypto exchange:* Crypto bank acts as a bridge between traditional banking and the decentralized ecosystem, enabling transactions and data exchanges. This bank's offerings enhance the user experience, with all functionalities located in a single application or website, where the user can purchase cryptocurrencies using fiat currency.
- *Crypto payment gateways:* Crypto gateways are integrated interfaces designed to process payments on various websites, e-commerce stores, and exchange platforms. They use application programming interfaces (APIs) that exchange data between servers and consoles. Crypto gateways form the user interface on the checkout page, the speed of the transaction, the fees, and the currencies accepted.

Cryptocurrencies have come into the sights of neobanks.

Neobanks (or digital banks) operate entirely online. Their service offering consists of checking and savings accounts, loans, and some investment options and is aimed at a tech-

savvy audience. (One Safe)

A neobank (also known as a fintech bank, challenger bank, or digital bank) is a digital financial company that offers banking services without having a physical location. The basic goal of such a banking institution is to streamline banking by providing financial services in a customer-centric format only digitally. (Antosz, 2023)

As the popularity of cryptocurrencies increases, these financial institutions are increasingly adopting crypto services. (Alpha Point, 2024) Neobanks like SoFi and Revolut have integrated crypto services into their platforms, allowing customers to diversify their portfolios directly in their accounts, which further differentiates them from traditional banks, which have been slow to adopt crypto. (Alpha Point, 2024)

Experts from Alpha Point (2024) presented the following arguments for banks to accept activity in the cryptocurrency market:

- *New sources of revenue:* When it comes to the opportunity to increase banks' revenues from the offer of crypto services, the following can be mentioned (Alpha Point, 2024):
  - *Trading:* Banks can offer customers the opportunity to buy, sell, and trade cryptocurrencies on their platforms, charging trading fees.
  - *Custody:* The bank may allow customers to store cryptocurrencies using an internal wallet, which would allow for transaction fees to be earned.
  - *Tokenization:* It is a process of creating a digital representation of a real thing on a banking platform for both experienced and new investors to digitize real-world assets.
- *Improve existing products:* Cryptocurrencies can replace traditional services such as savings accounts and remittances. Remittances provide a major source of revenue for many banks. Banks can use crypto to avoid intermediary fees, giving customers an easy and affordable way to send money. Banks can also offer customers crypto savings accounts.
- *Bigger market share:* Banking institutions can expand their customer base by introducing cryptocurrency into their service offerings, especially from tech-savvy customers, often Millennials and Generation Z, as well as unbanked and underbanked populations. This, in turn, could increase the bank's market share.
- *Enhanced security:* Banking institutions are investing significant financial resources in developing robust security technologies and protocols to protect themselves and their customers. Some experts believe that protecting banks from fraudulent activities is possible using Blockchain technology. This is because Blockchain records all transactions that cannot be altered and external forces do not have access to their management. Blockchain is also highly encrypted to prevent money manipulation, fraud, and money laundering schemes.
- *Quicker transactions:* An international transfer in fiat currency can take 1-5 business days, and crypto transactions can take between 30 minutes and two hours to complete due to the fact that they are decentralized and have no exchange rates. In this context, expert Marissa A. Scicchitano states: ”…banks can utilize public blockchains, including stablecoins, to speed up their payment processes. Blockchain technology provides a faster and less expensive alternative to clearing houses when processing transactions. The clearing and settlements could occur at a much faster rate if banks utilized blockchain technology.”

Some experts also point out the problem of smart contracts.

These are digital agreements stored and executed on a blockchain network, which are programmed to perform specific actions once predefined conditions trigger them. (Cryptopedia, 2025)

There is a low level of trust between the parties when a smart contract transaction is concluded, because the transaction is based on computer code and not on the behavior of a person. Banks could strengthen this trust by becoming a trusted third party, which can use smart contracts for mortgages, commercial loans, letters of credit or other transactions. (Scicchitano)

Based on the views of some experts on the benefits of accepting Bitcoin by banks, certain conclusions can be drawn regarding its impact on the respective market: (Moomoo, 2024)

Increased legitimacy and trust: Institutional acceptance of Bitcoin increases its credibility and signals to other market participants about the safety and legitimacy of this cryptocurrency.

Impact on market volatility: Some banking institutions are interested in long-term investments, which can bring stability to the volatile Bitcoin market. But on the other hand, institutional investors typically trade relatively large volumes, which could amplify Bitcoin's inherent volatility if they buy or sell significant volumes in a short time frame.

Increased liquidity: The involvement of banks with higher trading volumes in the Bitcoin market can increase its liquidity.

Market infrastructure development: Banks participating in the Bitcoin market are developing market infrastructure, providing custody services, trading platforms, and payment systems, making Bitcoin more attractive to retail investors and companies.

Diversification for institutional portfolios: Bitcoin, as a decentralized asset, is not directly correlated to traditional assets like stocks and bonds, making it a diversification tool.

Stimulus for innovation in digital asset technology: The institutional involvement of banks in the cryptocurrency market encourages innovation through investments in research, development, and product improvement.

Concentration of Bitcoin ownership: Institutional acceptance may lead to a concentration of Bitcoin ownership among a small number of large entities, reducing the decentralized essence of Bitcoin.

The expert group led by Kumshe Hauwa Modu (2024) came up with the following recommendations in light of the implementation of cryptocurrency activities in banking:

Traditional banking institutions should promote technological innovation by incorporating blockchain technology into their operational processes.

Banking institutions are advised, using their regulatory expertise, to implement cryptocurrency services, including custody solutions and cryptocurrency trading platforms, in order to attract new customers and generate additional revenue.

It is important for banks to work with regulators to establish coherent and effective legal frameworks for cryptocurrencies, as well as compliance with established legal norms. This partnership can help reduce risks associated with cryptocurrencies, such as money laundering and fraudulent activities, while simultaneously encouraging innovation.

Banking institutions should make efforts to educate customers about the benefits and risks associated with cryptocurrencies and blockchain technology. In this way, banks can help their customers make informed decisions and reduce the likelihood of becoming victims of fraudulent schemes.

Banks are encouraged to actively engage in discussions and pilot programs related to Central Bank Digital Currencies (CBDCs), as CBDCs can provide the benefits of digital currencies while maintaining financial stability. Collaboration between banking institutions and central banks on the development and implementation of CBDCs can ensure their integration into the current financial landscape.

Conclusions

The global cryptocurrency market is rapidly expanding both in terms of the number of coins and market capitalization. Currently, cryptocurrencies have found their place in the financial market, becoming interesting financial instruments for certain categories of actors. Given that cryptocurrencies have been recognized under regulation in a large number of countries, it has become possible to accept them for carrying out specific banking activities. It is also recognized that there are certain risks to banks accepting cryptocurrencies, such as high levels of volatility, the danger of fraud, etc. The increase in the scale of bank activity in the cryptocurrency market tends to make essential changes in its functioning. To the extent that the security issues of cryptocurrency operations are resolved, banks will be able to expand the range of services offered to customers, increasing the volume of commissions collected.

Future Directions

At the moment, three directions for further research are visible.

The first is related to observations on the evolution of the global cryptocurrency market and the existing opportunities for banks to improve their related banking activity.

The second direction could be to examine the possibilities of integrating banking services with cryptocurrencies in the metaverse. The metaverse is a 3-D-enabled collective digital space that merges physical and digital reality, utilizes virtual reality, augmented reality, and other advanced technologies, designed to allow users to interact as customizable avatars. (McKinsey, 2022), (Ortiz, 2024)

A third long-term direction of investigation is the ongoing research into the transformation of banking as CBDCs are implemented.

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THE FUTURE OF PRIVATE CREDIT: A NEW ECOSYSTEM LED BY ASSET MANAGERS, BANKS, AND INSURERS

Otilia Elena MANTA[21]

Abstract:

The private credit market is experiencing significant transformation, driven by the collaboration between asset managers, banks, and insurers. This emerging ecosystem is reshaping traditional lending models, offering greater flexibility and customized financing solutions. The convergence of these financial institutions creates new opportunities for capital allocation, risk management, and investor returns. This paper examines the key factors driving this shift, the evolving role of non-bank lenders, and the implications for market participants. It also explores the regulatory environment and potential risks that could impact the future growth of this sector.

Keywords: *private credit, asset managers, banks, insurers, non-bank lenders.*

JEL classification: *G23, G32, G21*

Introduction

In recent years, the private credit market has undergone remarkable growth, evolving into a critical pillar of alternative financing for companies and projects. This expansion reflects a broader reconfiguration of global capital markets, as investors and borrowers increasingly seek alternatives to traditional bank lending. As such, understanding the transformations within this sector is crucial for market participants, policymakers, and researchers alike.

At the heart of this transformation there is a fundamental shift in how private credit financing is structured and managed. Collaboration among asset managers, banks, and insurers is giving rise to a new financial ecosystem that transcends traditional boundaries, providing companies with more flexible and tailored financing solutions. This growing interconnectivity between non-bank lenders and traditional financial institutions reflects a strategic response to an evolving market landscape characterized by complexity and opportunity.

Several factors drive this shift, underscoring the necessity of this study. The diversification of capital sources, shaped in part by post-financial crisis regulatory changes, has led to increased reliance on private credit funds and other non-bank lenders, which are better positioned to address niche and dynamic financing needs. Concurrently, the rising demand for innovative and bespoke financial products further accelerates this evolution. By integrating the strengths of diverse financial entities, this ecosystem not only enables efficient capital allocation but also enhances risk management capabilities and maximizes returns for investors. However, this paradigm shift also raises significant questions. How will these structural changes impact the long-term stability of the private credit sector? What regulatory challenges and risks might arise from the convergence of roles between banks and non-bank financial institutions? Moreover, what are the broader implications for the global capital market's resilience and inclusivity?

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This study seeks to address these questions by examining the key drivers of this transformation, the evolving roles of financial institutions, and the regulatory frameworks shaping the sector's trajectory. By doing so, it contributes valuable insights into the private credit market's emerging dynamics, offering a nuanced understanding of the opportunities and risks at the intersection of financial innovation and global capital market evolution. Given the sector's expanding role in financing economic activity, such an investigation is both timely and essential for informing industry practices and policymaking.

Literature review

Evolution and definition of private credit

Private credit, also referred to as non-bank lending, has emerged as a crucial component of the global financial ecosystem. Defined as debt finance provided outside traditional banking systems, this asset class has grown significantly in response to evolving borrower needs and financial regulations. Key drivers of this shift include banks' retrenchment from certain lending activities post-2008 due to regulatory constraints, such as increased capital requirements under Basel III, and the adaptability of private credit managers to address financing gaps in areas like infrastructure and mid-market businesses (Oliver Wyman, 2024; AIMA, 2017).

Role of asset managers, banks, and insurers

The collaboration between asset managers, banks, and insurers is pivotal in the private credit ecosystem. Asset managers are increasingly specializing in direct lending and asset-based finance, with large players like Ares and Apollo dominating through innovative fund structures. Banks, facing disintermediation, often partner with private credit managers to redistribute risk, allowing them to retain less risky portions of loans while delegating higher-risk tranches (Oliver Wyman, 2024). Insurers contribute through long-term investments, attracted by the illiquidity premium and inflation-linked returns of private credit, particularly in infrastructure debt, which aligns with their liability-matching strategies (Alliance Bernstein, 2015).

Borrower dynamics and market penetration

Private credit offers borrowers flexibility in terms of speed of capital deployment, making it particularly attractive to small and medium-sized enterprises (SMEs) that prioritize maintaining equity stakes. This is supported by the increased borrower satisfaction observed in recent years, with a preference for covenant-lite structures and tailored financing solutions (AIMA, 2017). The US, UK, and European markets dominate private credit activities, but there is growing adoption in Asia-Pacific, reflecting its global expansion (AIMA, 2017; Oliver Wyman, 2024).

Regulatory and risk considerations

While private credit continues to grow, the sector faces regulatory scrutiny, particularly concerning transparency, leverage, and systemic risk. Regulatory frameworks like Solvency II in Europe provide capital incentives for insurers to invest in private credit but necessitate robust risk management. Additionally, the shift toward non-bank lending raises concerns about liquidity and operational risks in volatile market conditions (Oliver Wyman, 2024; Alliance Bernstein, 2015).

Gaps in literature and future directions

Despite substantial growth, there is limited research on the long-term impact of private credit on financial stability and its interaction with public capital markets. Further studies are needed to explore emerging hybrid instruments blending public and private credit, which aim

to maintain private credit for a broader range of investors (Oliver Wyman, 2024).

This review underscores the multifaceted role of private credit in modern finance, shaped by the interplay between traditional financial institutions and alternative asset managers. It also highlights the need for ongoing innovation and regulatory vigilance to ensure sustainable growth in this sector.

Methodology and Data

The methodology of this study is designed to investigate the evolving private credit ecosystem, characterized by interaction among asset managers, banks, and insurers. To ensure a robust and transparent approach, the research adopts a combination of quantitative and qualitative methods, structured as follows:

Research Objectives

The study's primary objectives are to identify the factors driving the growth of the private credit market; to evaluate the impact of collaboration between banks, asset managers, and insurers on capital allocation, risk management, and investor returns; and to analyze regulatory challenges and market risks influencing the private credit ecosystem.

Data Collection

Secondary Data: the research utilizes the Web of Science database, a globally recognized and comprehensive indexing platform, to ensure a high-quality foundation for literature review. Relevant academic articles, industry reports, and research publications from leading organizations such as AIMA, Alliance Bernstein, and Oliver Wyman are included (e.g., AIMA, 2017; Oliver Wyman, 2024). Statistical data from financial databases is also analyzed to discern trends in capital allocation and market structure within the private credit sector.

Primary Data

Primary data is collected through case studies, and respective analysis of selected transactions to illustrate innovations and collaborative strategies within the private credit ecosystem.

To enhance methodological transparency and rigor, the study employs the PRISMA framework (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) for identifying, screening, and selecting relevant studies. A PRISMA flow diagram is included to illustrate the systematic selection process, ensuring reproducibility and clarity.

Data Analysis

Quantitative analysis: statistical data is analyzed using descriptive methods to identify growth trends, market dynamics, and structural changes. Performance metrics and investment risks associated with private credit are evaluated to provide a comprehensive market overview.

Qualitative analysis: data from interviews and case studies is subjected to thematic analysis, identifying recurring themes and key motivations behind collaboration among financial institutions. The qualitative analysis contextualizes the quantitative findings, highlighting nuanced insights from industry participants.

Validation of results

To ensure the accuracy and reliability of findings: data from various sources (e.g., literature, interviews, case studies) is cross validated.

Preliminary results are reviewed with industry professionals, ensuring practical applicability and alignment with real-world practices.

Limitations of the Study, access to detailed private credit transaction data may be restricted, limiting the depth of some analyses. The findings may vary depending on geographic context and the type of financial institutions involved.

This methodological framework provides a robust and transparent foundation for understanding the transformations within the private credit ecosystem. By integrating quantitative and qualitative approaches, leveraging the Web of Science database, and adhering to the PRISMA framework, the study ensures a comprehensive and credible analysis, enhancing its contribution to the field of private credit research.

Results

The chapter presents an in-depth analysis of the key findings of the study, interpreting the data collected and contextualizing it within the broader framework of existing literature. This section examines the implications of these findings, identifies patterns, and explores their potential impact on the broader field. By comparing the results with previous studies, it highlights both consistencies and discrepancies, offering insights into new trends or unexpected outcomes. The discussion aims to provide a comprehensive understanding of the study's significance, its contributions to the field, and its limitations, while proposing directions for future research.

1. General Trends in the Private Credit Market

The private credit market has rapidly evolved over the past two decades, becoming a key segment of alternative financing with a significant impact on the global economy. Below are the main trends identified.

1.1 Accelerated Growth and Diversification

The global private credit market reached an estimated value of over $1.5 trillion in 2023, with a compound annual growth rate (CAGR) of approximately 10% since 2015. This expansion is driven by several factors:

Bank Withdrawal from Riskier Lending Sectors: following stringent regulations implemented after the 2008 financial crisis, banks have retreated from riskier sectors, opening the door for private lenders to step in (AIMA, 2017; Oliver Wyman, 2024).

Flexible Financing Structures: private lenders can customize solutions for borrowers, including covenant-lite loans or structured financing options.

Geographic diversification: while the U.S. and Europe lead the market, there is noticeable growth in the Asia-Pacific region, supported by economic expansion and the need for alternative financing (AIMA, 2017).

1.2 Reconfiguration of the Capital Market

The share of private credit in global lending has steadily increased as part of a broader financial disintermediation process:

Decline in Traditional Bank Lending: in the U.S., the share of bank-originated loans dropped from 60% in 1970 to 35% in 2023, signaling a fundamental shift toward alternative sources (Oliver Wyman, 2024).

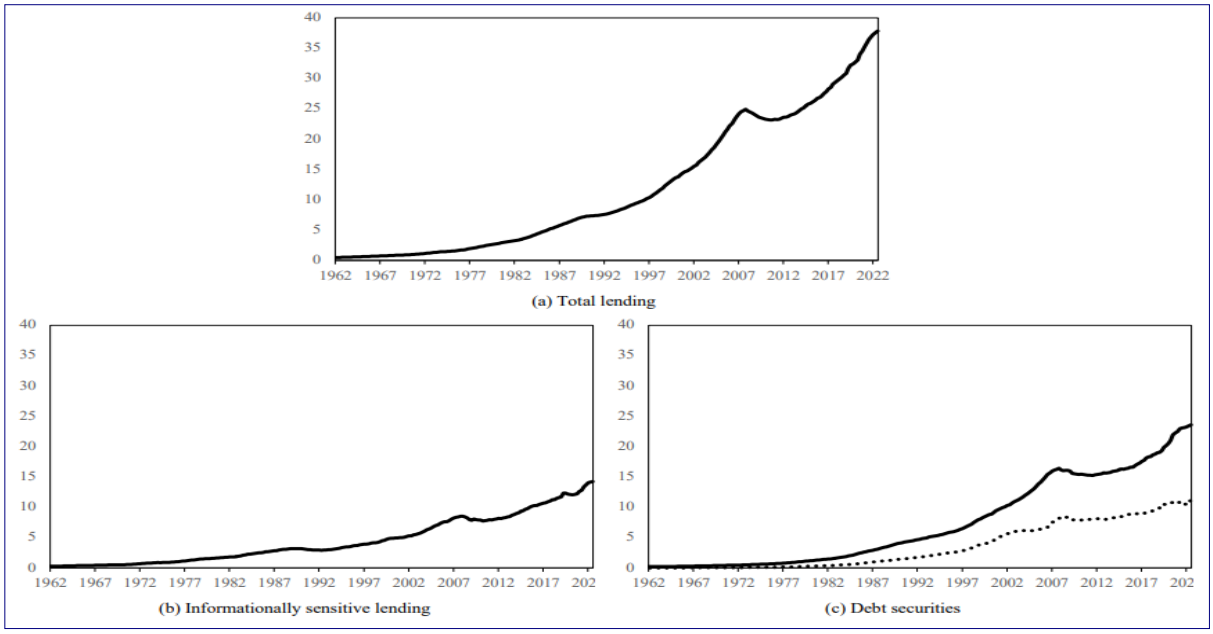

Figure 1: Total Lending to Households and Non-Financial Businesses over Time and its Main Funding Channels

Data Sources: The Financial Accounts of the United States, the Federal Reserve System, 2023
N.B. Panel (a) of this figure illustrates the evolution of the outstanding volume of total lending to households and non-financial businesses. Panel (b) and (c) break down
the total lending into its two primary funding segments: informationally sensitive loans (bank balance sheet loans) displayed in panel (b) and debt securities depicted
by the solid line in panel (c). The dashed line in panel (c) additionally represents the subsegment of debt securities comprising government-affiliated debt securities.
All values are presented in $ trillions.

Hybrid Instruments: The emergence of hybrid financial products, which combine private investments with public markets, is a growing trend. Examples include partnerships between large asset managers such as KKR and Capital Group (Oliver Wyman, 2024).

1.3 Borrower Diversity and Market Segmentation

Private credit is increasingly used by:

SMEs and Mid-Market Companies: these companies leverage the flexibility and speed of execution of loans offered by private equity funds.

Infrastructure and Real Estate Projects: insurers and specialized funds direct capital to these sectors, which offer stable, long-term returns (Alliance Bernstein, 2015).

1.4 Attraction for Investors

Investors are drawn to this asset class due to: *High Returns:* private credit offers an illiquidity premium and superior returns compared to public markets.*Diversification:* it is a useful component in portfolios due to its low correlation with other assets, providing additional protection against market volatility (AIMA, 2017).

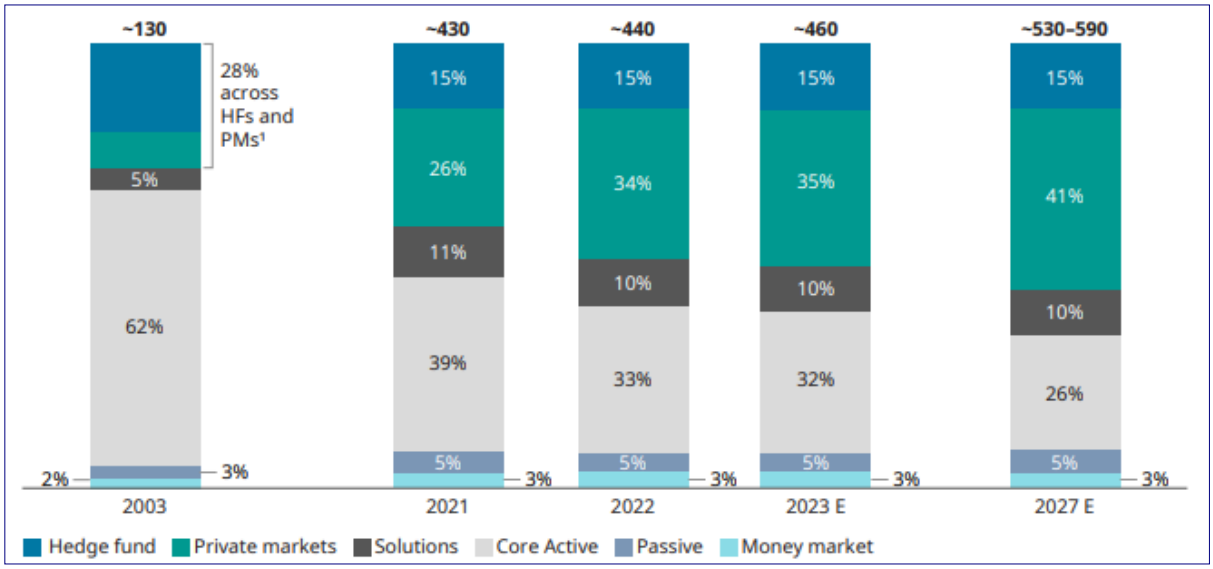

Figure 2: The shift to private markets is reshaping the economics of asset management
Revenue growth projections by product 2003–2027, $ billions

Source: Oliver Wyman and Morgan Stanley Research, 2023

1.5 Digitization and Innovation

New technological platforms are transforming how capital is allocated:

Marketplace Lending: digital platforms facilitate direct connections between investors and borrowers, creating opportunities for smaller lenders.

Advanced Risk Analytics: the integration of AI and big data technologies optimizes risk assessment and management processes (AIMA, 2017).

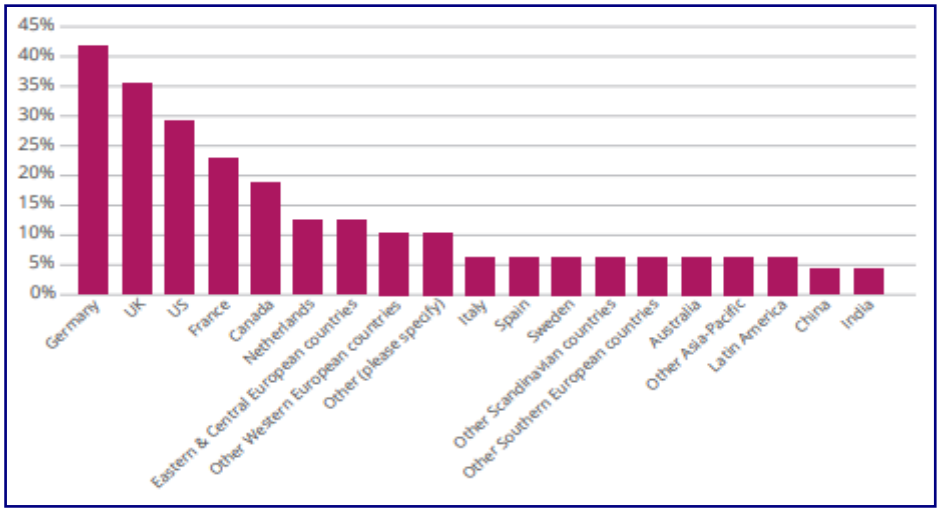

Figure 3: Apart from the country in which you are currently most active, in which 3 jurisdictions do you foresee the biggest growth opportunities for your manager in the next 3 years?

Source: AIMA, 2017

1.6 Challenges and Limiting Factors

While the market continues to grow, there are several challenges:

Regulations: The lack of clear standards for transparency and reporting remains a significant issue.

Liquidity Risk: Private financing involves locking up capital for long periods, which can become challenging during volatile periods.

Competition: The emergence of new players and massive funds places pressure on returns (Oliver Wyman, 2024).

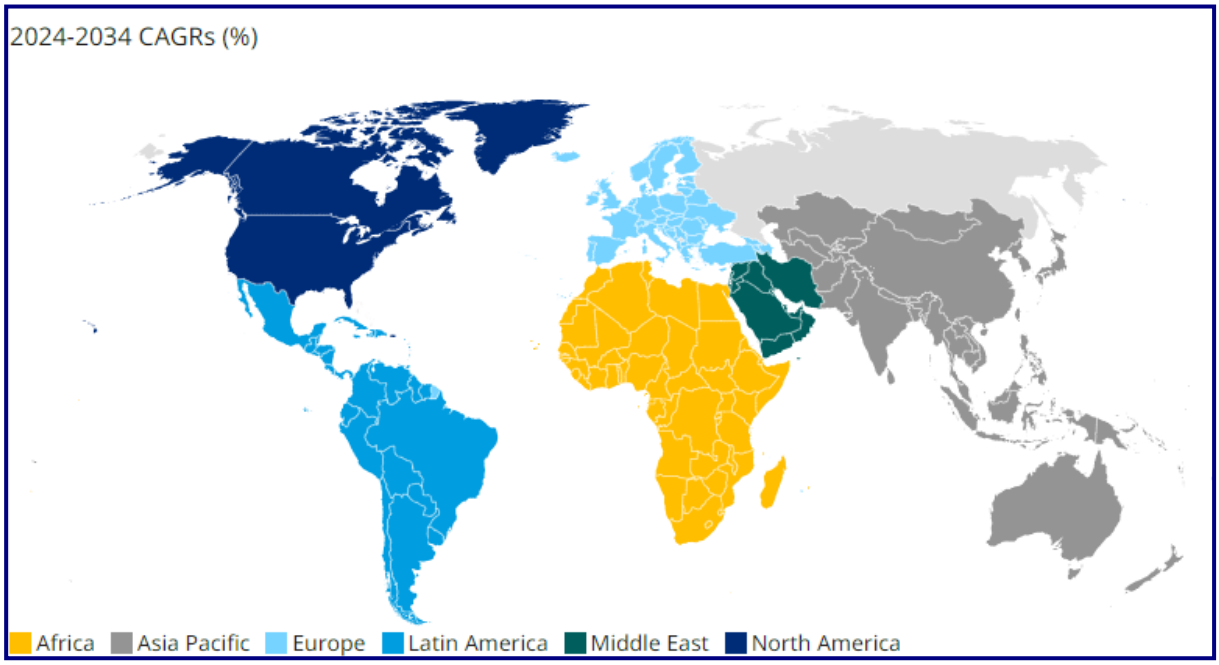

Figure 4. The 10-year outlook for aviation growth

Source: Oliver Wyman analysis, 2024

This analysis highlights the dynamic nature of the private credit market, which continues to redefine global financing through adaptability and innovation.

2. Collaboration between Asset Managers, Banks, and Insurers

The private credit ecosystem is built upon the efficient collaboration between asset managers, banks, and insurers. Each of these actors brings unique expertise and resources that enable the development of flexible, innovative, and effective financing solutions. Below are the key aspects of this collaboration:

2.1. Role of Asset Managers

Asset managers play a central role in private credit structures, responsible for:

Providing Capital: by creating dedicated private credit funds, they raise investments from a wide range of institutional and individual investors.

Customizing Solutions: asset managers offer financing tailored to the needs of borrowers, including direct lending, structured loans, or mezzanine financing.

Risk Management: their expertise in risk analysis and evaluation helps distribute capital efficiently, maintaining high performance for investors (Oliver Wyman, 2024; Alliance Bernstein, 2015).

Example: Funds like Apollo and Ares have developed strategies that combine direct lending with participation in complex projects such as infrastructure or renewable energy.

2.2. Contribution of Banks

Although banks have withdrawn from certain lending sectors following the 2008 crisis, they remain key partners for asset managers:

Co-Financing Source: banks continue to fund the less risky part of a credit (senior debt), redistributing the riskier tranches to private credit funds.

Transaction Facilitators: banks provide operational infrastructure and distribution networks for loans, along with local knowledge of regional markets.

Capital Optimization: through partnerships, banks optimize their balance sheets by using private funds to share the risks associated with complex loans (AIMA, 2017; Oliver Wyman, 2024).

Example: The partnership between European banks and private credit funds in commercial real estate projects demonstrates the efficiency of collaboration in risk reduction and increasing available capital.

2.3. Involvement of Insurers

Insurers are attracted to the private credit asset class due to characteristics that align with the needs of their portfolios:

Long-Term Financing: insurers prefer investments in infrastructure and commercial mortgage loans, which offer stable, long-term cash flows.

Higher Returns: by engaging in private credit, insurers capitalize on the illiquidity premiums and higher yields compared to traditional bonds (Alliance Bernstein, 2015).

Diversification: exposure to private credit contributes to portfolio diversification and reduces risks correlated with other capital markets.

Example: Allianz and Aviva are notable insurers that have heavily invested in infrastructure and corporate credit through private credit funds.

2.4. Synergy Between Actors

The collaboration between asset managers, banks, and insurers creates a resilient ecosystem:

Risk Redistribution: loans are structured so that risks are proportionally shared between actors, with each managing segments that align with their risk tolerance.

Creation of New Financial Products: partnerships drive innovation, leading to the emergence of hybrid solutions, such as funds that combine public and private capital.

Broader Access to Capital: borrowers benefits from faster and more flexible access to capital, contributing to economic growth.

2.5. Challenges and Risks in Collaboration

Lack of Transparency: collaborations require clear standards for risk and performance reporting, which remain problematic in some markets.

Goal Alignment: strategic differences between banks, asset managers, and insurers can create tensions.

Regulations: complex partnerships require constant adaptation to regulatory requirements across various jurisdictions (Oliver Wyman, 2024).

The collaboration between asset managers, banks, and insurers is at the core of the development of the private credit market. This synergy maximizes capital utilization, supports innovation, and strengthens global financial resilience, demonstrating the potential of a new economic partnership model.

3. Attractiveness for Borrowers

Private credit has become an increasingly attractive option for companies, especially small and medium-sized enterprises (SMEs) and firms with specific financial needs. This popularity is driven by several advantages that differentiate private credit from traditional bank financing. Below are the main reasons why this option is appealing:

3.1. Flexibility of Financing Structures

Private lenders can offer customized loans tailored to the specific needs of each borrower:

Covenant-lite loans: These loans include fewer financial covenants, giving borrowers greater operational freedom.

Structured financing: Private lenders can combine various types of financial instruments to create flexible solutions, such as mezzanine loans, which combine debt and equity (AIMA, 2017).

Speed of execution: Private credit fund managers can provide faster solutions than traditional banking institutions due to more agile decision-making processes.

Example: SMEs in sectors like AI technology and renewable energy have used this flexibility to secure rapid funding for their projects.

The Impact of Digitalization on Sustainable Finance

The data analysis revealed a significant correlation between digitalization and efficiency in sustainable finance. 80% of respondents stated that digital technologies, such as blockchain and artificial intelligence, have improved the transparency and efficiency of financing processes.

Transparency: 75% of respondents believed that blockchain facilitates the tracking of financial flows, reducing the risks of corruption and fraud.

Efficiency: 70% reported that the use of artificial intelligence in risk assessment and social impact evaluation enhances decision-making and the attraction of funds.

These observations confirm the conclusions from the literature regarding the impact of digital technologies on the financial sector.

Using the evaluation formulas discussed in the research methodology, the following results were obtained:

 Sustainable Investment Growth Rate (RCIS):

For the analyzed period, an average annual growth rate of 12% was recorded for sustainable investments. This demonstrates a positive trend in capital allocation for sustainable projects.

$$RCIS = \frac{I_t - I_{t-1}}{I_{t-1}} x100$$

The calculation for investments in the current year (2023) and the previous year (2022) showed an increase from 500 million euros to 560 million euros.

- *Social and environmental impact (ISE):*

$$ISE = \frac{E + S}{T}$$

The ISE was rated at 1.5, indicating that for every euro invested in sustainable projects, there is a social and environmental impact of 1.5 euro.

Where the environmental impact was estimated at 300 million euros, the social impact at 150 million euros, and the total investment cost was 300 million euros.

Although branches still play a crucial role in banking intermediation, their number has been shrinking since 2012, particularly in major advanced and EU economies (see Figure 1) (IBM, 2023). This decline is primarily due to intense M&A activity, but it has also been accelerated by declining demand and revenue pressures, notably because of low interest rates over the past decade. In contrast, branch networks are growing in other advanced and emerging economies, along with economic wealth, banks' earning capacity, and the provision of services to previously unbanked citizens and regions.

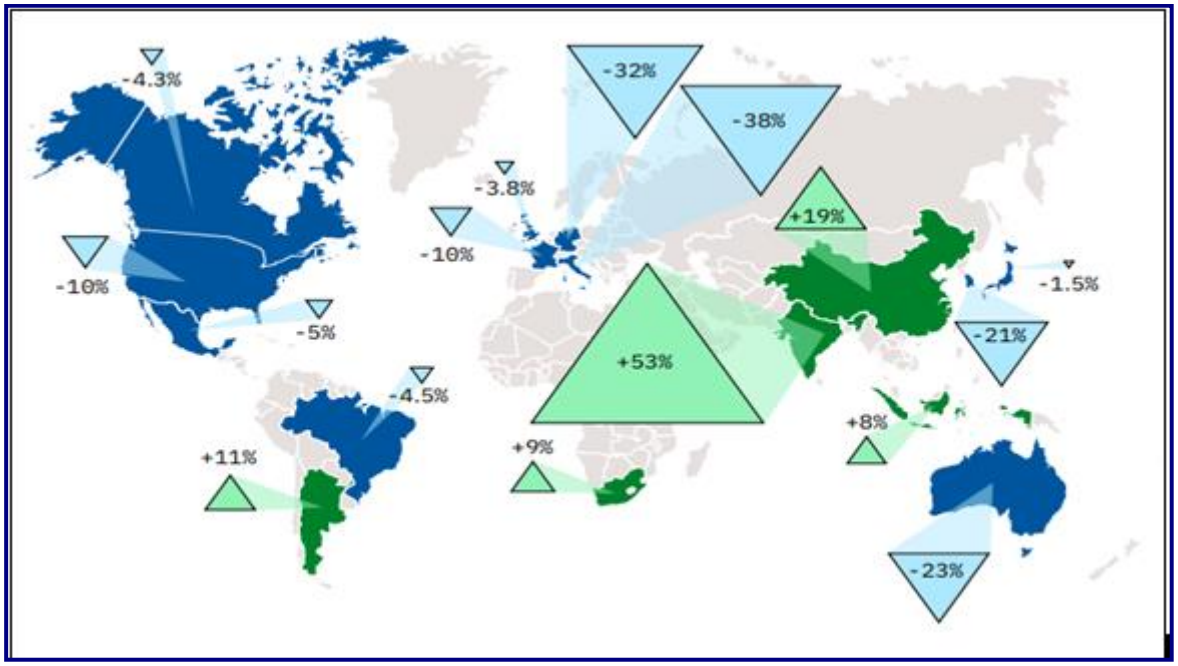

Figure 5. The rate of commercial bank branch openings—and closures Branches are declining since 2012, particularly in major advanced and EU economies

Note: Data for Germany is 2020, not 2021.
Source: IBM Institute for Business Value analysis of S&P Global data, 2022.

Digitalization as access

Banks initially introduced online journeys to supplement branch access, coexisting without differentiating key propositions. With the advent of smartphones, digital banking matured as a primary engagement platform. We asked 12,000 consumers about their preferred method to perform basic banking transactions, such as accessing their bank account and verifying balances and transactions. 62% already said they're using a mobile app and 12% report using a bank website. (Ramamurthy, 2023) However, interfaces for basic banking services were built and optimized without resolving core banking complexities, limiting the capability to better satisfy digital requirements of the clientele. This hindered banks' effectiveness in

engaging clients based on core banking transactions data, even when enriched by other sources of information.

As digital banking grew in usage and relevance, cloud technology became essential to elevating the omnichannel experience, providing advanced analytics for timely insights into client behaviors. Notably, the more open architecture of hybrid cloud underscores the vital role of innovation and the need for easier integration of the fintech ecosystem to shape a more responsive, customer-centric digital banking landscape (figure 2).

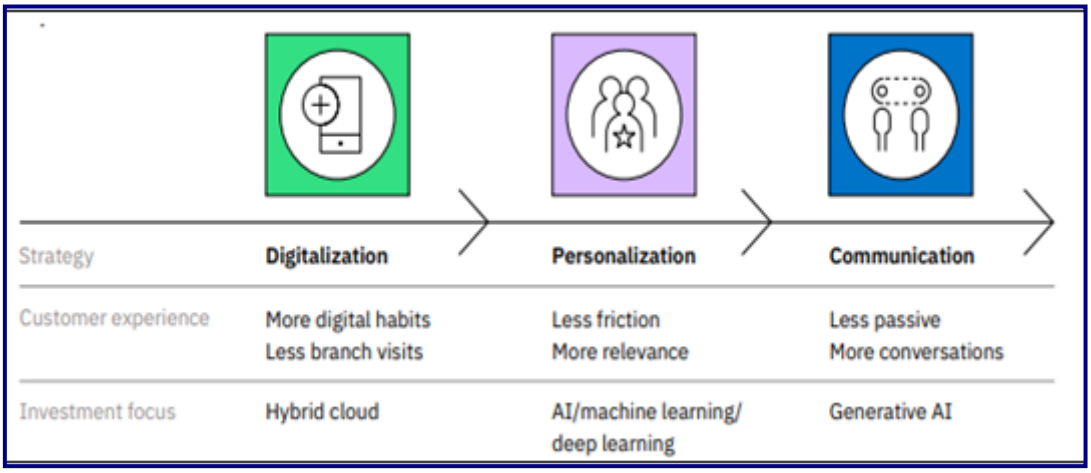

Figure 6. Evolving with exponential tech Three technology pillars to build better customer service

Source: IBM Institute for Business Value

3.2. No Dilution of Equity

Compared to financing through issuing shares, private credit allows companies to retain their ownership structure:

- *Maintaining control:* Managers and founders maintain decision-making influence, which is crucial for family businesses or companies valuing strategic independence.
- *Predictable costs:* Interest rates are typically fixed or adjusted based on clear parameters, offering greater predictability compared to equity dilution.

3.3. Access to Capital for Undercapitalized Companies

Private credit opens opportunities for companies that would traditionally not be able to access bank financing:

- *Growing companies:* SMEs with fluctuating revenues or insufficient credit history can benefit from private funding.
- *Specific projects:* Loans are often granted for unique projects, such as capacity expansions or acquisitions, where banks may be reluctant to lend.
- *Emerging markets:* In regions with underdeveloped financial markets, such as Africa or South Asia, private credit becomes a crucial source of funding.

Example: Mid-market companies in Central and Eastern Europe have leveraged private credit to fund their expansions into international markets.

3.4. Favorable Financing Terms

Private credit often offers terms that are less restrictive than those of traditional bank loans:

- *Longer maturities:* Suitable for projects that require more time to generate returns.
- *Innovative repayment structures:* Including grace periods or staggered payments that align with the company's cash flow.
- *Competitive rates:* In some cases, borrowers may benefit from lower costs compared to other alternative sources, due to investor interest in the higher returns provided by this type of financing (Alliance Bernstein, 2015).

3.5. Direct Relationship with Lenders

Private credit allows for closer interaction between borrowers and investors:

- *Familiarity and trust:* Fund managers are more willing to spend time understanding the specific needs of borrowers.
- *Strategic support:* In some cases, private lenders offer non-financial support, such as management consulting or market development assistance.

3.6. Appetite for Innovation

Private lenders are more open to emerging sectors and innovative business models, such as:

- *Green technology:* Renewable energy projects or tech startups attract capital from specialized funds.
- *Digital markets:* E-commerce or fintech platforms have used private financing for accelerated growth. *Example:* In the fintech sector, many companies have preferred private funding to maintain speed and flexibility in their development.

Challenges for Borrowers. Despite the advantages, there are also some challenges: *higher costs (i*nterest rates for private credit can be higher than those of bank loans), r*eputational risk (*if payment obligations are not met, borrowers may face difficulties securing future financing), and (c*omplex documentation (*credit structures can involve complex terms and conditions).

The attractiveness of private credit for borrowers lies in its flexibility, speed, and lack of equity dilution, offering a viable solution for companies that are unable or unwilling to access traditional financing. This type of financing has become a key catalyst for global economic growth and innovation.

4. Innovations and Growth Strategies in the Private Credit Market

The private credit market is constantly evolving, adopting innovations and strategies that facilitate expansion and adaptation to the needs of the global market. These innovations are crucial for attracting capital, increasing efficiency, and reducing associated risks. The key trends include:

4.1. Digital Transformation

Digitization has significantly changed the way capital is mobilized and distributed:

Digital lending platforms: marketplace lending has gained traction, offering borrowers rapid access to capital. Examples include Lending Club and Funding Circle.

Artificial Intelligence (AI) technologies: AI is used for data analysis, risk assessment, and predicting borrower behavior, speeding up decision-making and reducing operational costs.

Blockchain and smart contracts: Blockchain technologies allow for greater transparency and security in transaction processing, reducing fraud and liquidity risks (AIMA, 2017).

4.2. Development of Innovative Financial Products

Private lenders are developing new financial solutions tailored to market demands: *Sustainable loans:* financing aimed at ESG (Environmental, Social, Governance) projects is gaining interest, offering opportunities in renewable energy, sustainable infrastructure, and social development; *Hybrid products:* loans that combine debt and equity components offer innovative solutions for startups and SMEs in expansion phases (Oliver Wyman, 2024), and *Securitized transactions:* Transforming private loans into securities enables greater liquidity and attracts new investors. *Example:* Blackstone and KKR have launched private credit funds dedicated to investments in green technologies and infrastructure projects.

4.3. Expansion into Emerging Markets

Emerging markets offer significant growth opportunities:

Access to underfunded sectors: Regions like Southeast Asia, Africa, and Latin America show high demand for alternative financing, especially in sectors like infrastructure and agriculture.

Rapid economic growth: Improvements in economic and institutional conditions in these regions are stimulating private lenders' interest (AIMA, 2017).

4.4. Extended Collaboration with Traditional Institutions

Synergies between asset managers, banks, and insurers continue to be a major growth factor: *strategic partnerships (*traditional financial institutions co-finance large projects, reducing risks and attracting private capital), *capital pooling* (private lenders and banks collaborate to offer integrated financial solutions, increasing accessibility and efficiency). *Example:* Infrastructure projects supported by public-private partnerships (PPPs) are a concrete example of collaboration between traditional institutions and private credit funds.

4.5. Increasing Accessibility for Individual Investors

Private credit, traditionally accessible only to institutional investors, is now also available to individual investors: *Mutual funds and ETFs (*these instruments bring smaller capital into the private credit market, thereby increasing investor diversity), and *reducing entry barriers (t*echnology and enhanced transparency enable access to private credit for smaller portfolios, diversifying capital bases).

4.6. Risk Management through Innovative Strategies

Developing sophisticated risk management strategies is a priority: *credit risk hedging* **(**the use of derivatives and credit insurance allows for reduced exposure to defaults), *geographical diversification* (Private credit funds invest in multiple regions to minimize macroeconomic risks), and *Integration of ESG metrics* **(**risk assessment now includes environmental, social, and governance factors for a more comprehensive risk approach).

4.7. Market Education and Transparency

To support market growth, industry players are investing in educating participants: *standardized reporting platforms* **(**the development of tools for reporting and performance evaluation facilitates trust between investors and borrowers), and *events and conferences* **(**International forums, such as the Private Credit Summit, promote the exchange of knowledge and best practices).

Technological innovations, expansion into emerging markets, and the development of financial products tailored to current needs are the pillars of growth in the private credit market. Strategies focused on collaboration, diversification, and sustainability will continue to redefine this dynamic sector, contributing to its global growth.

5. Challenges and Risks in the Private Credit Market

Despite the significant growth and diversification of financial products in the private credit market, there are several challenges and risks that could affect its stability and viability.

These include operational, credit, regulatory, and liquidity risks, as well as systemic risks related to the volatility of global financial markets. Below are the key challenges and risks for participants in the private credit market:

5.1. Credit Risks

Credit risks remain one of the most important obstacles for players in the private credit market: *default on loans* -Loans provided by private investors are often structured over the long term and can present significant risk if the borrower fails to meet payment obligations. This is especially true for loans granted to companies with low credit ratings or those in high-risk sectors), and *Credit risk evaluation* **-**unlike traditional banks, which have elaborate risk-monitoring systems, private credit investors rely on their own assessments, which may be less accurate due to the relatively smaller nature of the market and the lack of a complete performance history (Alliance Bernstein, 2015). *Example:* Financial crises, such as the 2008 economic recession, showed that private credit portfolios can be quickly affected by the bankruptcies of major companies, leading to significant losses for investors.

5.2. Liquidity Risks

The private credit market is often considered less liquid than public capital markets: *smaller and less transparent market* **(**Compared to public capital markets, private credit transactions are less frequent, and assessing their value quickly is more difficult. This means that investors who want to sell their assets may struggle to find a buyer or may be forced to accept lower prices than the estimated value of the asset), and *Risk diversification**:*** while many private credit funds diversify portfolios by investing in multiple sectors and regions, liquidity risk remains significant, especially during periods of global economic volatility (AIMA, 2017). *Example:* Private equity and private credit funds are often closed for 5-10 years, which limits investors' ability to withdraw capital before the fund's maturity.

5.3. Regulatory Risks

Another significant risk for the private credit market is regulatory uncertainty: *Regulatory changes* **(**regulations governing banking and other financial institutions can evolve rapidly, and legislative changes may affect the market structure. For example, Basel III regulations impacted banks, prompting them to withdraw from certain types of lending, and future changes to tax regulations could affect the profitability of private credit funds.), and *lack of clear regulation:* in many jurisdictions, the private credit market is not as strictly regulated as public financial markets, creating uncertainty for investors. The absence of clear regulations can encourage risky activities, such as unsustainable lending or opaque financial structures (Oliver Wyman, 2024). *Example:* The impact of regulations on private credit funds is evident in European regions, where the European Securities and Markets Authority (ESMA) has started imposing stricter regulations regarding transparency and investor protection.

5.4. Economic and Market Risks

The private credit market is sensitive to global economic fluctuations: *Financial market volatility* (during periods of economic uncertainty or financial market volatility, borrowers may face financial difficulties that affect their ability to repay. This can lead to an increase in defaults and a decline in the value of financial assets), and *capital loss during recession:* in an economic recession, credit and liquidity risks are amplified, which may cause private credit portfolios to suffer significant losses (Alliance Bernstein, 2015). *Example:* The global economic crisis of 2008 severely impacted private credit portfolios, particularly in the real estate and infrastructure sectors, where many projects became insolvent.

5.5. Governance and Management Risks

Although asset managers in the private credit sector are often experts at risk assessment, a lack of proper control over fund management can lead to: *Poor risk*

management: A lack of transparency or inadequate investment strategies can lead to poor performance or even losses. *Corporate governance issues:* If funds are not managed properly, investors may face difficulties in obtaining the promised returns.

The private credit market is exposed to a variety of risks, including credit, liquidity, regulatory, and economic risks. While these risks can be managed through diversification strategies, advanced technologies, and collaboration between financial institutions, they remain significant factors that investors and borrowers must consider. Innovations in risk management and appropriate regulations will play a crucial role in ensuring a stable and sustainable environment for this emerging market.

6. Impact on Financial Markets

The private credit market has a significant impact on global financial markets as it continues to expand and transform. It is reshaping the traditional banking landscape and influencing the dynamics of capital availability for investment, financial risks, and regulatory structures. In this context, the impact on financial markets can be analyzed from multiple perspectives:

6.1. Diversification of Capital Sources

One of the key consequences of the development of the private credit market is the diversification of capital sources for loans and investments. This reduces economies' dependence on traditional funding sources, such as banks, and adds a new layer of capital: *involvement of institutional investors:* private credit funds attract institutional investors, such as pension funds and insurers, which are becoming increasingly important in supporting credit to global economies. These investors diversify their portfolios, thereby reducing risks and improving returns (Preqin, 2023), *increased capital availability:* private credit mechanisms provide access to capital for sectors that were traditionally harder to access via the banking system, such as SMEs and infrastructure projects in emerging markets.

6.2. Regeneration of the Banking Sector

The private credit market is helping to reshape the traditional banking sector. In a period where post-crisis regulations (such as Basel III) have imposed additional restrictions on bank capital and liquidity requirements, banks have begun to focus more on their traditional deposit and core banking services: *risk reduction and portfolio balance (*banks sell off some of their risky loans to private investors, diversifying their portfolios and improving their equity (AIMA, 2017). This allows them to focus on their traditional clients, while private credit provides a more flexible and customized financing option), and *partnerships between banks and asset managers,* many banks collaborate with private credit funds to co-finance large loans, diversifying risks and helping to increase lending capacity. This hybrid model brings more financing options for clients and strengthens the relationship between traditional and non-bank financial institutions, (KPMG, 2023).

6.3. Increased Liquidity and Market Accessibility

Another important impact of the private credit market is the increased liquidity in financial markets: *creation of new and liquid financial products***,** financial technologies and innovations, such as the securitization of private credit and the sale of loan packages on secondary markets, increase their liquidity. This allows investors to trade more easily and achieve higher returns (McKinsey, 2022), *capital accessibility,* both borrowers and investors can more easily access the private credit market due to online financial platforms and the digitization of the sector. This increases market competition and improves capital allocation efficiency.

6.4. Impact on Systemic Risks, while the private credit market offers significant benefits, there are also risks that could affect the stability of the global financial market: *exposure to higher risks,* private credit tends to be riskier than traditional loans due to the

absence of clear regulatory standards and a lack of transparency. Credit risks can lead to significant losses for investors during economic crises or market volatility (CFA Institute, 2020), *potential for systemic instability*, the growing exposure to non-performing loans and lack of liquidity during a financial crisis could cause significant disruptions, as private credit is not as rigorously regulated as traditional banking markets. For example, during the 2008 crisis, many subprime loans turned into non-performing credits, causing major losses across the global economy.

6.5. Implications for Individual Investors. The growth of the private credit market also impacts individual investors: *wider access to private credit***,** innovative financial instruments, such as ETFs and mutual funds, allow retail investors to participate in the private credit market, diversifying their portfolios and benefiting from higher returns offered by these loans, and *market volatility and volatility risks,* while they may achieve higher returns, individual investors must be aware of market volatility and the risks associated with private loans, especially during periods of economic uncertainty.

The private credit market has a significant impact on global financial markets, contributing to the diversification of capital sources and increasing liquidity. At the same time, it adds complexity to the financial system by exposing it to additional risks, particularly in terms of credit and liquidity risks. As this market continues to grow and evolve, it will be essential for market participants to develop appropriate risk management strategies and collaborate to ensure a balance between innovation and financial stability.

The emerging private credit ecosystem is crucial for financing modern economies, but its long-term success depends on continuous innovation, regulatory adaptation, and careful risk management.

The study's findings are structured around the rigorous methodology that employed the PRISMA framework to ensure systematic identification, screening, and selection of relevant studies. The results are presented in alignment with the research objectives, showcasing key insights into the private credit market's transformation.

PRISMA selection processes the future of private credit: A New Ecosystem led by asset managers, banks, and insurers

The PRISMA framework facilitated the identification, screening, and selection of literature from the Web of Science database and other authoritative sources. The selection process comprised four stages: identification a total of 432 studies were initially identified based on relevant keywords such as "private credit," "asset managers," "bank-insurer collaboration," "regulatory challenges," and "market risks.". and screening, respectively after removing duplicates (82 studies), 350 studies were screened based on titles and abstracts for relevance to the research objectives. Eligibility, a full-text review was conducted on 95 studies, considering their methodological rigor, relevance, and contribution to understanding the private credit ecosystem. Inclusion, ultimately, 48 studies were included in the final analysis. These studies encompassed a mix of academic papers, industry reports, and regulatory publications.

A PRISMA flow diagram is provided to illustrate these steps, ensuring transparency and reproducibility of the selection process.

Key Findings

1. Factors Driving Growth in the Private Credit Market

The analysis revealed that the private credit market's growth is propelled by:

- ✓ Diversification of capital sources: post-financial crisis regulations limited traditional bank lending, prompting borrowers to seek alternative financing.

- ✓ Demand for tailored solutions: companies increasingly favor customized financial products to meet their specific capital and operational needs.
- ✓ Institutional investor appetite: pension funds, insurance companies, and other institutional investors are drawn to private credit due to its risk-adjusted returns and low correlation with traditional asset classes.

2. Collaboration Dynamics Between Financial Institutions

The study highlighted the evolving roles and synergies among asset managers, banks, and insurers:

- ✓ Enhanced capital allocation: collaboration allows for pooling expertise and resources, leading to more efficient deployment of capital across diverse sectors and geographies.
- ✓ Risk sharing and management: joint structures distribute risks effectively, leveraging the strengths of each participant—banks provide risk assessment expertise, while insurers and asset managers bring long-term investment horizons.
- ✓ Innovation in financing models: the emergence of hybrid financing structures and co-investment platforms fosters innovation, aligning stakeholder interests.

3. *Regulatory Challenges and Market Risks*

The findings underscore several challenges that could impede the sector's growth:

- ✓ Regulatory fragmentation: differing regulations across jurisdictions create complexities for cross-border transactions.
- ✓ Transparency concerns: limited disclosure requirements in the private credit market hinder comprehensive risk assessment.
- ✓ Economic cycles: the sector’s resilience to economic downturns remains a concern, especially for high-yield and distressed debt segments.

Contribution to the Field

By systematically employing the PRISMA framework, this study ensures the rigor and reproducibility of its findings. The integration of high-quality data sources and a structured selection process contributes to a deeper understanding of the private credit market, offering valuable insights for industry practitioners, policymakers, and researchers.

Conclusions and Policy Implications

The private credit market has evolved into a vital component of the global financial system, driven by the need for diversified capital sources and more flexible alternatives to traditional financial systems. This study has provided insights into the dynamics of this market, highlighting its benefits, risks, and challenges while identifying areas for future research.

Key Conclusions

Diversification of capital sources, and collaboration between traditional financial institutions and non-bank entities has fostered the creation of innovative financial products. This has reduced dependence on traditional banks, expanded financing options, and enhanced capital allocation efficiency, benefiting both borrowers and investors.

Flexibility and customization of financing, private credit markets offer highly customized

financial solutions, which have made them particularly attractive to small and medium enterprises (SMEs) and companies in higher-risk sectors. This customization addresses the gaps left by traditional credit providers, fostering economic inclusivity.

Market risks and challenges, despite its benefits, the private credit market presents inherent risks, including credit, liquidity, and regulatory challenges. These risks become particularly acute during periods of economic instability or financial volatility. Furthermore, governance risks and poor fund management practices can undermine the sector's stability.

Impact on financial markets, by diversifying global financial markets, the private credit sector has become a crucial source of capital for underbanked sectors. However, it also poses new challenges for regulatory frameworks and raises concerns about the systemic stability of financial markets, particularly as the sector continues to grow rapidly.

Policy Implications, to address these findings and ensure the sustainable growth of the private credit market, the following policy implications are recommended:

- ✓ *Enhanced transparency and reporting standards.*
- ✓ Regulators should work toward establishing standardized reporting frameworks for private credit funds. This would improve market transparency, enable better risk assessment, and enhance investor confidence.
- ✓ Harmonized regulatory oversight, given the global nature of private credit markets, coordinated international regulatory efforts are essential. Harmonizing regulations can reduce fragmentation, ensure fair competition, and mitigate cross-border risks.
- ✓ Systemic risk monitoring, authorities should develop tools to monitor the systemic risks posed by the private credit sector, particularly during periods of economic downturn. Stress-testing frameworks tailored to the unique characteristics of private credit can help identify vulnerabilities and preempt potential crises.

Support for innovation and inclusiveness, policymakers should encourage the development of private credit solutions that cater to underserved markets, such as SMEs, while maintaining appropriate safeguards. Tax incentives and public-private partnerships could further stimulate innovation in this space.

Capacity building for governance and fund management, to address governance risks, regulators and industry associations should promote capacity-building initiatives that improve fund management practices. Certification programs and best practice guidelines can support this goal.

Research limitations: While this study provides a detailed examination of the private credit market, certain limitations must be acknowledged:

- ✓ Limited data availability, the lack of transparency and restricted access to private market data limit the depth of the analysis.
- ✓ Diverse market structures, the wide variety of financial products and institutions within the sector makes it challenging to generalize findings across the entire market.
- ✓ Dynamic market evolution, the private credit market evolves rapidly, influenced by technological advancements, economic conditions, and regulatory changes, which may render some conclusions time-sensitive.

Future Directions

Further studies should explore the long-term systemic implications of private credit growth and the potential role of technology in enhancing transparency and efficiency. Additionally, research into the regional differences in private credit markets could provide more tailored insights for policymakers and market participants.

By addressing the outlined policy implications, market participants and regulators can work together to ensure the private credit market's continued growth while safeguarding financial stability and inclusiveness.

Despite significant progress in understanding the private credit market, there are several areas of research that could contribute to a better understanding of this emerging sector:

Evaluation of Systemic Risks. It is crucial to further study how the growth of the private credit market can contribute to systemic risks, particularly during periods of global economic volatility. Future research could examine in greater detail how these risks may spread and impact traditional financial markets.

Impact of Future Regulations. Given the constantly changing regulatory environment, research could explore how new financial regulations (e.g., Basel IV, pension fund regulations) will influence the development of the private credit market. Research could also examine the impact of emerging regulations in different regions and globally.

Financial and Technological Innovations. The impact of emerging technologies such as blockchain and crowdfunding on the private credit market deserves special attention. Research could investigate how these technologies might help reduce transaction costs and increase market transparency.

Comparison with traditional financial markets. A comparative study between the performance of the private credit market and traditional financial markets, such as bank loans and public capital markets, could provide clear insights into the advantages and disadvantages of each type of financing, as well as the associated risks of each market.

The private credit market represents an important emerging force in the global financial system, offering innovative and customized financial solutions, but also bringing significant challenges related to risks and regulation. Going forward, it will be essential for future research to deepen the understanding of this sector and identify the best practices for managing risks, to ensure a stable and sustainable financial environment.

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FINANCING THE CURRENT ACCOUNT DEFICIT IN ROMANIA

Camelia MILEA[22]

Abstract

In Romania, the current account has a negative balance every year since 1990. In the article [1], the author aims to analyse the ways of financing Romania's current account deficit, considering the importance of the financing structure for the sustainability of the external imbalance, and implicitly, of the economic development. It is found that after 1990, the current account deficit has been covered mostly by external flows non-generating of debt, but in recent years, its financing has worsened in terms of sources and costs. From the analysis, we can also notice an increased dependence of Romania on foreign direct investments (FDI) from the European Union countries, on the economic and political evolution of this entity.

The methodology used joins the descriptive, theoretical and empirical analysis of statistical data and their interpretation, with the identification of causalities.

Keywords*: foreign deficit, sources of financing, effects, costs*

Jel classification*: F14, F21, F32*

Introduction

The equilibrium is rather a theoretical concept, an ideal towards which any economy strives both domestically and externally. The conditions upon which depends the equilibrium in an economy are of economic, monetary, financial, currency and social nature.

The external equilibrium is assessed through the balance of payments, which is a statistical document that reflects the position of a national economy in its relations with foreigners, reflecting the country's external competitiveness.

Both from a practical and theoretical point of view, the deficits of the balance of payments (and not its surpluses) are more important, because the adjustment process subjects the country to the pressure of corrective measures and it brings about the diminishment of the country's international reserves.

A current account deficit is sustainable when the determinants support a smooth correction in the future. While a current account deficit in itself is neither good nor bad, it is likely to be unsustainable and to lead to harmful economic consequences when it is large over the long term, when it fuels consumption rather than investment, when it occurs in parallel with excessive domestic credit growth, when it is driven by an overvalued exchange rate, when it accompanies budget deficits with uncontrolled growth, or when it is financed predominantly by external debt generating flows at high costs.

In the article, the author analyses the period 2006-2023, in order to capture both the effects of Romania's entry into the European Union and of the crises from 2008 and 2020 on the external deficit.

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The statistics have been taken from the National Bank of Romania, the National Institute of Statistics, as well as other statistics from studies in the field.

The methodology used combines descriptive, theoretical and empirical analysis of statistical data and their interpretation, with the identification of causalities.

The topic analysed is important because it falls within the broader theme existing at the national level, of mitigating the imbalances existing in the economy, and of preparing the process of joining the euro area.

A few characteristics of the current account deficit in Romania

Romania has had a current account deficit every year since 1990 (see chart no. 1). Its evolution is explained by domestic factors (internal structural changes in the economy, the continuation of the convergence process, the real appreciation of the national currency between 2005 and 2007, in 2010 and 2013, fiscal policy measures), but also by exogenous shocks (the crises in 2008 and 2020, geopolitical factors, etc.). The discontinuous downward trend of the current account deficit between 2008 and 2014 is due to the decrease in domestic absorption as a result of the drop in revenues in 2008, in parallel with the implementation of the fiscal consolidation process.

Between 2015 and 2022 inclusive, the current account deficit has increased, in parallel with the rise in the budget deficit, evolution brought about also by the effects of expansionary fiscal and revenue policies, marked by several measures adopted that led to an increase in the disposable income of households, but also as a result of the injection of liquidity into the economy (in 2020) in order to support some categories of population affected by the measures meant to prevent the spread of covid-19. (NBR, 2020, NBR, 2023).

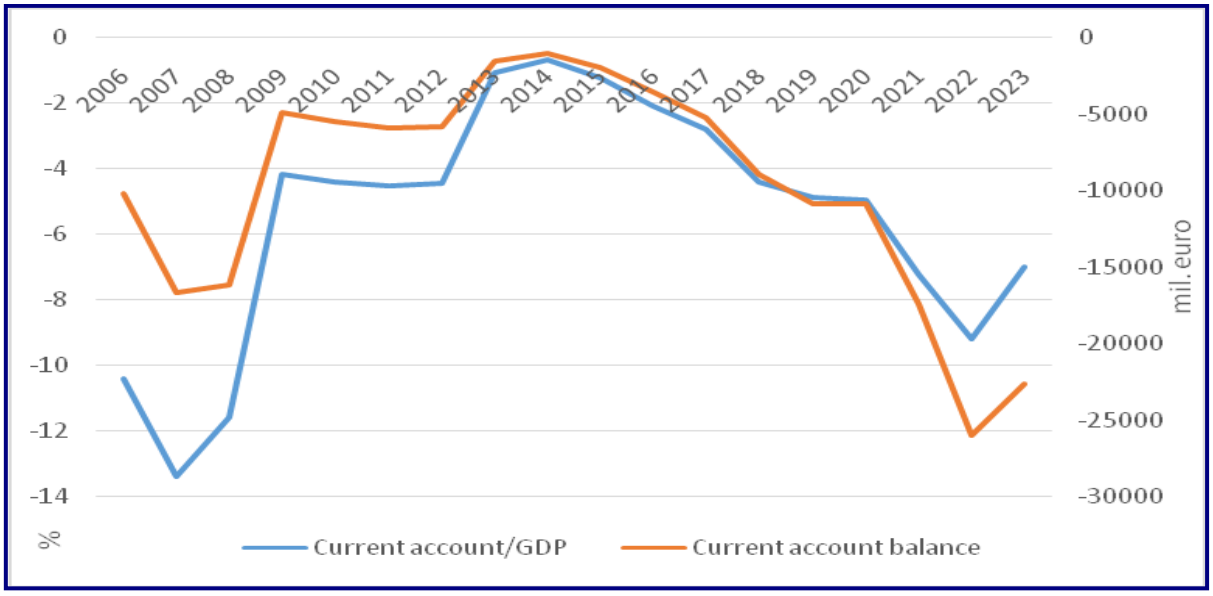

Chart no. 1. The trend of the current account deficit in Romania (%)

Source: author's calculations based on NBR data

In Romania, the conventional threshold for sustainability of the current account deficit (5% of GDP) was constantly exceeded during the period 2004-2008, and after 2020, making it necessary to adopt policies in order to ensure the sustainability of the current account deficit in the medium and long term.

During the period 2009-2014, as a result of the reduction in population income and liquidity in the context of increased risk aversion of investors, the share of Romania's current account deficit in GDP decreased considerably (compared to the previous period) (see chart no. 1) (to values below the conventional sustainability threshold accepted internationally). This evolution has been also caused by an exogenous factor, namely the international economic and financial crisis. Starting with 2015, the share of the current account balance in GDP has risen again, as a result of the recovery of the national and international economy, the Romanian economy still having structural deficiencies. In 2020, the share of Romania's current account deficit in GDP reached the conventional sustainability threshold (of 5% of GDP), and in the following years it exceeded it.

The domestic demand unsatisfied at the national level is the main cause of the trend of the current account balance, and it requires the adoption of economic restructuring measures in order to manufacture inside the country some of the necessary goods, which are currently imported.

The financing of the current account deficit

Although it was large according to international standards, Romania's current account deficit was not a cause for concern as long as its financing was ensured through autonomous sources of financing. Thus, after 1990, the current account deficit has been covered mostly by flows non-generating of external debt, the most important of which were the inflows of foreign direct investment. These represented a constant source of financing of Romania's external deficit, but with very different shares. Thus, there were years when they covered almost the entire current account deficit, but there were also years when they financed less than half of our country's foreign deficit.

But, starting with 2009, along with the deterioration of the current account balance, its financing has also worsened in terms of sources and costs. Thus, foreign direct investments and flows recorded in the capital account have diminished their share in financing the external imbalance, and the contribution of debt-generating financing sources (external loans and portfolio investments that represent risk elements for the sustainability of the Romanian economy) have increased, especially in 2020 (when the net balance of foreign direct investments in Romania decreased dramatically, reaching the lowest level after 2013). This evolution has been due both to the effects of the crises (from 2008 and from 2020-2021 - the almost generalized dispaly of investors' aversion to risk, and the decrease in international liquidity, against the background of uncertainty), to regional tensions (armed conflict), and to domestic causes (the exhaustion of privatizable objectives, the existence of insufficient tax facilities or not adapted to investors' requirements, the existence of strategies for drawing strategic investors that do not always lead to the desired effects, poor transport infrastructure, etc.), with effects in the direction of rising borrowing costs.

Although the net balance of direct investments increased between 2015 and 2018 and in 2021, amid the sharp growth of the current account deficit, their share in financing Romania's current account negative balance decreased almost continuously from 2015 to 2023, except for the rise in 2021. Thus, in 2021, the situation improved (as a result of the decrease in investors' risk aversion and of the improvement in foreigners' perception of our country), significantly increasing the share of direct investments compared to the previous year, and decreasing the importance of foreign loans in covering the current account deficit (see chart no. 2).

In 2022, the inflows, respectively the net balance of foreign direct investments, slacken in the context of increasing risk aversion brought about by geopolitical factors that created uncertainty, and led to increased inflation (against a background of increased volatility in the

prices of raw materials and energy resources) and to the worsening of financing terms. Thus, FDI contribution to financing the current account deficit decreased compared to the previous year.

The top five investing countries, in 2022, provided over 60% of the net inflows of direct investments of non-residents in Romania. They were Austria, the Netherlands, Germany, Luxembourg and France. We can see there is a high dependence of Romania on the countries of the European Union, on the economic and political situation of this entity.

In 2023, the net balance of foreign direct investments decreased, as it did their contribution to financing Romania's external deficit.

For many years, Romania has attracted foreign investors due to its fiscal policy, to cheap labor and to low energy prices. As a result, the rise in energy prices in the aftermath of the war in Ukraine, together with the deepening labor shortage, have caused the loss of our country's main advantages over other economies in the region in attracting foreign direct investments.

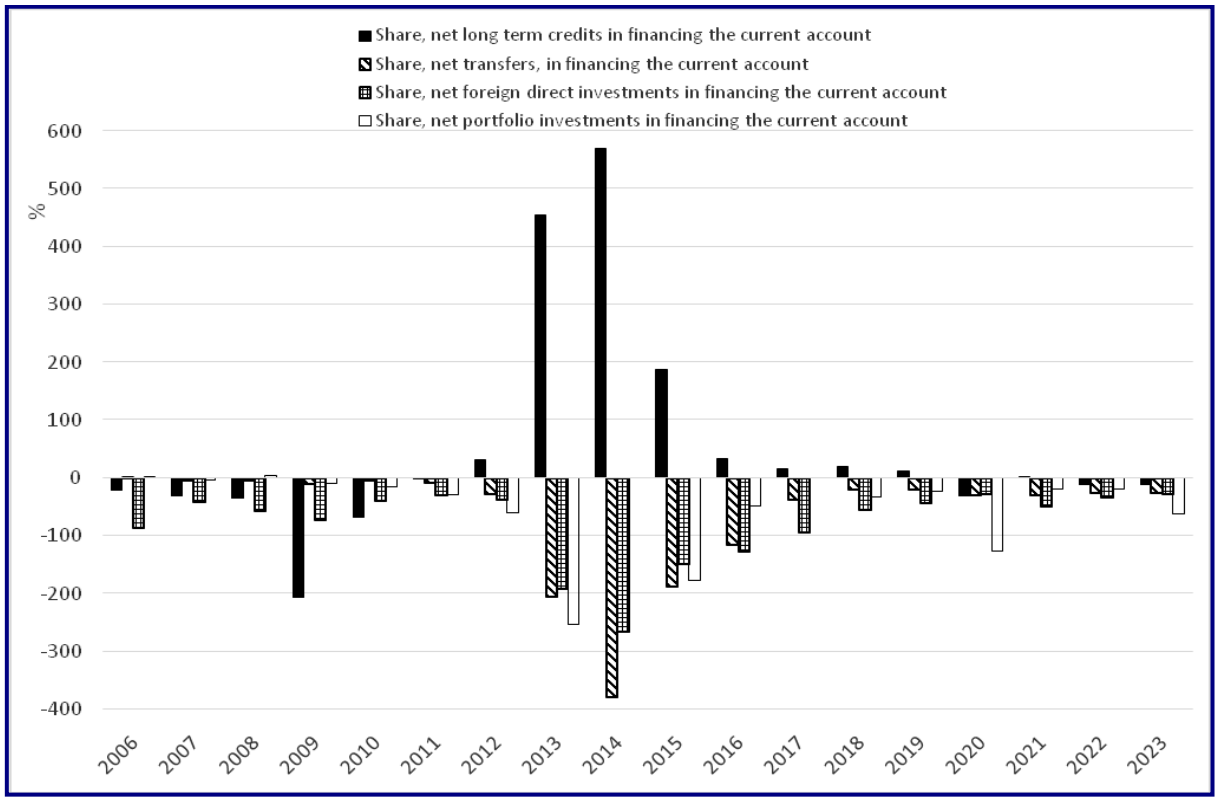

Chart no. 2. Sources of financing the current account deficit in Romania (%)

Source: author's calculations based on NBR data

Nota bene: the negative sign shows the counteraction of the current account deficit, and the positive sign signifies the contribution to the current account negative balance

The main element generating the increase in net inflows of FDI was the rise in equiry and investment fund shares/units until 2016, but their trend is discontinuous decrease starting with 2017. In the context of the improvement of investors' confidence in the economy, after the negative values from 2008-2014, the reinvestment of earnings has been positive and rising in 2016-2022, with a large growth in 2022. In 2023, the reinvestment of earnings has decreased after eight years of continuous increase. Starting with 2019, the reinvestment of

earnings has been higher than equity and investment fund shares/units. Debt instruments had a fluctuating balance from year to year, of lower value compared to equity and investment fund shares/units and to reinvestment of earnings in 2013-2020. But in 2021 and 2022, they became positive and they represent an important element of foreign direct investments. Although the trend of reinvestment of earnings reflects the improvement of the quality of capital inflows since 2015, the evolution of debt instruments shows that there is still a dependency on them in the structure of FDI (see chart no. 3).

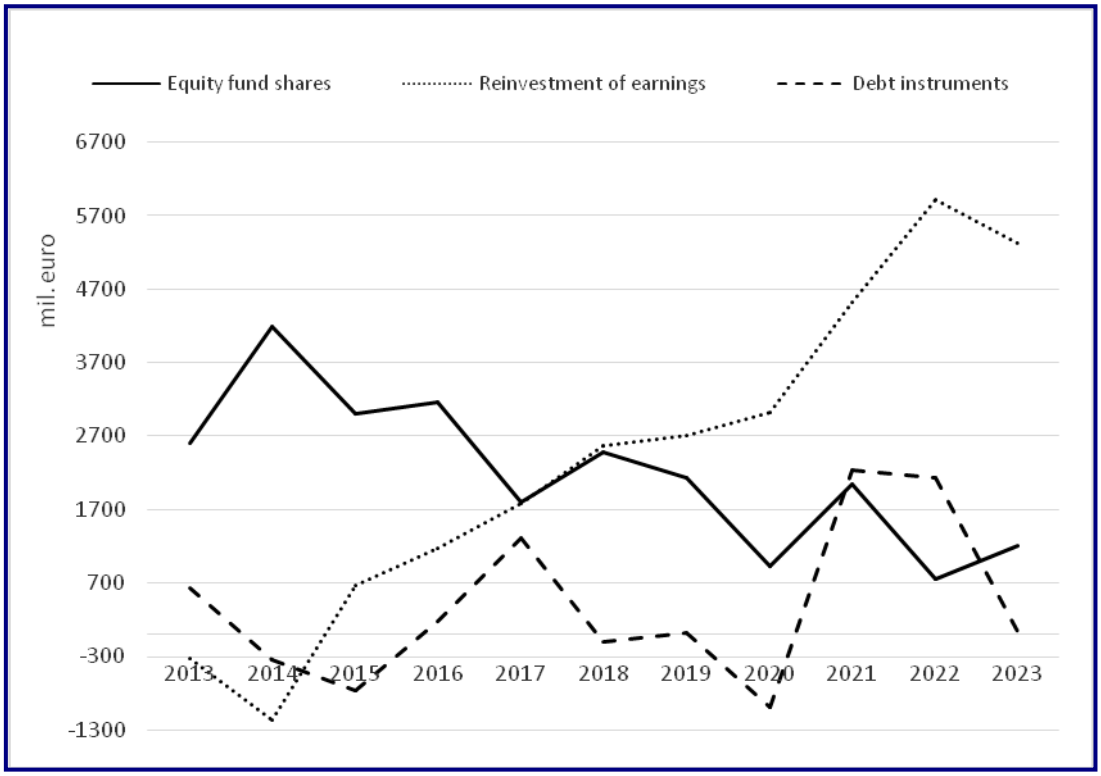

Chart no. 3. The structure of foreign direct investments in Romania

Source: NBR data

The surplus of the ***Capital Transfers*** account represents another autonomous source of financing the current account deficit in Romania during the analyzed period, mainly due to public administration operations, namely the non-reimbursable funds received from the European Union for fixed capital formation: the European Regional Development Fund, the Cohesion Fund, partly the European Agricultural Fund for Rural Development.

The importance of capital transfers in financing the current account deficit fluctuates during the analyzed period. Starting from 2020, Romania benefits of more non-refundable European funds for fixed capital formation, which causes the value of capital transfers to increase slightly (compared to the trend in previous years) in financing the current account deficit (see chart no. 2).

Medium and long-term external loans received increased significantly in 2007, the year of joining the European Union, and in 2009, as a result of the loans received by Romania that year from the International Monetary Fund, the World Bank and the European Union, in the context of the economic and financial crisis. In 2011, the evolution of medium and long-term external loans had a turning point. Thus, from 2011 to 2019 and in 2021, capital outflows

from our country have occured in order to repay the medium and long-term external loans received.

In 2020, amid the uncertainty generated by the evolution of covid-19, but also by the measures adopted by the authorities with the declared aim of limiting the spread of this disease, and, due to the increase in risk aversion of private investors, another turning point has occured in the evolution of the medium and long-term external loans, net, after 2011. Thus, in 2020 Romania has received loans from abroad, for the first time after 2010, a situation that has continued in 2022 and 2023.

It should be borne in mind that ***the increase in the external debt generates risks at the microeconomic level*** (over the Romanian banking sector and the rise in exposure to a possible external shock), but ***also at the macroeconomic level***, from the point of view of the sustainability of the external debt. The increase in external debt can cause problems through the exchange rate channel (the sudden depreciation of the national currency could lead to a significant increase in the cost of external financing), through contagion (due to an economic, political or social shock in the region), through the confidence channel (change in investor sentiment and perception leading to an increase in the risk premium and implicitly in the cost of external financing), or even through an intrinsic shock to the national economy, of a conjunctural or structural nature.

Portfolio investments represent another autonomous source of financing the current account deficit in Romania, with particular importance since 2016 (see chart no. 2).

In 2020, the portfolio investments balance had a significant annual increase (468%), representing the highest rise of this indicator since 1990. Thus, portfolio investments represented the main source of financing the current account deficit in 2020. In the period 2021-2023, the portfolio investments balance has had an increasing trend.

On the one hand, the existence of a diversified portfolio of bondholders (both by type of investor and geographically), reflects long-term confidence in the economic policies and in the development of the Romanian economy.

On the other hand, analysing the composition of portfolio investments in recent years, we find that most of them are long-term debt instruments. So, after 2020, Romania has become heavily indebted to private creditors, which implies an increase in costs, and implicitly in the risks related to the repayment and sustainability of external debt.

Throughout all the period analysed, the current account deficit has been covered in a proportion of over 50% from autonomous sources, namely through direct investments (equity fund shares and reinvested profits), capital transfers and other net inflows of the capital account, the difference being covered through government bonds and external loans.

From chart no. 2, it can be noticed that foreign direct investments, portfolio investments and capital transfers support the financing of the current account deficit. In contrast, between 2011 and 2019 and in 2021, medium and long-term loans received, net, exacerbate the external deficit; in the other years, including 2022 and 2023, external loans also concur to covering the current account deficit.

Considerations on the different types of financing the external deficit

Covering the current account deficit through external loans is a short-term solution. In the long term, this method only means postponing the settlement of the real causes that generated the deficit. In addition, by recording the payment of these credits (interest, fees) in

the debit of the income account (in the current account), the current account deficit is perpetuated in the medium and long term.

Drawing foreign direct investments can support rebalancing the balance of payments through the foreign capital injected into the economy, but also through the inflows of technology. In addition, FDI diminish the pressure on the exchange rate generated by a trade balance in deficit. This method seems to be more suitable for counteracting the external deficit, provided that the interests of foreign investors are not opposite to the interests of our country (foreign investors do not pursue profit without taking into account the legislation in force, good practice; repatriation of profits does not generate shocks on the foreign exchange market, etc.).

Accessing European funds can support the economic growth and the financing of Romania's external deficit, and European resources can support public investments, which would partially mitigate the contractionary impact of budgetary consolidation.

European funds can also be used for infrastructure development. Agriculture and tourism also benefit from special structural funds with which investments can be made to achieve European standards and progressively reduce the pressure of these sectors' deficits on the current account. In addition, there are structural funds with which the workforce can be retrained/specialized, which would make the labor market more attractive domestically for companies and stop the workforce from leaving abroad in search of a job.

Conclusions

The financing of the current account deficit has been achieved, in the analyzed period, mostly from autonomous sources, namely direct investments, capital transfers and other net inflows of the capital account, which is an element that supports the sustainability of the external deficit. The difference has been covered by portfolio investments and external loans. But the almost continuous deterioration of the current account deficit has also been accompanied by a worsening of its financing in terms of the sources structure and costs. Thus, foreign direct investments and capital transfers have diminished their importance in financing the external imbalance, and the share of external loans (starting from 2020) and portfolio investments has increased, which led to the emergence of vulnerabilities and risks in the evolution of Romania's external balance, in terms of the repayment effort and of the sustainability of the accumulated external debt. The Covid-19 crisis has concurred to accentuating this trend, in the context of rising investors' risk aversion.

Also, the weakening of global economic growth in 2022, especially in the context of the war in Ukraine and other geopolitical factors that created uncertainty and led to increased inflation (against a background of high volatility in the prices of raw materials and energy resources) led to the deterioration of financing conditions, as a result of the increase in interest rates and in risk aversion, and to the decrease of foreign direct investment inflows in 2023. In this context, there are premises that the possibilities of attracting foreign direct investments will continue to diminish both internationally as well as domestically and regionally.

Under these conditions, the rise in borrowing costs together with the increasing trend of the external debt and of the total external debt service represent risk elements for the sustainability of the Romanian economy.

The evolution of the structure of foreign direct investments since 2019 (increase in reinvestment of earnings, equity fund shares and decrease in inflows of debt instruments), shows the improvement of the quality of capital inflows since 2015 and of investors'

confidence in the economy, the diminishment of the dependence on debt instruments, and implicitly the improvement of the sustainability of the external balance financing.

Analyzing the origin of foreign direct investment inflows, we can note an increased dependence of Romania on the countries of the European Union, on the economic and political evolution of this entity.

The correlation of the current account deficit with its financing sources should be pursued, in order to stabilize and even increase non-interest financing sources (foreign direct investments and capital transfers).

Text notes

[1] The article is based on the research project **"Romania's external deficit in current domestic and international conditions"**, elaborated in CFMR "Victor Slăvescu" in 2023, under the coordination of Camelia Milea, Ph.D in economics.

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SECTION III. SUSTAINABLE DEVELOPMENT AND INCLUSIVE ECONOMIC GROWTH

SUSTAINABLE DEVELOPMENT GOALS AND FINANCIAL STABILITY IN CEE COUNTRIES

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Abstract:

The Sustainable Development Goals (SDGs), established by the United Nations as part of the 2030 Agenda, represent an ambitious set of targets aimed at addressing global challenges related to poverty, inequality, climate change, environmental degradation, and economic prosperity. In the context of an increasingly interconnected global economy, subject to pressures from climate change and socio-economic crises, financial stability plays a critical role in achieving these objectives. This article aims to explore the relationship between the SDGs and financial stability, arguing that sustainable development is not only a social and environmental challenge but also a fundamental condition for economic growth and the long-term stability of the financial system.

Keywords: *financial stability, sustainable development goals*

JEL classification: Q01, G00

Introduction

The Sustainable Development Goals (SDGs), established by the United Nations as part of the 2030 Agenda, represent an ambitious set of targets aimed at addressing a wide range of global challenges, including poverty, inequality, climate change, environmental degradation, and economic prosperity. These goals are interconnected and require a multifaceted approach, emphasizing the importance of sustainable development across all sectors. In the context of an increasingly globalized economy, financial stability has emerged as a crucial factor in realizing these objectives. The global economy faces mounting pressures from climate change, socio-economic disparities, and systemic risks, all of which have the potential to undermine efforts toward sustainable development.

Expanding access to financial services helps reduce vulnerability to financial shocks and promotes inclusive economic growth, both of which contribute to broader financial stability. Moreover, some macroprudential policies are designed with objectives that align closely with SDG targets, particularly those aimed at fostering financial inclusion and ensuring economic growth. (National Bank of Romania, 2024)

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In Romania, two intermediate objectives of the macroprudential policy are related to credit growth and financial inclusion. Both the SDGs and financial stability frameworks prioritize sustainable and inclusive growth as a means of ensuring resilience against systemic risks. (National Committee for Macroprudential Oversight, 2023)

Nevertheless, challenges such as increased economic inequality, market instabilities, and climate-related disruptions pose significant risks to financial stability, making it crucial for these frameworks to integrate adaptive, forward-looking risk mitigation measures. Governments, financial institutions, regulatory bodies, and international organizations must collaborate to create frameworks that promote financial stability, inclusion, and sustainability. (United Nations)

This article explores the complex relationship between financial stability and the achievement of the SDGs, considering, on the one hand, that sustainable development is not only a pressing social and environmental challenge but also a key factor in ensuring long-term economic growth and the stability of the global financial system, and, on the other hand, that a sound financial system is essential for fostering sustainable development. A central aspect of this relationship is financial inclusion, which is vital for achieving several SDGs, including those related to poverty reduction, inequality, and economic growth. (United Nations)

The remainder of the paper is structured as follows: Section 2 provides a review of the relevant literature. Section 3 describes the methodology and the data sources employed in the analysis. Section 4 presents and discusses empirical results, while Section 5 concludes by summarizing the main findings, policy implications and suggesting directions for further research.

Description of the Problem

In the literature, the subject of interactions between financial stability and development can be assumed to have been first addressed by Schumpeter (1912), who attributed an important role in the development of market economies to innovation, the banking system and the concept of credit. He considered that the presence of uncertainty in the economic environment can represent an opportunity for the banking system, which can finance innovative projects, leading to economic development. Furthermore, Stiglietz (1994) and Westley (2001) believe that access to financing for a larger mass of citizens will increase their productivity and increase their chances of achieving a sustainable lifestyle that ensures the development of society.

From the perspective of sustainable development goals, the focus has been on how they can influence economic growth. Tampakoudis et al. (2017) studied the relationship between economic growth and SDGs in the euro area and concluded that there are significant differences between countries regarding the way the two targets interact, further suggesting that human needs require a concept capable of combining economic development and environmental protection. Coscieme et al. (2020) studied this relationship for EU countries and demonstrated that the risk of not meeting the SDGs was increased by the unconditional GDP growth goal. The study shows that the GDP growth rate is uncorrelated with sustainability indicators and is inversely correlated with economic performance indicators, so one of the study's suggestions was to carefully select policies so as to ensure synergies for achieving sustainable development.

More recently, approaches to this topic have mainly focused on how financial stability interacts with climate change issues (Dafermos et. al (2018) or Caloia and Jansen (2021)).

However, studies such as Ozili and Iorember (2023) or Kirkpatrick and Green (2002) show that financial stability is a necessary condition for ensuring sustainable development goals, because in a stable financial system, financial institutions will tend to finance projects oriented towards sustainable development, which can bring a higher return in the future than the current one, by financing projects that are less close to the SDG goals. The study by Ozili and Iorember (2023) shows that the link between financial stability and the SDG goals can be positive in countries where the banking system has important capital buffers, while the relationship can be negative if fluctuations in the economic and financial cycles, as well as regional characteristics of the SDG indicators, are taken into account.

Methodology and Data

For our study we considered data for five countries in the CEE region, namely Romania, Bulgaria, Czech Republic, Hungary and Poland, with annual frequency over a twenty-year horizon, between 2002 and 2022 (due to data availability). Variable selection is based on existing studies on the interactions between sustainable development goals and financial stability, Ozili and Iorember (2023). In Table 1 are presented the variables used, their definition and the source for each indicator.

Table 1

Variables used in the analysis, definitions, and sources(authors' elaboration)

Variable	Symbol	Definition	Source
SDG:Good health and well-being	SDG 3	The proxy measure of SDG3 is health expenditure as a percentage of GDP.	EUROSTAT
SDG: Quality education	SDG 4	The proxy measure of SDG4 is education expenditure as a percentage of total public sector expenditures.	EUROSTAT
SDG: Affordable and clean energy	SDG 7	The proxy measure of SDG7 is renewable energy consumption as a percentage of total final energy consumption.	EUROSTAT
SDG: Reduced inequalities	SDG 10	The proxy measure of SDG10 is the vulnerable employment ratio. It is measured as vulnerable employment as a percentage of total employment.	WGI [1]
Z-score	Z-SCORE	It captures the probability of default of a country's banking sector. Z-score compares the buffer of a country's commercial banking sector (capitalization and returns) with the volatility of those returns.	GFDI [2]
Bank cost performance	COST	Operating expenses as a percentage of the value of total assets of the banking sector.	GFDI
Domestic credit to the private sector	DCP	Loans provided to the private sector by banks and other financial institutions. It is measured as credit to the private sector as a share of GDP.	GFDI
Real GDP growth	GDPR	Annual change in real GDP	EUROSTAT
Institutional quality index	ISI	The ISI index is the average of the score of the six world governance indicators (WGI) which are the voice and accountability index, the political stability and absence of violence/terrorism index, the government effectiveness index, the regulatory quality index, the rule of law index and the control of corruption index.	WGI

Table 2 presents the mean values of the data used in the analysis. We can observe that the out of four sustainable development indicators, Romania has the best mean scores for two of them, namely SDG 7 and SDG 10. Possible explanations for these results could be in the first case, affordable and clean energy, the large share of energy produced from green sources, namely wind and hydro sources, but continuous investment in modern and efficient production capacities are needed. In the second case, reduced inequalities, although

according to data extracted from WGI database, Romania ranks first among the analyzed states, the issue of inequalities in society remains one of the most pressing problems that decision-makers must address in the medium and long term. On the other hand, for the quality education, expressed as current education expenditure as a percentage of total expenditure in public institutions, Romania has the lowest mean value over the period.

For the financial stability variable, in contrast to Ozili and Iorember (2023), we have used only the Z-score. This indicator was often applied in the literature to capture the level of financial stability in a country, see Lee and Hsieh (2013), or Fiordelisi and Mare (2014).It is obtained as the sum of return on assets ratio (ROA) and equity to asset ratio (CAR), divided by the standard deviation of return on assets. Higher values of the indicator mean a higher level of financial stability. From Table 2, we can observe that Romania and the Czech Republic register scores above 10,5, meaning that in those countries financial stability policies and macroprudential policies could be considered more effective compared to peers.

Regarding the financial sector indicators used in the model, domestic credit to the private sector is the one at which Romania ranks the last among peer countries. Being one of the structural weaknesses of the country, this issue was also addressed by the National Committee of Macroprudential Oversight in one of its reports in 2022.Possible solutions to fix this issue suggested by the report were among others: a higher absorption capacity of EU funds, a faster digitalization process for financial services, an industrial policy that supports access to finance for competitive firms, as well as an increased role of the domestic banking system in financingcompanies. Regarding the banking business efficiency, expressed as operating costs to total assets, Romania has the second highest score in the region after Hungary.

The other variables used in the model, namely ISI and GDPR, should have a positive relation with SDGs according to literature. In the first case, for the indicator representing institutional quality, Romania ranks the second, having an equal score with Hungary, while on the first position is the Czech Republic. Looking at the GDP growth, Poland leads the ranking with a mean value of 3,9%, while Romania is the second country with 3,77%. This could be attributed to the integration of CEE countries in the EU, which meant new opportunities for development and commerce.

Table 2

Mean values of variables used (authors' elaboration)

Country	SDG 3	SDG 4	SDG 7	SDG 10	COST	DCP	GDPR	ISI	Z-SCORE
BG	4,86	10,06	15,13	8,85	2,73	51,41	3,32	0,17	8,61
CZ	7,66	10,79	12,11	13,46	1,9	43,72	2,5	0,91	10,65
HU	5,15	10,76	11,5	8,07	4,28	43,3	2,5	0,67	7,88
PL	4,79	12,37	10,73	18,61	2,92	42,79	3,9	0,15	8,71
RO	4,12	9,5	21,58	29,69	3,58	27,73	3,77	0,67	10,75

Figure 1 - Countries selected for research (authors' own elaboration)

The aim of this paper is to determine whether the financial stability of a particular country, as quantified through the variables detailed previously, is a statistically significant predictor of its sustainable development scores. Starting from some of the four most important SDGs as scoped in the literature review, we standardize them through the standard scaling method by removing the meaning of each SDG variable and scaling it to the unit variance. We apply Principal Component Analysis (PCA) on the scaled SDG variables to then extract the first component, with 48.43% variance captured, and use it as a proxy dependent variable in the model we designed. The independent variables thus remain Z-SCORE, COST, DCP, GDPR and ISI. We use a 2-step Generalized Method of Moments (GMM) from the *linearmodels* library in Python. As an instrumental variable we applied the first principal component's 1-step lag. The choice of model is supported by the fact that these macroeconomic relationships between our variables may be linear in nature but constrained non-linearly (Hansen and Bruce, 2002), as well as having proven greater performance in smaller panel datasets and interpretability by providing more precise estimates than other traditionally-used panel models. (Woolridge, 2001)

Results

The aforementioned methodology was tested across multiple subsets of these variables. We ultimately arrived at the conclusion of Z-SCORE, DCP, GDPR and ISI being statistically significant variables for the prediction of sustainable development indicators, while COST is not at the 5% significance level. Therefore, we decided to remove it, and we arrived at the following end-results:

Table 3

2-Step GMM Results, *linearmodels* System GMM output(authors' elaboration)

Variable	Coefficient	Std. Err.	T-stat	P-value	Lower CI	Upper CI
ZSCORE	0.2087	0.0683	3.0544	0.0023	0.0748	0.3426
DCP	-0.0283	0.0090	-3.1605	0.0016	-0.0458	-0.0107
GDPR	-0.1027	0.0472	-2.1749	0.0296	-0.1952	-0.0101
ISI	-1.1057	0.4354	-2.5397	0.0111	-1.9591	-0.2524

Two of the variables are strongly significant even at the 1% significance level: Z-SCORE as the probability of banking system default, and DCP as domestic credit to the private sector. Still significant but at the lower 5% level we have the real GDP growth (GDPR) and ISI as the average of sixpublic governance indicators.

The final regression equation is thus the following:

$$SDI_{i,t} = 0.2087 \cdot ZSCORE_{i,t} - 0.0283 \cdot DCP_{i,t} - 0.1027 \cdot GDPR_{i,t} - 1.1057 \cdot ISI_{i,t} + \varepsilon_{i,t}$$

Equation 1 - Final 2-Step GMM Equation (authors' own elaboration)

The signs of the predictor coefficients are as expected with regards to Z-SCORE, which validates that financial stability positively contributes to the sustainable development scores of the countries scoped. Our result confirms the crucial role played by a sound banking sector in achieving sustainable development goals. The remaining coefficients are all negative, meaning that for higher values of domestic credit in the private sector, real GDP growth and ISI stability indicators, SDG scores tend to decrease. This suggests a possible inverse relationship between a country's productivity or economic performance and SDG scores' improvement. However, these findings are not in line with intuition, indicating potential limitations of the model, data constraints, or the presence of underlying structural factors influencing the relationship.

The model is validated by the instrument F-statisticwhich, at 43.93> 10,confirms that the lagged instrument is relevant for the model. The statistical test typically used for this model is Hansen's J-test, however due to having a single instrument, equaling the number of endogenous variables, the test becomes meaningless due to just-identification. (Pierce et al, 2011) We additionally test the robustness of the model by re-fitting the final equation using four different GMM weight types reflecting different assumptions about the variance-covariance structure of the underlying data, such as homo/heteroskedasticity, autocorrelation. Different weights have a different weighting matrix used to correct standard errors during the fitting of the model. For our particular case, we test the homoskedasticity-assuming (no heteroskedasticity or autocorrelation), robust (adjusts for heteroskedasticity) and kernel or "HAC" (Heteroskedasticity and Autocorrelation Consistent) matrix estimators.

Table 4

Statistical significance of SDI predictors in GMM, comparison of three covariance estimators (authors' elaboration)

Cov. Estimator Type	ZSCORE (p)	DCP (p)	GDPR (p)	ISI (p)
Homoskedastic	0.0030 (***)	0.0001 (***)	0.0499 (**)	0.8928 (n.s.)
Robust	0.0023 (***)	0.0016 (***)	0.0296 (**)	0.0111 (**)
Kernel	0.0086 (***)	0.0053 (***)	0.0784 (*)	0.0170 (**)

We note that ZSCORE and DCP remain robustly significant at the 1% level across the three covariance estimators, validating the two variables as highly significant predictors for SDG scores in the five countries examined. Real GDP growth becomes marginally significant when estimated with the Kernel weighting matrix suggesting some autocorrelation may be present and skewing this variable for the other estimators if left uncorrected. ISI remains significant at the 5% level when correcting heteroskedasticity and is otherwise markedly insignificant at any level with the homoskedastic estimator.

Our results thus indicate some level of sensitivity to the estimation method used when fitting the model, particularly for the GDPR and ISI variables, however in line with our initial assumptions we validate that financial stability, particularly noted through ZSCORE and DCP in this case, remain significantly robust predictors of SDG-related performance for our set of chosen countries and timeframe observed. The significance of GDPR is lowered when accounting for autocorrelation but remains moderately robust, while ISI remains statistically significant when correcting for heterosekdasticity and potentially autocorrelation.

In order to check the inverse of this relationship between financial stability and SDG scores, we will fit an additional model to support our findings with regards to the potential impact SDG scores would have on the financial stability of the countries analyzed. The model is replicated with the ZSCORE and SDI variables thus switched, resulting in:

Table 5

ZSCORE ~ coefficients, linearmodels System GMM output (authors' elaboration)

Variable	Coefficient	Std. Err.	T-stat	P-value	Lower CI	Upper CI
DCP	0.0087	0.0087	0.9965	0.319	-0.0084	0.0257
GDPR	0.0189	0.0338	0.5579	0.5769	-0.0474	0.0851
SDI	-0.0347	0.1234	-0.2816	0.7783	-0.2765	0.207
ISI	0.2055	0.5529	0.3718	0.7101	-0.878	1.2891

We note that all variables are markedly statistically insignificant , matching our understanding of the way development has been achieved in European countries, with a focus in the time period examined on rapid economic growth and development which is thus typically inversely correlated with SDG-related goal achievement as underlined in the literature review of our study.

2Conclusions

The main conclusion of the paper is that there is a close connection between the Sustainable Development Goals and financial stability. This finding confirms the importance of a sound financial system in fostering long-term economic growth and improving living conditions. In this context, macroprudential policies - a relatively new field in the areas of public policies, aimed at maintaining financial stability as its primary objective - can be effective also in achieving SDGs. Some steps have already been made in terms of selecting intermediate objectives for the macroprudential policies that fall also within the umbrella of SDGs. For instance, in Romania, beyond the five intermediate objectives recommended by the European Systemic Risk Board, the Macroprudential Strategy of the NCMO has two national specific objectives: (i) increasing financial intermediation in a sustainable manner and (ii) increasing financial inclusion. Additionally, in the context of greening the economy, there are ongoing discussions at the European level regarding the potential use of macroprudential tools,such as systemic risk buffers, to address banking sector exposures to climate-related risks.

Achieving the proposed targets requires collaboration at both national and international levels between various authorities and the implementation of a policy mix. Also, from a practical perspective, in order to assess the degree of achievement of the SDGs goals it is useful that Member States select a set of indicators that ensure comparability at the European level.

Future Directions

This analysis can be extended horizontally to other areas of impact in the UN SDG 2030 programme as well as vertically to a more in-depth impact assessment of the financial stability-related SDGs in grassroots-level areas of the economy.

As recommendations for future research' direction starting from this paper, we consider extending the analysis to determine other relevant indicators, as well as testing the second principal component to obtain an even "stronger" subset of statistically significant predictors to SDG scores improvement. A more contextual economic research direction starting from the signs of the predictor coefficients and leading into the relationship between SDG and economic performance would additionally be a powerful addition to the research space surrounding this topic.

Text notes

[1] WGI– Worldwide Governance Indicators.

[2] GFDI – Global Financial Development Database

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MONEY LAUNDERING – WHITE COLLAR CRIMES IN ISRAEL

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Abstract:

In recent years, numerous criminal investigations have involved white-collar workers, including bank managers, insurance company executives, senior government officials, and prominent businessmen. This article presents findings on white-collar crime to evaluate the law enforcement policies required to address this phenomenon in Israel. A focus is placed on the dimension of money laundering to assess whether general deterrence exists for such crimes.

Keywords: *criminal, white-collar crimes, law enforcement*

JEL classification: *K42, H26, G38*

Introduction

The term "white-collar criminality" is defined as an offense exploiting special resources (in jobs, assets, and political influence) to generate illegal profits through camouflage and deception methods while preventing discovery by controlling information sources (Man, 1990). White-collar crimes, including forgery, fraud, and money laundering, have become central to criminal enforcement in Israel. Edwin Sutherland first introduced the term in 1949, emphasizing its distinction from visible crimes like theft and assault (Sutherland, 1949).

White-collar crimes are not merely isolated financial offenses but are deeply interwoven with economic and social dynamics. These crimes exploit systemic vulnerabilities, including gaps in regulatory frameworks, technological advancements, and the complexity of financial systems. The scale and sophistication of such offenses have grown alongside globalization, as international financial networks allow criminals to operate beyond the reach of individual jurisdictions.

In Israel, the challenge of combating white-collar crimes has intensified in recent decades. The country's integration into global markets and its position as a technological leader have made it both a target and a hub for economic offenses, particularly money laundering. High-profile cases, such as the embezzlement at the Bank of Commerce, have drawn public and governmental attention to the critical need for robust preventive and enforcement measures.

White-collar crime's impact extends far beyond immediate financial losses. It undermines public trust in institutions, weakens governance, and disrupts the economic stability of affected sectors. For instance, a single case of fraud in a major company can ripple through supply chains, affecting small businesses and individual livelihoods. Additionally, the perception that white-collar offenders often evade justice contributes to societal cynicism and a diminished sense of fairness in the legal system.

This paper explores these pressing issues, focusing on money laundering as a cornerstone of white-collar criminal activity. By examining the methods, motivations, and legislative responses associated with such crimes, the study aims to provide actionable insights for

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improving Israel's enforcement policies. It highlights the importance of both international collaboration and the adoption of advanced technologies to combat increasingly sophisticated economic offenses. Ultimately, addressing white-collar crime effectively is not only a matter of law enforcement but also of restoring public confidence in the integrity of economic and legal systems.

Description of the Problem and literature review

White-collar crimes are instrumental, requiring planning and resourcefulness. Offenders rationally weigh potential gains against risks. In Israel, courts emphasize deterrence through imprisonment and substantial fines (Mann, 1990). Supreme Court Justice S. Levin noted: "When it comes to tax offenders, economic offenses, fraud offenses... it is important to impose, alongside a prison sentence, a painful and burdensome fine to ensure no offender profits from crime" (Criminal Appeal 23/97).

White-collar crimes have evolved in complexity, incorporating advanced technologies and global networks. For instance, cyber fraud and cross-border money laundering have presented unique challenges for Israeli law enforcement.

White-collar offenders differ from ordinary criminals in education, employment, and socio-demographics. Studies indicate they are typically middle-aged, educated men in stable employment, unlike younger, less-educated ordinary offenders (Weisburd, Bode & Waring, 1982). This distinction impacts their treatment in the legal system and their ability to exploit loopholes.

Money laundering is the process of disguising illicit funds as legitimate through three stages:

- **Placement:** Introducing illegal funds into the financial system (Shapiro, 1990). This can occur through depositing funds in banks, casinos, or other financial institutions.
- **Layering:** Creating complex transactions to obscure origins. Layering often involves multiple accounts, jurisdictions, and entities to separate the money from its criminal origins, making it difficult for law enforcement to trace.
- **Integration:** Reintroducing the laundered funds into legitimate markets, such as real estate, stocks, or legitimate business operations. Once integrated, the funds appear clean and indistinguishable from legally earned income.

The Israeli Prohibition on Money Laundering Law (2000) aligned Israel with international standards, leading to its removal from the FATF blacklist (Zimring & Hawkins, 1973). This law defines the offense, sets reporting obligations for financial institutions, and establishes mechanisms for asset seizure and forfeiture.

Methodology and Data

Money laundering often facilitates continued criminal activities and conceals profits from crimes such as fraud, bribery, and drug trafficking. Methods include:

- **Cash Smuggling:** Transporting large amounts of cash across borders to avoid detection. This method remains popular due to its simplicity.
- **Fictitious Transactions:** Creating fake invoices or business activities to justify fund flows. Shell companies are frequently used for this purpose.
- **Structuring (Smurfing):** Splitting large sums of money into smaller, less conspicuous amounts to avoid triggering reporting thresholds.
- **Digital Currencies:** Increasingly, cryptocurrencies such as Bitcoin are exploited for laundering due to their anonymity and global accessibility.
- **Trade-Based Money Laundering:** Manipulating trade transactions, such as under-invoicing or over-invoicing goods, to move funds internationally.

In Israel, black capital constitutes approximately 15% of GDP, with 2–5% resulting from laundering activities (Robb, 2005). Criminals exploit gaps in regulation and enforcement, particularly in non-bank financial systems and informal money transfer networks.

Data Sources and Analytical Framework

This study relies on a combination of qualitative and quantitative data sources, including:

1. **Official Reports:** Data from the Israeli Tax Authority, Israel Police, and the Ministry of Justice provide insights into reported cases, prosecutions, and convictions.
2. **International Collaboration:** Reports from organizations like the Financial Action Task Force (FATF) and Interpol offer global perspectives on trends and best practices.
3. **Academic Studies:** A review of peer-reviewed literature on money laundering methods, detection, and prevention provides a theoretical framework.
4. **Case Studies:** Analysis of high-profile Israeli cases, such as the Bank of Commerce scandal, highlights systemic vulnerabilities and enforcement challenges.

Despite advancements, significant challenges remain in gathering comprehensive data on money laundering:

- **Underreporting:** Many cases go undetected due to the sophistication of offenders and the lack of complainants.
- **Jurisdictional Issues:** Cross-border laundering complicates data sharing and enforcement.
- **Evolving Techniques:** Rapid technological advancements create gaps in existing detection frameworks, particularly with digital currencies.

By triangulating data from these sources, the study aims to identify patterns and recommend targeted interventions to strengthen enforcement and deterrence mechanisms in Israel.

Results

The *extent of white-collar crime in Israel* can be said as Israeli law enforcement records only record reported and exposed cases, leaving many crimes undetected due to their complexity. Initiatives such as fraud units aim to improve detection and enforcement (Fishman & Dinitz, 1977).

There is a legislative development such as the Antitrust Act (1988) and the Anti-Money Laundering Act (2000) strengthened enforcement. The Law on Combating Criminal Organizations (2002) further targeted organized economic crime (Bezeq, 1981).

Challenges in law enforcement consisted in the fact that, although legislation has improved, enforcement faces challenges, including sophisticated methods of concealment and the absence of complainants in many cases. The expansion of professional investigative units was essential to uncovering these crimes (Cohen, 1991).

To tackle transnational money laundering and white-collar crime, Israel has enhanced cooperation with international law enforcement agencies. Membership in organizations like FATF underscores the importance of global partnerships in combating complex financial crimes (Braithwaite, 1989).

White-collar crimes erode public trust in financial systems and institutions. In Israel, high-profile cases, such as the Bank of Commerce embezzlement, demonstrate how such crimes lead to significant economic instability and weaken public confidence in governance and markets (Shapiro, 1990).

Conclusions

White-collar crimes, particularly money laundering, represent a multifaceted challenge that extends beyond economic harm to social and institutional trust. The complexity and evolving nature of these crimes demand a multi-pronged approach to enforcement, prevention, and public engagement.

Key Findings and Recommendations

1. *Strengthened Legislation*: While Israel has made strides in legislating against money laundering and other white-collar crimes, continuous updates are essential to address emerging methods of financial fraud. Laws must evolve to incorporate digital currencies, cross-border transactions, and advancements in financial technologies.
2. *Enhanced Law Enforcement Capabilities:* Allocating resources to specialized units within law enforcement agencies is critical. These units require training in financial forensics, advanced analytics, and cybercrime detection. Establishing international task forces can help share expertise and reduce jurisdictional hurdles.
3. *Deterrent Punishments:* To effectively deter offenders, penalties must outweigh the potential financial gains from criminal activities. This includes not only prison sentences but also asset confiscation and public accountability measures.
4. *Public Awareness and Education:* Raising public awareness about the societal impacts of white-collar crimes can foster cooperation between the public and law enforcement. Educational campaigns should target vulnerable groups, such as small business owners and employees in financial institutions, to reduce the risk of unwitting complicity.
5. *Corporate Governance:* Strengthening internal compliance mechanisms within corporations is a preventive measure. Regular audits, transparency in operations, and ethical business practices must become standard. Companies should also be incentivized to report suspicious activities through legal protections and rewards.
6. *Technological Integration:* Leveraging artificial intelligence and machine learning tools to analyze financial data can significantly enhance early detection of suspicious activities. Blockchain technology offers potential for transparent tracking of transactions, reducing opportunities for money laundering.

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Future Directions

Adopting advanced technologies such as AI and blockchain analytics can significantly enhance the ability to detect and trace money laundering activities. These tools can analyze large datasets and identify suspicious transactions more efficiently (Weisburd et al., 1982).
Training law enforcement personnel in financial forensics and cybercrime investigation will be crucial to keeping pace with increasingly sophisticated white-collar crimes. Collaboration with academic institutions and international organizations can provide updated methodologies and tools (Braithwaite, 1985).
Raising public awareness about the societal impacts of white-collar crime can encourage whistleblowing and cooperation with law enforcement. Highlighting successful prosecutions may also serve as a deterrent (Cohen, 1991).

Given the cross-border nature of white-collar crimes, Israel should strengthen regional cooperation frameworks with neighboring countries. Joint task forces, shared intelligence, and synchronized legal reforms could bolster collective enforcement capacities (Man, 1990).
Encouraging better corporate governance practices can help prevent white-collar crimes from occurring. Regular audits, stricter compliance protocols, and increased accountability within organizations can deter potential offenders (Shapiro, 1990).
Further research into the economic and social impacts of white-collar crime can inform more effective policies. Integrating insights from criminology, economics, and technology studies could enhance prevention strategies (Fishman & Dinitz, 1977).

Broader Implications

The fight against white-collar crime requires a shift in perception. It is not merely a "victimless crime" but one with tangible consequences for society at large. Public trust in governance and financial systems is eroded when offenders go unpunished, leading to disillusionment and reduced economic stability.
Israel's proactive stance in recent years—through legislative measures, international cooperation, and enhanced enforcement—has laid a foundation for combating these offenses. However, continuous effort is necessary to adapt to the dynamic nature of financial crimes.
By addressing white-collar crime comprehensively, Israel can position itself as a leader in financial integrity, setting an example for other nations. This will require sustained commitment, innovative solutions, and collaborative efforts across governmental and private sectors.

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PROMOTING DECARBONISATION OF THE ENERGY SECTOR FOR A CLIMATE NEUTRAL ECONOMY

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Abstract:

The article starts from the premise that, in the current context, the European Union has assumed the objective of achieving climate neutrality by 2050. Climate change and ambitious global and European CO_2 emission reduction targets require a transition from fossil fuels to renewable sources. In a global context marked by increasing greenhouse gas emissions, the study analyzes various strategies to reduce carbon emissions, including the expansion of renewable energy, energy efficiency and technological innovations. The analysis also explores innovative solutions, such as developing renewable energy sources, improving energy efficiency, and using advanced technologies for carbon storage and use. By adopting a coherent and coordinated approach, we can ensure not only a sustainable energy economy, but also a safer and greener future for future generations.

Keywords: *climate-neutral economy, decarbonisation, renewable energy, energy efficiency.*

JEL classification: *Q56*

Introduction

energy efficiency. In addition, the integration of emerging technologies, such as carbon capture and storage, will play a crucial role in reducing the carbon footprint of the energy sector, while ensuring security of supply and affordability of energy for all consumers. Promoting decarbonisation is therefore not only an environmental necessity but also an economic opportunity.

Achieving decarbonisation through EU objectives for a climate - neutral economy

The European Union (EU) is at the forefront of global efforts to combat climate change. By adopting the *European Green Deal* and an ambitious set of targets, the EU has committed to transitioning to a climate-neutral economy by 2050. This requires a profound transformation of all economic sectors, including energy, transport, industry, agriculture and buildings, through the implementation of sustainable and innovative measures.

To achieve climate neutrality, the European Union aims to reduce greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. It will also accelerate the uptake of green technologies such as renewable energy, green hydrogen, carbon capture and the digitalisation of economic processes. These initiatives are supported by financial and social

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strategies designed to ensure a fair and sustainable transition for all regions and social groups. (Table 1)

Table 1:

European Union objectives for a climate - neutral economy

No.	Objective	Details
1	Climate neutrality by 2050	Reducing net greenhouse gas (GHG) emissions to zero by 2050 (as set out in the *European Climate Law*).
2	Reducing GHG emissions by at least 55% by 2030	Compared to 1990 levels, it is an intermediate objective to facilitate the achievement of climate neutrality.
3	Promoting renewable energy sources	Increasing the share of renewable energy to at least 42.5% of total energy consumption by 2030.
4	Increasing energy efficiency	Reducing energy consumption by at least 11.7% by 2030. Includes initiatives to renovate buildings and make industry more efficient.
5	Developing the circular economy	Reducing waste, increasing recycling and reducing dependence on finite resources. Implementing the circular economy action plan.
6	Sustainable transport	Reducing transport emissions by 90% by 2050. Promoting electric vehicles, public transport and sustainable mobility.
7	Biodiversity protection	Restoring degraded ecosystems, expanding protected areas to 30% of EU territory and reducing the use of pesticides.
8	Financial support for the green transition	Mobilizing 1 trillion Euros through the *Just Transition Mechanism* and creating the *Social Climate Fund*.
9	Development of green technologies	Investments in research and innovation for carbon capture, green hydrogen production and digital solutions.
10	The EU's global role	Strengthening the EU's position as a global leader in the fight against climate change. Supporting other countries in the green transition through financing and international cooperation.

Source: data processing authors

To accelerate the decarbonisation process, the European Union supports the adoption of advanced technologies and clean energy sources, such as solar, wind, hydroelectric and green hydrogen. Key technologies include carbon capture, utilisation and storage, the development of batteries for energy storage and the implementation of smart grids. There is also a particular focus on reducing energy consumption by improving energy efficiency in buildings and industry, as well as on promoting the circular economy, which helps to reduce dependence on finite resources.

Table 2:

Key technologies for decarbonising the economy

No.	Technology	Details
1	Renewable energy	Solar, wind, hydroelectric and biomass energy. Includes the use of photovoltaic panels, wind turbines and the conversion of organic waste into energy.
2	Green hydrogen	Production by electrolysis with renewable energy. Used in industry, transportation and energy storage.

No.	Technology	Details
3	Carbon capture, use and storage	Technologies for capturing CO_2 from the air or industry, using it in products or storing it in geological storage for the long term.
4	Electrolysis and energy storage	Development of electrolyzes, advanced batteries (lithium-ion, sodium) and pumped storage systems.
5	Energy efficiency technologies	Advanced insulating materials, heat pumps, LED lighting and intelligent systems for optimizing consumption.
6	Electric mobility and alternative fuels	Electric vehicles, synthetic fuels and advanced bio fuels for road, sea and air transport.
7	Digitalization and artificial intelligence (AI)	Smart power grids, AI for process optimization and climate modelling.
8	Regenerative agriculture and nature-based solutions	Soil carbon storage practices, reforestation and wetland protection.
9	Advanced nuclear reactors	Safe and efficient Generation IV reactors and small modular reactors (SMRs) for power and hydrogen production.
10	Advanced materials and sustainable construction	Ecological cement recycled steel, use of laminated wood and other materials with a low carbon footprint.

Source: data processing authors

The European Union's green transition is not only focused on reducing emissions, but also on protecting biodiversity and natural resources. Initiatives such as restoring damaged ecosystems, reforestation and regenerative agriculture contribute to capturing carbon from the atmosphere and increasing resilience to climate change. The EU is also promoting the development of digital solutions and artificial intelligence-based technologies to improve resource management and reduce energy losses. To ensure a fair and inclusive transition, the EU is investing considerable resources through the *Just Transition Mechanism*, targeting the economic regions most affected by this green transition. In addition, the *Social Climate Fund* provides support to vulnerable households to help them cope with the costs of decarbonisation.

Through these comprehensive measures, the European Union reaffirms its position as a global leader in the fight against climate change and in promoting a sustainable economy. Its objectives are not limited to reducing carbon emissions alone, but contribute to creating a more resilient, innovative and competitive economy, capable of meeting future challenges. In this way, the EU serves as an example for other regions of the world to follow, demonstrating that the transition to climate neutrality can be both an ecological necessity and an economic and social opportunity.

In conclusion, the European Union's decarbonisation objectives are not just a response to the climate crisis, but also a long-term sustainable development strategy, capable of transforming the European economy into a global example of sustainability. These initiatives will have a considerable impact on the global economy, demonstrating that environmental protection and economic growth are not contradictory goals, but, on the contrary, can support each other to create a greener, healthier and more prosperous world.

Supporting the decarbonisation of the energy sector towards climate neutrality

Decarbonising the energy sector is crucial to achieving climate neutrality, as it is one of the largest sources of greenhouse gas (GHG) emissions. Renewable energy and energy efficiency are essential components of the green transition and together they form the foundation of emission reduction strategies in the energy sector. These two areas not only help to reduce carbon emissions, but also support the development of a more sustainable and resilient energy system.

A. Development of renewable energy sources

Renewable energy plays a central role in the decarbonisation of the energy sector, replacing traditional fossil energy sources, which are the main sources of CO_2 emissions. (Table 3)

Table 3

Renewable energy sources

Renewable energy source	Description	Advantages	Challenges
Solar energy	It uses solar radiation to produce electricity through photovoltaic panels or solar thermal power plants.	Decreasing production costs, inexhaustible sources, and high scalability.	Depending on weather conditions, it requires large space for installation.
Wind energy	It uses wind turbines to convert wind energy into electricity.	Abundant sources in areas with strong winds, low operating costs.	Intermittent (wind variability), visual and sound impact.
Hydropower	It uses flowing water to drive hydroelectric turbines, in large or micro-hydropower plants.	High efficiency, energy storage capacity (through dams), stable source.	Ecological impact on ecosystems, high construction costs.
Biomass	Organic matter (wood, agricultural waste) is burned or transformed into biofuels (bioethanol, biodiesel).	Abundant sources, waste can be used, contribute to waste reduction.	CO_2 emissions, competition with food production (in the case of energy crops).
Biogas	Methane gas obtained through anaerobic decomposition of organic waste (food, agricultural waste).	Reduces dependence on landfills, continuous source of energy, helps reduce methane emissions.	Requires processing facilities, emissions from processing facilities.
Geothermal energy	It uses the heat from inside the earth to produce electricity or for heating.	Constant energy sources, high efficiency in active geothermal regions.	Location dependent, large investments in infrastructure.
Marine energy (tides and waves)	It uses water movements (waves, tides) to generate electricity.	High potential in coastal areas, predictable energy sources.	High implementation costs, limited to specific maritime areas.
Green hydrogen	Hydrogen produced by electrolysis using renewable energy (solar, wind).	Zero carbon emissions, versatility in use, efficient energy storage.	High production costs, requires specialized infrastructure for storage and transportation.

Source: data processing authors

B. Improving energy efficiency

Energy efficiency is an essential element in the decarbonisation of the energy sector. By optimizing efficiency, energy needs are reduced, which leads to a decrease in greenhouse gas emissions and promotes a more responsible use of resources. Measures aimed at improving energy efficiency include:

Table 4

Solutions for optimizing energy consumption

Domain	Energy efficiency improvement measure	Description	Advantages	Challenges
Buildings	Thermal insulation	Improving building insulation to reduce heat loss and optimize energy consumption.	Reducing energy consumption for heating and cooling, long-term savings.	High initial costs require renovations and modernization of infrastructure.
Buildings	Efficient hardware (quality hardware, double-glazed windows)	Use of efficient materials (double/triple glazing, insulated doors) to prevent heat loss.	Reduced heating and cooling costs, increased comfort in buildings.	They require initial investment, but bring long-term savings.
Industry	Heat recovery technologies	Using technologies that recover waste heat from industrial processes and redirect it for later use.	Reducing energy consumption, significant savings in the industry.	It requires investment in recovery equipment and technologies.
Industry	Process automation and intelligent energy management	Implementation of control and monitoring systems to optimize energy use in industrial processes.	Reduction of energy losses, increased efficiency in production.	Implementation may require a complex process of integrating new technologies.
Transports	Electric vehicles	Replacing traditional vehicles with fossil fuel engines with electric vehicles that are much more energy efficient.	Reduction of CO_2 emissions and operating costs, higher energy efficiency.	Need for charging infrastructure, higher initial costs for vehicles.
Transports	Promoting public transport and alternative mobility (bicycles, electric scooters)	Reducing the number of individual vehicles by stimulating public transport and other forms of sustainable mobility.	Reducing energy consumption and carbon emissions, decongesting traffic.	The need for infrastructure investments and changing citizen behavior.
Energy	Smart grids	Technologies that enable efficient distribution of electricity, with dynamic monitoring and management of consumption and production.	Reducing energy losses, optimizing consumption, integrating renewable sources.	High implementation and maintenance costs, requires advanced infrastructure.
Energy	Energy storage	Using energy storage	It allows the use of	High storage costs,

Domain	Energy efficiency improvement measure	Description	Advantages	Challenges
	(batteries, green hydrogen)	technologies, such as batteries or green hydrogen, to manage fluctuations between supply and demand.	renewable energy in a more efficient way, reducing dependence on fossil fuels.	technical and economic challenges in implementation.
Agriculture	Efficient irrigation techniques	Using drip irrigation systems or smart technologies to reduce water and energy consumption in agriculture.	Reducing water and energy consumption, significant savings for farmers.	Higher initial costs for implementing irrigation technologies.
Buildings and industry	Efficient lighting systems (LED, smart lighting)	Replacing traditional light bulbs with LEDs and implementing a smart lighting system that adjusts light intensity according to needs.	Reduced electricity consumption, reduced operating costs.	Requires initial investment in equipment and infrastructure.

Source: data processing authors

Optimizing energy efficiency is a fundamental strategy in the transition to a sustainable economy. The measures listed in the table are just some of the solutions that can help reduce energy consumption and carbon emissions. However, implementing these measures requires initial investment and ongoing commitment from all economic sectors, and the long-term benefits can justify these costs.

C. Integrating renewable energy sources with energy efficiency

To ensure an effective transition to a low-carbon economy, it is essential to integrate renewable energy sources with energy efficiency measures. (Table 5)

Table 5:

Synergy between renewable energy sources and energy efficiency

Renewable energy sources	Technologies/Strategies for integration	Benefits of integration
Solar energy	Photovoltaic panels + energy storage systems	Reducing dependence on the electrical grid, integrating with energy management systems for maximum efficiency.
Wind energy	Wind turbines + smart grids	It allows for more efficient distribution of produced energy, reduction of losses and integration into existing electrical networks.
Hydropower	Micro hydropower plants + optimized hydropower efficiency	Efficient use of water for energy production, reduction of losses in energy transportation and distribution.
Biomass	Advanced bio fuel technologies + cogeneration plants	Increasing energy efficiency by using organic waste for simultaneous energy and heat production.

Renewable energy sources	Technologies/Strategies for integration	Benefits of integration
Biogas	Biogas plants + heat recovery systems	Recovering organic waste, reducing methane emissions and improving energy efficiency through the use of heat.
Geothermal energy	Geothermal heating systems + efficient geothermal power plants	Using thermal energy for heating or electricity production in an efficient and sustainable way.
Marine energy (tides, waves)	Tidal power plants + wave capture technologies + energy optimization	Using water movements to produce energy in an efficient way, reducing carbon emissions.
Green Hydrogen	Renewable energy powered electrolysers + energy storage	Storing renewable energy in the form of hydrogen, reducing energy losses and integrating it into various sectors.

Source: data processing authors

Integrating renewable energy sources with energy efficiency measures is a key step in the transition to a more sustainable energy system. These technologies not only contribute to reducing carbon emissions, but also to increasing energy efficiency by optimizing energy consumption and storage. Existing challenges, such as the variability of energy sources and the need for adequate infrastructure, can be overcome through technological innovations and investments in the development of efficient integration solutions.

Conclusions

Reducing carbon emissions in the energy sector is closely linked to the integration of renewable energy sources. These sources represent a sustainable alternative to fossil fuels, having a significant impact on reducing CO_2 emissions. In addition to promoting renewable energy sources, optimizing energy efficiency in the industrial, transport and building sectors is essential for reducing total energy consumption and emissions.

The adoption of advanced energy storage technologies will support the integration of intermittent renewable into the electricity grid and ensure efficient energy storage. These solutions are crucial to addressing the challenges posed by the variability and intermittency of renewable energy sources.

Developing renewable energy sources and increasing energy efficiency are crucial for decarbonising the energy sector and achieving climate neutrality. These two approaches are closely linked and require a strong commitment from governments, the private sector and citizens to facilitate the transition to a sustainable and emission-free energy system. By integrating renewable energy sources into the energy mix and maximizing the efficiency of this energy use, we can significantly reduce our environmental impact and ensure a greener future for future generations.

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THE ETHICAL AND SOCIAL IMPLICATIONS OF ARTIFICIAL INTELLIGENCE IN FINANCIAL INCLUSION

Tudor CIUMARA [29]

Abstract:

Artificial Intelligence (AI) is transforming the financial sector by enhancing risk assessment, automating decision-making, and expanding access to financial services. While AI holds promise for improving financial inclusion, it also raises significant ethical and social challenges. Based on a theoretical approach, this paper examines key concerns such as algorithmic bias, data privacy risks, lack of transparency, digital inequalities, and job displacement, which can inadvertently reinforce financial exclusion rather than reduce it. Additionally, it explores potential solutions, including regulatory frameworks, explainable AI (XAI), enhanced data protection, digital literacy programs, and workforce reskilling initiatives. Responsible AI implementation, guided by regulatory oversight and ethical design principles, can foster an inclusive and sustainable financial ecosystem. The study highlights the need for stronger regulations, public-private partnerships, and international cooperation to ensure that AI-driven financial services benefit all socio-economic groups equitably.

Keywords: *financial inclusion, AI ethics, algorithmic bias, data privacy, AI transparency*

JEL classification: *Q33, G28, D63*

1. Introduction

The financial sector has embraced Artificial Intelligence (AI) as a transformative tool, streamlining operations, enhancing customer experiences, and optimizing decision-making processes. AI-driven technologies, such as automated credit scoring and fraud detection, are reshaping financial services, yet their reliance on historical data risks may perpetuate systemic discrimination. By leveraging alternative data sources and advanced analytics, AI has the potential to provide financial services to underserved populations, including those without formal credit histories or access to traditional banking.

Despite its benefits, the implementation of AI in the financial sector raises critical ethical and regulatory concerns. One of the main challenges discussed in the literature is algorithmic transparency (Batchu, 2023). Algorithmic bias in credit decision-making, lack of transparency in AI-driven financial processes, and data privacy risks also pose challenges to fairness and accountability. Giudici et al. (2024) emphasize that the risks generated by AI in the financial sector include both operational and ethical risks, primarily due to the opacity of algorithms and the use of sensitive data. Additionally, digital inequalities and financial illiteracy create barriers for marginalized communities, limiting their ability to benefit from AI-powered financial services. The automation of financial processes, while increasing companies efficiency, also contributes to job displacement, particularly in economies where traditional financial sector jobs are a major source of employment.

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This paper explores the current key ethical and social challenges associated with AI in financial inclusion, examining their causes, implications, and potential solutions. It highlights the need for robust regulatory frameworks, responsible AI development, and targeted policy interventions to mitigate the risks of bias, ensure data protection, and promote transparency in automated decision-making. Furthermore, the study emphasizes the importance of financial and digital literacy initiatives, workforce reskilling programs, and investments in digital infrastructure to bridge the existing gaps in AI-driven financial ecosystems. While prior work has examined the role of AI in financial sector transformation (Ciumara, 2024), this study shifts the focus toward the ethical and social risks associated with AI-driven financial services and explores policy solutions for mitigating them.

Collaboration between financial institutions, regulators, and AI developers is important to mitigating algorithmic bias and ensuring responsible AI adoption in financial services. Addressing these challenges proactively will ensure that AI serves as a catalyst for financial equity, rather than reinforcing existing disparities in access to financial services.

This paper is structured as follows: the next section outlines the methodology employed in this research, followed by an exploration of the ethical dimensions of AI in the financial sector, and an analysis of the social challenges, particularly regarding financial inclusion. The final sections present strategic solutions and future directions for responsible AI implementation.

2. Methodology

This study employs a theoretical and conceptual approach to explore the ethical and social implications of AI in the financial sector. The research is grounded in a review of existing literature, drawing from academic publications, regulatory frameworks, and case studies related to AI ethics, financial inclusion, and technological governance.

The paper is structured around two primary dimensions: the ethical challenges associated with AI in financial decision-making processes (such as algorithmic bias, data privacy risks, and lack of transparency), and the social challenges (including digital inequalities, financial literacy gaps, and job displacement). By synthesizing findings from recent studies and industry reports, the analysis identifies key risks and proposes strategic solutions to maximize the benefits of AI while minimizing potential harms.

Additionally, the study incorporates comparative insights from different regulatory environments, such as the General Data Protection Regulation (GDPR) in the European Union, and emerging governance frameworks like the EU AI Act. This comparative lens allows for a broader understanding of how AI-driven financial services can be implemented responsibly across diverse socio-economic contexts.

3. Ethical dimensions of AI in finance

3.1 Algorithmic bias

Artificial Intelligence has the potential to enhance financial inclusion by automating decision-making processes. However, it also carries the risk of reinforcing existing inequalities through algorithmic bias. This bias arises when AI models are trained on historical financial data that reflect past socio-economic disparities. As a result, credit-scoring algorithms may

systematically disadvantage certain groups, such as women, rural populations, or individuals without formal credit histories, thereby perpetuating financial exclusion rather than reducing it. Research has shown that predictive models used in financial decision-making can reinforce systemic biases present in historical data, disproportionately affecting disadvantaged groups (Berk & Bleich, 2013)

A major cause of algorithmic bias is the lack of representativeness in training datasets. Many AI models are developed using data primarily from urban or high-income populations, leading to inaccurate predictions for underrepresented groups. Additionally, the opacity of AI decision-making—often referred to as the "black box" problem—makes it difficult to identify and correct biased outcomes. This lack of transparency reduces accountability and limits affected individuals' ability to challenge unfair decisions, especially in critical financial processes such as loan approvals and interest rate calculations.

To mitigate algorithmic bias, financial institutions should regularly audit AI models, ensuring that biases are detected and corrected before they impact users. Additionally, training datasets should be diversified to reflect a broader range of socio-economic backgrounds. Involving interdisciplinary teams, including ethicists and social scientists, in AI development can further enhance fairness and accountability. Lastly, increasing the use of explainable AI (XAI) can help create more transparent decision-making processes, fostering trust and enabling corrective measures when biases are identified.

3.2 Data privacy and cybersecurity

The increasing reliance on AI in financial services requires vast amounts of personal and financial data, raising significant privacy and cybersecurity concerns. AI-driven financial platforms process sensitive information such as credit histories, transaction patterns, and personal identifiers, making them attractive targets for cyber threats. Additionally, in many emerging economies, weak data protection frameworks increase the risk of unauthorized access, fraud, and misuse of financial data.

One of the primary challenges is the lack of robust regulatory frameworks to ensure data security and user privacy. While regulations such as the General Data Protection Regulation (GDPR) in the European Union provide rather strong safeguards, many countries still lack comprehensive data protection laws, leaving financial consumers vulnerable. Moreover, AI models require continuous data collection to improve their accuracy, often leading to opaque data usage policies that make it difficult for users to control how their personal information is utilized.

To address these risks, financial institutions are faced with the need to implement strong encryption techniques to protect user data and adopt clear consent mechanisms that allow individuals to manage their data more effectively. Additionally, policymakers should strengthen regulatory oversight, ensuring AI-driven financial platforms comply with privacy standards similar to GDPR. Transparency in data collection and usage, combined with enhanced cybersecurity measures, is needed in the process of building trust in AI-powered financial services while safeguarding user privacy.

AI-driven fraud detection systems have become a critical component of modern financial security, helping institutions identify suspicious transactions and prevent illicit activities. However, these systems are not infallible and can sometimes incorrectly flag legitimate transactions as fraudulent, leading to unnecessary disruptions for users. Such false positives disproportionately affect individuals with unconventional spending patterns, small business owners, or those from underrepresented financial backgrounds, whose transactions may not align with the historical data used to train AI models. In extreme cases, repeated misclassification can result in account freezes, declined transactions, or even financial exclusion for affected users. Additionally, the lack of transparency in fraud detection

algorithms makes it difficult for customers to challenge or rectify incorrect classifications, further eroding trust in AI-powered financial services. To mitigate these risks, financial institutions should enhance AI model accuracy, incorporate explainable AI techniques, and establish clear appeal mechanisms that allow users to contest unjustified fraud-related actions efficiently.

3.3 Transparency of automated decisions

Artificial Intelligence has transformed financial decision-making, but the lack of transparency in many AI-driven systems poses significant ethical and regulatory challenges. Many financial institutions rely on complex algorithms that function as "black boxes," meaning that even their developers may struggle to explain how specific decisions—such as loan approvals or interest rate calculations—are made. This opacity reduces trust in AI-driven financial services and limits users' ability to contest unfair outcomes. The opacity of AI-driven financial systems has been widely criticized, as users and even developers often struggle to understand how specific decisions—such as loan approvals—are reached. This lack of explainability has been referred to as the 'black box problem' and raises concerns about accountability in automated financial services (Pasquale, 2015).

A key issue is that AI models base their predictions on vast datasets and intricate statistical correlations, rather than explicit, easily interpretable rules. As a result, individuals denied financial services may receive no clear explanation for why their applications were rejected or how they can improve their eligibility. This lack of accountability is particularly concerning in financial inclusion efforts, where vulnerable populations may face barriers to accessing credit without a clear justification.

To improve transparency, financial institutions need to develop and implement XAI techniques that make AI-driven decisions more understandable. Additionally, clear mechanisms for disputing automated decisions should be established, allowing users to challenge and correct potential errors. Regulatory bodies should also enforce industry-wide transparency standards, ensuring that AI remains a fair and accountable tool for financial decision-making. Regulatory frameworks such as the EU AI Act and GDPR emphasize the need for AI transparency, particularly in high-risk applications such as financial decision-making. However, widespread adoption of XAI remains limited. In their work, Dupont et al. (2020) also emphasize the need for adaptive governance of artificial intelligence in finance that keeps pace with the rapid rate of technological innovation. The authors highlight that such an approach can support the development of safe and equitable AI applications, while simultaneously reducing the operational and reputational risks associated with the improper use of these technologies.

4. Social challenges of AI in financial inclusion

4.1 Digital inequalities

Despite the potential of AI to enhance financial inclusion, digital inequalities remain a major barrier to equitable access. Many individuals, particularly in rural areas and low-income communities, lack the necessary digital infrastructure—such as internet access, smartphones, or financial literacy—to engage with AI-driven financial services. This digital divide exacerbates existing socio-economic disparities, leaving marginalized populations without access to essential banking, credit, and investment opportunities. Research has shown that individuals in rural and low-income areas are significantly disadvantaged in terms of access to high-speed internet and digital devices, limiting their ability to engage with

financial technologies. These disparities contribute to a widening digital divide, affecting economic opportunities and financial inclusion (Robinson et al., 2015).

One of the primary challenges is the unequal distribution of digital infrastructure, with many developing regions still lacking reliable internet connectivity or affordable digital devices. Additionally, financial services designed for tech-savvy users may be inaccessible to those with limited digital literacy, further restricting their ability to benefit from AI-powered solutions. Without targeted efforts to address these gaps, AI-driven financial systems risk excluding the very populations they aim to serve.

To bridge digital inequalities, governments and financial institutions must invest in expanding internet and mobile banking infrastructure, particularly in underserved regions. Additionally, simplified digital financial platforms should be developed to accommodate users with low technological proficiency. Promoting financial and digital literacy programs can further empower individuals, ensuring they can fully participate in AI-driven financial ecosystems and benefit from emerging technological advancements. In addition to expanding digital infrastructure, governments should implement subsidized internet programs or public Wi-Fi initiatives to ensure affordability for low-income populations

4.2 Financial and digital literacy

The effective use of AI-driven financial services depends not only on access to technology but also on financial and digital literacy. Many individuals, particularly in developing economies, lack the necessary knowledge to navigate digital banking platforms, assess financial risks, or protect themselves from fraud. Without adequate literacy, even those with access to financial technology may struggle to use it effectively, leading to low adoption rates and increased vulnerability to financial exclusion.

We find that a key challenge is that financial education is often not integrated into formal education systems, leaving many individuals unprepared to manage digital financial tools. Additionally, the complexity of AI-driven financial platforms can certainly intimidate first-time users, discouraging them from engaging with services that could otherwise improve their financial well-being. In cases where literacy gaps exist, users may also become more susceptible to fraud and misinformation, further exacerbating financial insecurity.

To address these challenges, governments and financial institutions need to invest in nationwide financial and digital literacy campaigns, ensuring individuals understand how to safely and effectively use AI-powered financial services. Incorporating financial education into school curricula can also provide long-term benefits by equipping future generations with essential financial skills. Moreover, designing user-friendly, accessible financial platforms can help bridge the literacy gap, making AI-driven services more inclusive and effective for all.

4.3 Job displacement

The increasing automation of financial processes through AI is transforming the industry, but it also raises concerns about job displacement. As AI systems take over repetitive and data-driven tasks—such as risk assessment, customer support, and fraud detection—many traditional roles in banking and finance are at risk of becoming obsolete. This shift is particularly concerning in developing economies, where a significant portion of the workforce relies on jobs that AI-driven automation could replace. Studies have found that automation is likely to disproportionately affect routine-based jobs, with financial sector employees at risk of

displacement due to increasing reliance on AI-driven processes (Arntz, Gregory, & Zierahn, 2016).

While AI can create new opportunities in fintech and data analytics, the transition period poses major challenges for workers lacking the necessary digital skills. Without proactive reskilling efforts, many employees may find themselves unprepared for an AI-driven job market, exacerbating economic inequalities. Additionally, financial institutions may prioritize cost savings through automation without adequate workforce transition strategies, further widening the employment gap.

To mitigate these risks, financial institutions and policymakers need to implement reskilling and upskilling programs, equipping workers with the necessary skills to adapt to AI-driven roles. Public policies should also support job transition initiatives, ensuring that those affected by automation have access to alternative employment opportunities. By proactively addressing job displacement, AI can serve as a tool for economic growth rather than a driver of inequality in the financial sector. While AI automates repetitive tasks, it also creates new opportunities in fintech innovation, AI governance, and data analysis. Workforce transition policies should not only focus on reskilling but also on enabling workers to transition into emerging AI-driven roles.

5. Discussion and strategic solutions

To maximize the benefits of AI in financial inclusion while mitigating its ethical and social risks, a coordinated, multi-stakeholder approach is necessary. Governments, financial institutions, and technology developers should work together to create policies and frameworks that ensure AI-driven financial services are fair, transparent, and inclusive.

One key strategy is the implementation of adapted regulations, including ethical guidelines, bias auditing protocols, and stronger data protection laws. Ensuring compliance with global standards, such as the GDPR, can help safeguard user privacy while promoting responsible AI use. Additionally, fostering public-private partnerships can drive investments in digital infrastructure, financial literacy programs, and AI transparency initiatives, particularly in underserved regions.

Financial institutions also need to prioritize responsible innovation, integrating XAI and alternative data sources to improve decision-making without reinforcing existing biases. Furthermore, international cooperation is crucial to share best practices, mobilize funding, and support emerging economies in developing AI-driven financial ecosystems that promote equitable access.

By combining regulatory oversight, technological innovation, and cross-sector collaboration, AI can become a powerful tool for reducing financial inequalities. Addressing its risks proactively will ensure that AI-driven financial services contribute to sustainable and inclusive economic growth, benefiting individuals across all socio-economic backgrounds. International organizations such as the World Bank and IMF have emphasized AI ethics in financial inclusion. Global cooperation is needed to develop shared AI governance frameworks that protect vulnerable populations.

6. Conclusions

Artificial Intelligence has the potential to further revolutionize financial inclusion by making financial services more accessible, efficient, and personalized. However, its adoption comes with significant ethical and social challenges that must be addressed to ensure fair and equitable outcomes. Issues such as algorithmic bias, data privacy risks, lack of transparency, digital inequalities, and job displacement pose substantial barriers to achieving AI-driven financial inclusion. If left unchecked, these challenges could exacerbate existing disparities rather than reduce them.

Mitigating these risks requires a strategic, multi-dimensional approach that combines regulatory oversight, technological advancements, and public-private collaboration. Strengthening ethical AI governance, promoting transparency in automated decision-making, and ensuring robust data protection measures are important steps in fostering user trust and preventing discriminatory outcomes. At the same time, investments in digital and financial literacy, infrastructure expansion, and workforce reskilling are necessary to bridge digital divides and prepare individuals for an AI-driven financial landscape.

Ultimately, AI's role in financial inclusion depends on how it is designed, implemented, and regulated. By embracing responsible innovation and international cooperation, financial institutions and policymakers can ensure that AI serves as a tool for reducing inequalities rather than reinforcing them. If properly managed, AI has the potential to transform financial systems into more inclusive, transparent, and equitable structures, contributing to sustainable economic development worldwide. Moving forward, policymakers, financial institutions, and technology developers need to collaborate to ensure that AI serves as a tool for financial equity rather than exclusion. Continued research, ethical oversight, and policy innovation will be necessary in shaping an AI-driven financial system that benefits all.

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INTERNATIONAL CONDITIONS WITH IMPACT ON THE ECONOMIC EVOLUTION OF ROMANIA

Cătălin DRĂGOI[30]

Abstract.

The global economy has been through a series of significant shocks over the past three years, the Covid-19 pandemic, supply chain disruptions, the Russia-Ukraine conflict, the rapid increase in the rate of inflation worldwide, a major increase in public debt followed by a significant increase in monetary policy interest rates by central banks. Romania's economy, like all other economies regardless of their degree of development and size, suffers both direct and indirect influences from the occurrence of unknown and unexpected events that determine the evolution of the global economy for certain periods of time. The paper aims to analyze some of the main global economic trends at the level of 2023 that influence the Romanian economy and whose knowledge at the decision-making level can help a better adaptation of the economy and implicitly a better performance.

Keywords: *world economy; global trends; economical growth;*

JEL Classification: *H62, E62, E66;*

Methodology and Data

In order to come to conduct research on the problem of global economic trends, the paper analyzes data using comparative, descriptive method and the use of a set of information sources, collecting financial data in databases, based on annual reports, consolidated statistical data and the scoreboard provided by the International Monetary Fund. The study was completed by formulating conclusions related to this phenomenon.

Introduction

The global perspective

At the level of 2023, geopolitical tensions will continue to exert pressure on trade flows. In addition to the continuation of the war in Ukraine, relations between the United States and China as well as relations in Asia Minor (due to the conflict in the Gaza Strip) have been strained over the past year.

Bottlenecks in global supply chains eased over the previous year and transport costs fell considerably, helping to ease inflationary pressures and improve supply capacity. However,

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global trade is recovering, but it registers lower values than the years before the outbreak of the Covid pandemic.

Global energy, oil and natural gas prices have returned to levels comparable to those before the start of the war in Ukraine, helping to lower inflation this year. Other commodity prices, global prices for raw materials, agricultural products and food also fell. However, inflation remains relatively high in a number of economies, although even in those countries inflation has been falling since the second half of last year.

High inflation worldwide had several factors that contributed to its growth. First of all, during the lockdown period, even if production was greatly reduced, the incomes of employees as well as companies were compensated for a period of time with funds from state budgets. Obviously, incomes without a correspondent in the production of goods and services would later produce inflationary pressures. To these were added the increase in the prices of natural gas and energy at the outbreak of the war in Ukraine, followed by the increase in the price of fertilizers and agricultural products.

In order to be able to stop the increase in the inflation rate, last year most central banks significantly increased their monetary policy interest rates during the year. Although this year the tightening of lending conditions have largely achieved their goal, through a considerable decrease in inflation, many central banks continue to maintain a cautious policy.

Governments have spent large sums to first protect their economies during the pandemic and then to protect households and businesses from higher energy prices. This has caused the public debt of many states and the world-wide debt to reach high levels, with less room for fiscal policies to favor economic recovery.

Rising interest rates have made these higher levels of debt more costly, putting further pressure on government finances, necessitating sustained efforts to reduce government debt and keep it on a sustainable path.

demand for goods and services was on the rise in the previous year, thanks to money saved during the pandemic when spending in particular on certain products and services was greatly reduced.

Global growth will be helped less by the recovery of the Chinese economy, which is performing much less than in previous years, and more by relatively strong growth in some of the emerging markets (notably India), while the European and US economies due to the slowdown economic growth, as well as due to the decrease in the total contribution of these economies will contribute less to global growth in the coming years.

Main global trends

Next, we will analyze the global economic conditions that have an impact on the global economy on the major economies as well as on the Romanian economy.

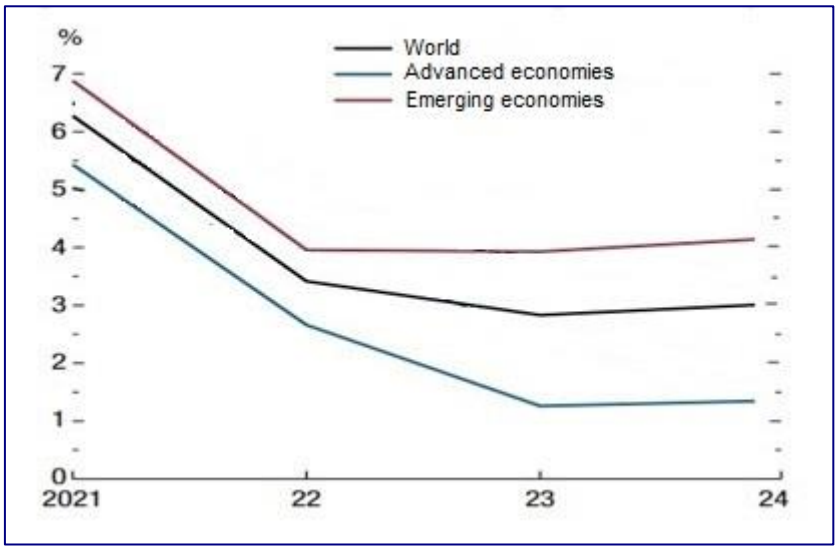

Figure 1. Global GDP evolution

Source: IMF World Economic Outlook

The global economy had a growth of 3.50% in 2022 and in 2023 it will drop to 3%, thanks to fiscal tightening measures taken by central banks around the world to be able to reduce inflation. The increased interest rates affected credit and implicitly the global production of goods and services. The GDP of advanced countries decreased from 5.4% in 2021 to 2.6% in 2022 and will continue on a downward slope to 1.5% in 2023. The GDP of emerging economies has evolved similar, i.e. it decreased from 6.8% in 2021 to 4.1% in 2022 and will have a value of 4% in 2023. We remind you that the increased GDP from 2021 was due to the very weak evolution at the worldwide in 2020 against the background of the Covid pandemic and the lock-down that affected the economies of all countries and the recovery of economic activities to values similar to the pre-pandemic values in 2021.

When there is a global slowdown in economic activity, even the strongest economies are affected by their economic relationships with the rest of the world. Less developed economies are even more influenced by global trends because they do not have a developed internal market that can support economic development. For Romania, which has been registering large current account deficits for many years, an economic development that ensures large exports and a lower need for imports is imperative. A country that is in economic growth can more easily correct its deficits (budget, current account) than a country in economic decline, stagnation or even crisis.

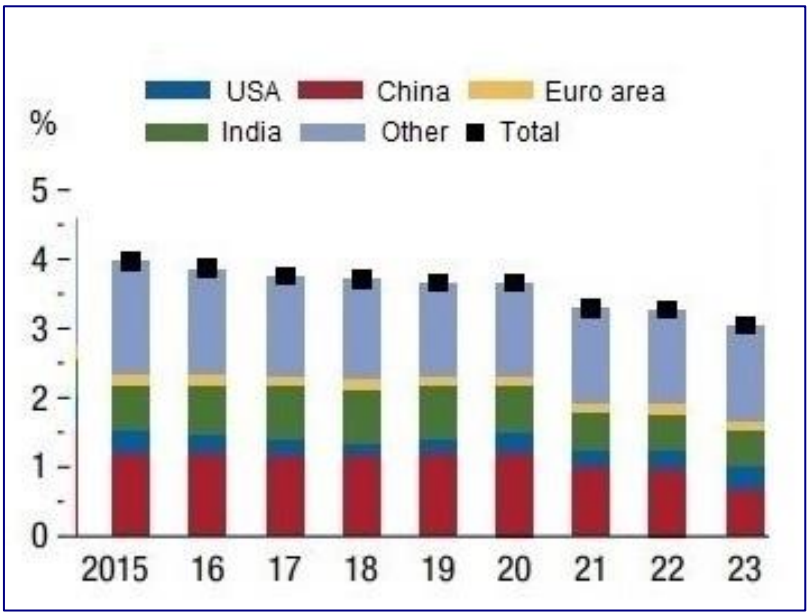

Figure 2. Contribution of different economies to global growth.
Source: IMF World Economic Outlook

When a country has a sustained economic development through the increase of imports necessary for the functioning of the economy as well as through the surplus financial resources it has and can direct them abroad, it generates an economic growth impulse in the countries with which it has economic relations. Over time, it was the great economic powers that started the economic growth. The countries of Western Europe (especially Great Britain, Germany and France), then the United States, and in the last two decades China, through their own development but also through the effect generated in the partner economies and these further to the direct commercial partners, have generated an increase economic at global level. For the last three years, the declining contribution of China can be noted, the country whose rapid evolution in the last decades pushed the growth at the global level, but whose rapid expansion diminished, it was compensated by the good evolution of the economy of the United States. Another country with an important contribution to the dynamics of the global GDP is India, which seems to be in full economic momentum. The contribution of the European Union is quite small, instead an increasingly important contribution is made by emerging and developing economies. Romania's economic relations are mainly oriented towards the countries of the European Union. The fact that Germany, which is the economic engine of Europe and the main commercial partner of Romania, has an inconclusive economic evolution (technical recession in 2023), had the effect of reducing the economic growth of the European Union and Romania. It is necessary for Romania to diversify its commercial relations, turning to other foreign markets, including countries with which there have been traditional relations, countries in Asia (China and India), countries in the Arab world or countries in Latin America

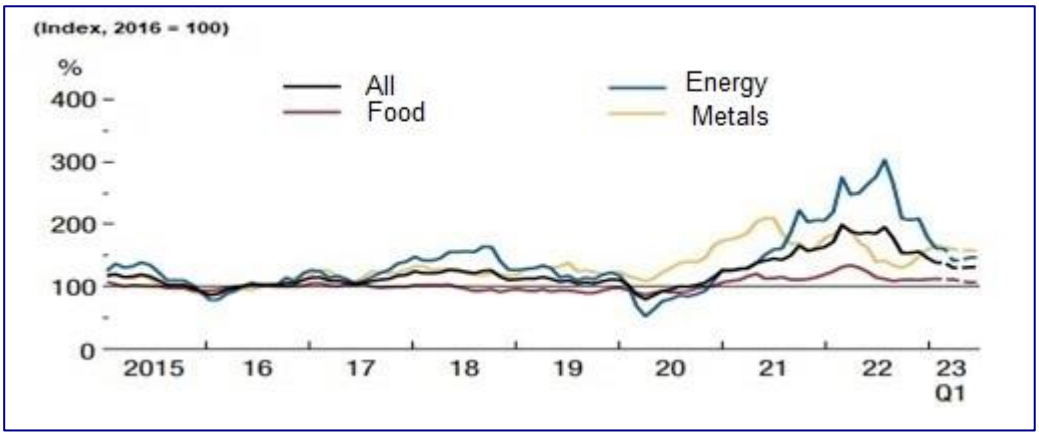

Figure 3. The evolution of the price of raw materials and energy worldwide.
Source: IMF World Economic Outlook

The price indices of raw materials and materials had a big jump at the time of the invasion of Ukraine by Russia due to the imposed restrictions and sanctions as well as the need for a global reconfiguration of economic alliances. Against the background of the difficulties in China's economic recovery following the pandemic wave in 2020, but also the blockage of the real estate sector, the decreasing demand for raw materials, energy, material goods caused their prices on the stock exchanges to drop to levels that are approximately 40 % higher than at the beginning of 2020.

The increase in the prices of raw materials and energy affected Romania's current account in the sense of increasing the deficit. Romania is an importer of raw materials and methane gas, even if compared to other European countries it has multiple sources of energy (hydro, wind, atomic, etc.) and its own resources of methane gas provide about 80% of the annual requirement. Romania could take advantage of this rising price trend through a better exploitation of its natural resources (both mineral resources and unexploited energy resources)

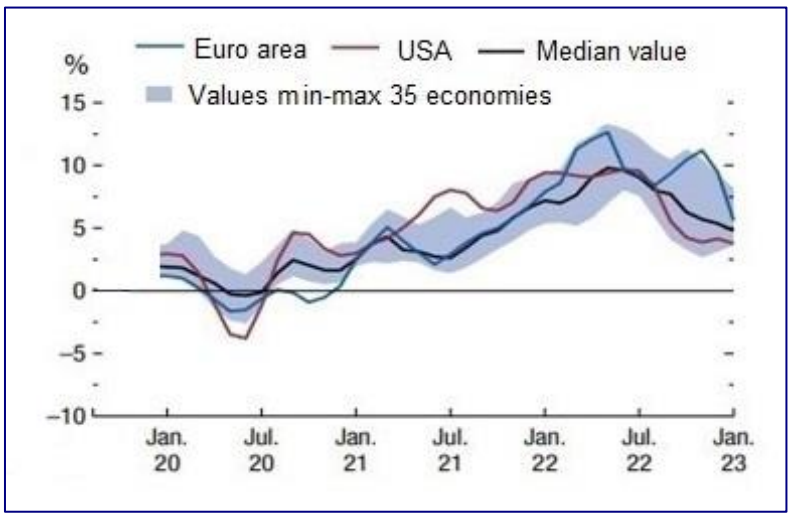

Figure 4. Evolution of consumer goods inflation worldwide
Source: IMF World Economic Outlook

The invasion, in 2021, of Ukraine by Russia caused the price of natural gas, energy, raw materials and food to rise rapidly and generate a global increase in the price of all products and services. The consumer goods price index increased on average for advanced economies from 0.7% in 2020, (when due to the decrease in demand for goods and services the inflation rate was low), to 7.3% in 2022. For the euro area the evolution was from 1.3% average value for 2020 to 8% in 2022 and 4.6% in 2023. For emerging economies there was a similar evolution with values a few percentage points higher as follows: 5.2% in 2020 , 9.8% in 2022 and 8.5% in 2023. In the absence of other shocks or a possible escalation of the war between Russia and Ukraine, a downward trend in the global consumer price index will be maintained.

Certain sectors of the Romanian economy are more affected by the evolution of international prices. Thus, some important industries in Romania (such as the motor vehicle and machinery industry - the main exporter) and the construction sector depend on energy imports and imported raw materials (rubber, steel, iron, timber and phosphorite, an essential production factor in the fertilizer industry and in the chemical industry), being vulnerable to variations in the prices of energy and the necessary raw materials.

And these developments will affect both Romania's exports, in the sense of braking and increasing prices, but also imports in the direction of price increases, with effects in deepening the external deficit.

The more modest economic growth and the higher inflation in the EU affect Romania in the sense of decreasing the export demand of the main trading partner, and therefore of the worsening of the external situation.

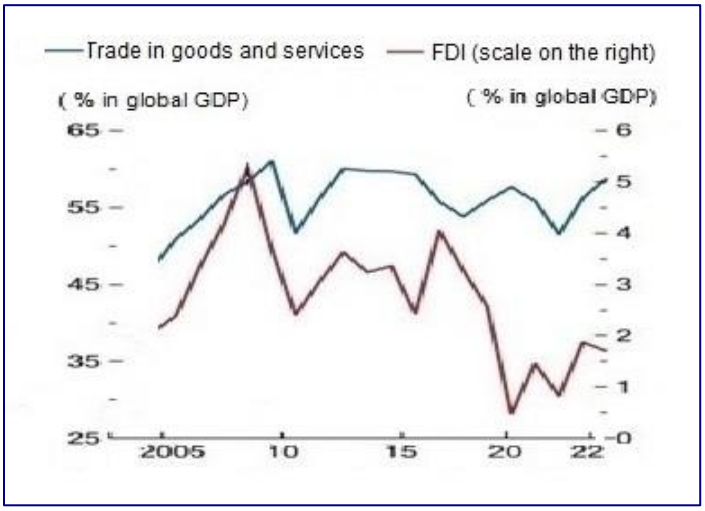

Figure 5. Evolution of trade in goods and services and foreign direct investment worldwide

Source: IMF World Economic Outlook

International trade in goods and services (left axis) had an upward trend from the mid-1980s until the onset of the economic crisis in 2008 when it had a sharp drop of about 10 pp from 65% of global GDP to 55 %. The following years had an oscillating evolution, never reaching the pre-crisis value. Foreign direct investment (right axis) which peaked at over 5% of global

GDP before the economic crisis of 2008 reached a low of only 0.5% of GDP in early 2020. The Trump administration's policy has dramatically reduced American investments abroad, especially in China, as well as the acquisitions of some American companies by Chinese investors. From 2020 to 2022, there is an increase in the value of foreign investments worldwide, reaching 1.7% of global GDP.

Trade flows were disrupted by the war in Ukraine, fortunately Romania's direct trade flows with Ukraine and Russia have only an insignificant weight in Romania's total trade.

The decrease in FDI at the global level has a major impact on Romania's economy. Romania needs massive capital investments in many fields, especially in industry, to increase the quality of products, added value, incorporated technology, the production of *tradable products* . In this way, imports can decrease and exports increase, leading to a decrease in the current account deficit and even entering a positive trend with a current account surplus. However, even if on a global level foreign investments have registered a setback, Romania manages to attract investments due to the fact that it is a safe country, being part of NATO and the European Union.

In addition, foreign direct investments are necessary as a source of financing the current account deficit, their decrease means that Romania is in a position to cover the external deficit through debt generating sources (portfolio investments and/or external loans) which are more burdensome for economy in terms of costs.

Conclusion

At the global level, the period under review is characterized by not very high global economic growth, the growing importance of Asian countries, especially China and India, the increase in world trade in goods and services, general inflation, and raw material and energy prices, which rose significantly in 2022 but will rise further. The recovery puts European countries at a disadvantage, among other factors, due to their increasingly smaller share of global GDP.

Romania recorded economic growth in the period under review, negatively affected by uncertainties related to energy and raw material costs, global inflation and decisive developments in its main trading partners.

Although inflation remained high in 2023, there were signs of stabilization globally and a reduction in the pace of price increases. This change reflects the Central Bank's stance and the measures taken to contain inflation. High inflation in consumer goods has had a significant impact on the Romanian economy. High inflation led to a decline in purchasing power, while high prices for food, energy and consumer goods led to lower consumption as households' disposable incomes fell, and lower consumption affected businesses' sales and profitability.

Overall, commodity price indices have fluctuated over the period under review, showing a general upward trend, but also corrections. These fluctuations exerted significant economic pressure on consumers and businesses. Price trends of raw materials and supplies have had a significant impact on the Romanian economy. Rising energy prices, especially gas and electricity prices, have increased costs for many industries and led to higher consumer tariffs.

Governments have had to implement support measures to mitigate the impact on households and businesses, affecting national budgets, increasing debt and state debt. Rising fertilizer and energy costs pushed up food prices, affecting both farmers and consumers. High production costs affected investor confidence and reduced investment. Rising prices led the government to prioritize energy and environmental policies and focus on renewable energy and energy efficiency. Trade in goods and services continued to recover

from the pandemic in 2022, but was affected by inflation and supply chain disruptions. In terms of foreign direct investment, 2022 was a positive year, but 2023 was inconclusive, affected by global factors such as economic uncertainty and sustainability trends.

Challenges in the global supply chain led to delays and higher costs, affecting several sectors, such as Romania's automotive and construction sectors; in terms of FDI, Romania remains attractive for foreign investors, especially due to the transition to a green economy and digitalization. However, global economic uncertainty and market volatility adversely affected investment and export decisions and slowed the pace of economic growth. The continued, albeit moderate, growth of the global economy is essential for Romania, which has an open economy where exports play an important role in income and job creation. In order to mitigate the negative effects of global uncertainty, the Romanian Government has had to take measures to support consumption and stimulate domestic investment. Romania should diversify its trade relations by increasing exports, especially in sectors such as IT, renewable energy and agricultural products. It is crucial to attract customers from emerging markets such as India and maintain relations with economic powers such as the US and Germany.

Encouraging FDI from these countries through tax incentives and a more favorable business environment is important to increase the infrastructure capacity of the regional economy and promote technologization. Romania should seek partnerships with US and Chinese companies to benefit from innovation and expertise, especially in technology and energy.

Romania's economic stability is affected by developments in the European economy. Close cooperation with other European economies can help mitigate the negative impact of regional problems. The contribution of large economies to global GDP growth is vital for Romania's economic future. By strengthening trade and investment relations with these countries, Romania can benefit from global growth and adapt to the global economic environment.

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THE ROLE OF BUSINESS MODELS IN THE TRANSITION FROM LINEAR TO CIRCULAR ECONOMY - CASE OF ALBANIA

Albina HYSAJ[31]

Abstract:

This paper explores the transition from a linear to a circular economic model in Albania, a country in the early stages of CE implementation. Through a comprehensive review of CE literature, the study identifies critical business model strategies for CE implementation at the firm, industrial, and national levels. These include waste-to-resource initiatives, product life extension, and industrial symbiosis. The paper also examines sector-specific opportunities in Albania, such as the integration of CE practices in waste management, agriculture, renewable energy, and tourism, emphasizing their potential to drive sustainable development and economic growth.

Despite progress, Albania faces challenges such as infrastructure deficiencies, weak regulatory frameworks, low public awareness, technological gaps, and cultural barriers. Addressing these issues requires a multilateral approach involving policymakers, businesses, academia, and international stakeholders. The study concludes that adopting creative business models, strengthening policies, and involving local communities are essential for Albania to benefit from a circular economy. By using its natural resources wisely and aligning with European Union standards, Albania can achieve sustainable growth and support global environmental goals.

Keywords: *Circular Economy, sustainability, business models.*

JEL classification*: O44, Q01, Q56.*

Introduction

The circular economy has drawn the attention of researchers and policymakers as it is oriented toward the sustainable management of resources contributing to sustainable development (Arruda et al., 2021; Moraga et al., 2019; Padilla-Rivera et al., 2020). A circular economy ensures the sustainability by extending the life of products. The aim of the circular economy model is to reduce the waste to the minimum. When a product comes to the end of life, it is aimed to keep the materials within the economy and recycle them.

Circular economy has a significant economic, environmental, and social impact. Rizos, Tuokko, & Behrens, 2017, Lewandowski, 2016 and Ekins et al., 2019 find out that the purposes of moving from a linear to a circular economy are to reduce environmental harm from the waste of nonreusable materials and to reduce the use of nonrenewable natural resources. Moreover, Mccarthy et al., (2018) suggest that the efficient use of natural resources may contribute to the achievement of environmental goals; using domestic secondary resources may reduce the risks for importing countries, and the reforms, activities, and processes of the circular economy may have a significant impact on economic growth

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and job creation. The main principle of circular economy is the use of output of a product as the input of another product.

There is a huge difference between a Linear Economy system and Circular Economy. In the linear economy the resources are extracted, manufactured, consumed and at the end they are discarded as waste. In the circular economy the resources are kept in a closed loop and the waste is minimized. After the products are used, they enter the cycle of Recycling, Recovering, Repairing, Retaining and Returning.

Ellen MacArthur Foundation (2015) explains the circular economy through a diagram called butterfly diagram. Based on this diagram the circulation of materials is based on two circles. The first one is the technical cycle consisting of all the activities and processes such as sharing, maintaining or prolonging, reusing, remanufacturing and recycling that will ensure the circulation of the finite sources. The second one is the biological cycle which consists of the all the activities and processes that will enable the regeneration of nature and natural renewable resources that will ensure the sustainability of their utilization.

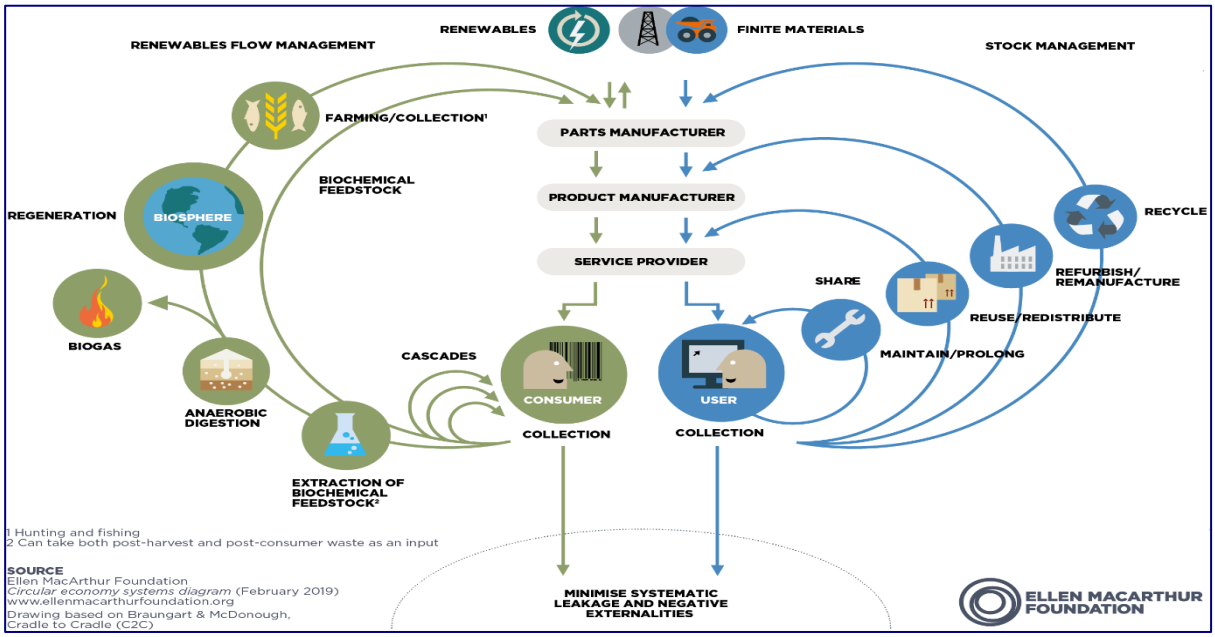

Figure 1. Circular Economy systems diagram

Source: Ellen McArthur Foundation

In Albania, the circular economy is in its early stages. The first National Strategy on Waste Management was implemented in 2011. The focus of this strategy was regional waste management in order to comply with the EU waste management standards. This strategy included plans for improving the infrastructure for waste management for the sustainable use of natural resources. The concept of circular economy is introduced in the National Integrated Waste Management Strategy (NIWMS) for the period 2020-2035. This strategy emphasizes the transition from linear to circular economy. The three main pillars of this strategy are the improvement of the regulatory framework, strengthening institutional capacities, and providing green business models.

In Albania the circular economy efforts are mainly focused on managing waste, recycling, promoting sustainable produce and consume, increasing the public awareness and education and aligning the legal framework with the EU standards. Even though circular economy is a key priority in Albania, until 2019, almost 30% of population in Albania was not covered by waste collection services (European Environment Agency, 2021).

Figure 2 displays the waste management in Albania from 2017 until 2022. The dash line shows a downtrend in the total waste generation. The dark blue bar shows that the majority of the waste is disposed in landfills. The recycling activity shown with light blue is very limited and there is not significant progress while the Incineration role in waste management is minimal.

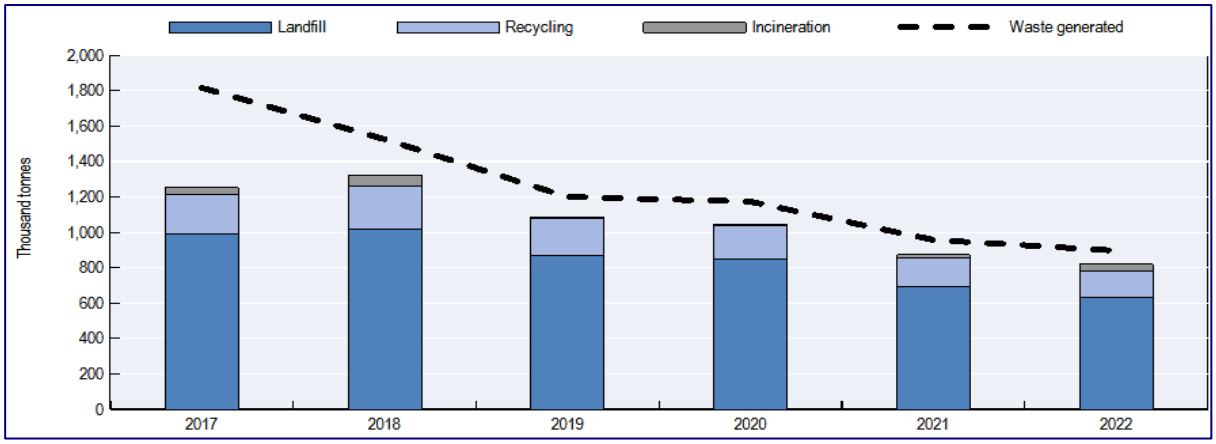

Figure 2. Municipal waste generation and treatment in Albania (in 1000 tones), 2017-2022

Source: Institute of Statistics

Literature Review

Business models play a significant role in the implementation of the circular economy by recovering, recycling, reducing, and reusing materials at various points during the production and usage of goods.

According to Yuan et al. (2006) circular economy may be implemented in three levels: at micro level or firm level through cleaner production, at meso level through eco industrial applications, and at macro level through the development of eco cities. Considering the significant impact of circular economy on sustainable development, many studies focus on identification of business policies, strategies and models that would facilitate the implementation of circular economy. Planing (2015) identifies materials and product designation, new business models, global reverse networks, and enabling conditions as the fundamental blocks of transaction from linear to circular economy. Another study by Urbinati et al., (2017) associates the implementation of circular economy with four main principles such as product life extension, redistribution and reuse, remanufacturing, and recycling.

Manninen et al. (2018), Geissdoerfer et al. (2020) and Ferasso et al., (2020) determine that adaption of business models and the creation of new business models are essential in the transition from linear to circular economy. Stumpf et al. (2021) analyses the implementation of circular economy on businesses. By using the case study analysis and interviews the authors find that that the implementation of circular economy happens through three channels eco-designation, re manufacturing and recycling of the products. The findings of the study suggest that there is a sector difference regarding circular economy principles execution.

Bocken et al. (2016) state that circular business models adopt sustainable methods to reuse products and materials, using renewable resources where possible. By following the work of Stahel (2001), McDonough and Braungart (2002), and Braungart et al.(2008), the authors propose three fundamental strategies regarding the resource cycling strategies used in

business models.1) Slowing resource loops which consists of the extension of products life by remanufacturing and recycling 2) Closing resource loops through recycling and 3) Narrowing resource flows through the increased efficiency of resources usage.

Richardson (2005) develops a business model framework based on three key elements: 1) the value preposition; 2) the value creation, and 3) the value capture. The value proposition is a theoretical approach to the offering of the firm, the targeted customers and the firms' strategy on how to be competitive. Value creation is the appliance of theoretical value preposition into activities that consist of creating and delivering the offering to the firms' customers. Value capture is the economic model capturing all the revenue, the cash sources, the costs, the margins and all the financial matters of the company.

Based on a report of (OECD, 2019) there can be identified 5 main groups of circular business models; Circular supply models in which the business aims to replace the traditional raw materials with bio-based and renewable ones. Resource recovery models which consist of using the waste of one process to produce secondary raw materials. Product life extension models which consist of extending the useful life of products by using different methods. Sharing models consist of sharing products that are underutlitized to avoid the need of the new ones. Product service system models consist of sharing services instead of products.

Bocken et al. (2016) suggest six circular business model strategies. The first, access and performance model which consists of offering service products which enable the users to fulfill their needs without owning the product. The second, extending product value, consists of remanufacturing the products after the customers use them. The third, classic long-life model, consists of offering products that can be used for a long time and can be repaired as well. The fourth, encourage sufficiency, consists of principles that aim to avoid the end user consumption of products. The fifth, extending resource value consists of giving value to the wasted resources. The sixth, industrial symbiosis, consists of reusing the residuals of a process as an input of another process. The first four strategies are strategies for slowing loops, while the remaining two are strategies for closing loops.

Additionally, Husain et al. (2021) propose five additional business models for a sound implementation if circular economy in business. The first, sharing platforms consists of creation of platforms that enable the shared use of product. The second, assets management that consists of efficient utilization of the assets. The third, dematerialized services consist of the utilization of services with products function instead of products with a physical existence. The fourth, hire and leasing the products instead of owning it and the last, collaborative consumption of products among people.

Albino and Fraccascia (2015) analyze the industrial symbiosis models and how those models can be implemented to provide profits for the economic entity. The authors conclude that utilizing the residuals as an input of another process not only reduces the costs, but it also contributes to expanding the firm through higher revenues or even penetrating new markets by promoting innovative products or services.

Jørgensen & Remmen (2018), investigate the options of developing circular economy in businesses by considering different businesses in Danmark. The study suggests that circular economy in businesses can be implemented through; the re designation of the services; the re designation of value chain creation by including all the participants; re designation of the organization of the business. Another important finding of the study consists of the fact that circular economy can be adopted by all kind of businesses, existing or start-ups, service or product companies, and all industries no matter the position in the value chain creation. While, Henry et al. (2020) investigate the role of start-ups in the transaction from linear economy to circular economy. The authors conclude that start-ups are more likely to adopt strategies toward circular economy compared with existing companies.

Following the incentives of European Union, Katz & López (2019) investigate the implementation of circular economy by analyzing 11,000 companies in 28 European Union countries. The findings of the study suggest that there is interdependence among the activities of circular economy, and they are implemented following a hierarchal order from the easiest one which is waste minimization to the most difficult one, the usage of renewable energy. Small companies in terms of employees and low turnovers show less engagement in circular economy activities, while bigger companies show higher engagement. Another important finding is that there is a sector difference in the intensity of engagement as well. Service companies engage less in circular economy activities, while manufacturing industry and natural resource industry engage more. Regarding the country engagement, the earliest EU members are the ones that are on the way or already engaged in circular economy activities, while the others are not engaged yet even though they have positive attitude.

Barreiro & Lozano (2020) use surveys to study the implementation of CE by different organizations in 40 countries, mostly European countries. Based on the results of the surveys the internal implementation happens through four channels, recycling, remanufacturing, reduction, and repairing even though the two most important channels are recycling and reducing. The authors suggest that closer collaboration with stakeholders would make the implementation of a circular economy easier.

Table 1. Literature Review Summary

Dimension	Firm Level	Industrial Networks	Regional/National	General Observations
Key CE Activities	Recycling, reusing, remanufacturing (Urbinati et al., 2017; Barreiro & Lozano, 2020)	Industrial symbiosis, shared resources (Albino & Fraccascia, 2015; OECD, 2019)	Regional waste recovery, eco-cities (Yuan et al., 2006)	Collaboration with stakeholders (Barreiro & Lozano, 2020)
Business Models	Product life extension, repair (Bocken et al., 2016; OECD, 2019)	Circular supply, resource recovery (OECD, 2019; Albino & Fraccascia, 2015)	Renewable energy, eco-policies (Katz & López, 2019)	Start-ups adopt CE faster than large firms (Henry et al., 2020)
Strategies	Eco-design, long-life products (Bocken et al., 2016; Stumpf et al., 2021)	Residual resource reuse, shared systems (Bocken et al., 2016; Albino & Fraccascia, 2015)	National incentives, CE frameworks (Jørgensen & Remmen, 2018; EU policies)	Service industries less engaged than manufacturing (Katz & López, 2019)
Execution	Recycling, redesigning, repairing (Barreiro & Lozano, 2020)	Shared platforms, secondary materials (Husain et al., 2021; OECD, 2019)	Regional CE zones, public policies (Katz & López, 2019)	Collaboration helps CE implementation (Barreiro & Lozano, 2020)
Challenges	Sector-specific adoption differences (Stumpf et al., 2021)	Industry-wide collaboration needed (Jørgensen & Remmen, 2018)	Early adopters are more successful (Katz & López, 2019)	Smaller firms show lower CE engagement (Katz & López, 2019)

Source: Authors' summary

Business Models in Albania

Circular economy business models prioritize resource optimization, waste reduction, and value preservation. These models include waste-to-resource approaches, product life extension, and restorative practices. Ellen MacArthur Foundation (2015) demonstrates that such models enhance ecological sustainability while generating financial benefits. Although the implementation of CE in Albania remains limited, several sectors have begun incorporating these principles, reflecting the global transition toward sustainability.

Waste management represents a critical sector for implementing the circular economy (CE) in Albania, as highlighted by GIZ (2023). The country generates substantial volumes of municipal waste, a significant portion of which is disposed of in an unsustainable manner. Recently, efforts have been directed toward the sorting and recycling of key materials such as plastics, paper, and construction waste. Urban pilot initiatives, such as those in Tirana, exemplify progress in advancing waste separation and recycling practices. However, challenges persist, notably in the form of insufficient infrastructure and low levels of public awareness, as noted by the OECD (2024).

Agriculture emerges as a sector with considerable potential for adopting circular practices. According to Kola & Cerpja (2024), the integration of crops and livestock, coupled with the composting of organic waste, can enhance soil fertility while reducing reliance on synthetic fertilizers. In smaller towns, localized composting initiatives have begun transforming agricultural byproducts into valuable production inputs. Such practices align with CE principles by fostering closed-loop systems that minimize waste and maximize productivity.

The renewable energy sector represents a promising opportunity for the application of CE business models in Albania. The country's abundant solar, wind, and hydropower resources provide significant opportunities to integrate CE principles. For instance, bioenergy projects utilizing agricultural waste, such as biogas plants in rural areas, exemplify such efforts (European Commission, 2021). Additionally, the refurbishment and recycling of renewable energy infrastructure contribute to resource efficiency, further advancing CE objectives.

Tourism, a vital component of Albania’s economy, has also begun to align with CE principles. Eco-tourism initiatives in the Albanian Alps and along the Adriatic coastline emphasize the conservation of natural resources and the reduction of environmental impact (Partners Albania, 2023). Moreover, sustainability measures such as the use of recycled materials and energy-efficient technologies in hotel construction demonstrate the sector's commitment to integrating CE practices.

Despite progress, Albania faces significant challenges in fully adopting circular economy models. These challenges include:

Infrastructure Deficiencies: Waste management, recycling, and resource recovery infrastructure do not match the demand and supply levels in respective jurisdictions. OECD (2024) reveals that most municipalities lack sorting and processing systems for recyclable waste and are, hence, characteristic of high landfill rates.

Weak Regulatory Frameworks: The regulatory policies meant to promote CE are either underdeveloped or poorly enforced. GIZ (2023) asserts that unclear guidelines and lack of incentives lead to hindering of sustainable practices uptake by businesses.

Low Public Awareness: Publicly, understanding of CE principles is very limited. According to the European Commission (2023), it requires widespread public awareness campaigns and educational initiatives to encourage consumers and businesses to engage actively in this issue.

Technology Gaps: CE technologies for recycling and resource efficiency are relatively advanced. The current technological potential of Albania does not seem sufficient for such large-scale implementation, especially regarding manufacturing and construction (Kola & Cerpja, 2024).

Culture Barriers: Waste and consumption discourses are closely correlated in culture-meaning that too little attention is given to waste reduction, reuse, or recycling as a society; thus, circular practices uptake is inhibited (Partners Albania, 2023).

Overcoming these challenges demands collaborative actions from governments, businesses, and global institutions to establish a supportive framework for implementing circular economy (CE) practices.

Conclusions

This study emphasizes the extent to which business models can replace Albania's linear economic structure into circularity. The evidence reveals that while Albania is still at the early forms of circular economy application for its context, the role of innovative business models is critical to solving complex systemic challenges and mobilizing untapped opportunities.

Integrating circular business models in waste management, agriculture, renewable energy, tourism, and the textile shows Albania is committed to sustainable development. These models have also guided steps in waste-to-resource strategies, maximization of product lifetimes, and promotion of restorative practices. However, the study identifies difficult conditions such as poor infrastructure, low public awareness, and lack of strong regulatory frameworks that prevent general adoption of circular principles. Increasing collaboration among policymakers, business, academia, and international stakeholders will overcome these barriers.

Albania's opportunities lie in its rich natural resources, favorable positioning to the EU, and great promise of economic diversification and job creation through circular economy practices. Also, transitioning will be sped up by accessing EU funding, technology transfer, and increasing public enthusiasm for sustainability. Promising cross-cutting areas for such integration are eco-tourism and renewable energy.

Last but not the least, the path of Albania towards circular economy is possible through a multilateral approach encompassing innovative business models, strong policy frameworks and community engagement. Given the leverage that will derive from it in its own opportunities while addressing the existing challenges, it can lead Albania towards its desired sustainable future, contributing to the regional as well as global environmental and economic goals.

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THE UTILIZATION OF ARTIFICAL INTELLIGENCE IN MEASURING, ACCOUNTING AND REPORTING FOR ECOSYSTEM SERVICES

Florentina JOMIR [32]

Abstract: *Artificial intelligence (AI) has become deeply integrated into daily life, enhancing decision-making efficiency and optimizing the use of personal and temporal resources. In response to rapidly evolving economic landscapes, industries across sectors are increasingly adopting AI tools to remain competitive and innovative. Heightened consumer demands and intensified competition drive businesses to operate at peak performance. Simultaneously, regulatory bodies are imposing stricter environmental guidelines, pushing companies toward sustainability. Given the growing concerns over resource scarcity and climate change, AI emerges as a pivotal tool for businesses to navigate these challenges. This paper examines the role of AI in enhancing the accounting, measurement, and reporting of ecosystem services, particularly within the scope of corporate environmental responsibility.*

Keywords: *artificial intelligence (AI), ecosystem accounting, sustainable reporting*

JEL classification: *Q55, Q56*

Introduction

The landscape of the sustainable economy is undergoing continuous evolution due to several influential factors: the growth of businesses and their environmental impact, the strengthening of legislative and regulatory requirements on how companies must measure, account for, and report environmental indicators, and more recently, the advancement of technology permeating nearly every aspect of daily and professional life. Employees are required to expand their knowledge by adopting new technologies, while companies must be open to investing in and implementing technologies that facilitate their business practices. The Fourth Industrial Revolution, a term popularized by economist Klaus Schwab, founder of the World Economic Forum, describes the rapid pace of technological advancement in the 21st century, bringing a new focus to ecosystem economy—artificial intelligence.

Description of the Problem

The reasons for considering the selected research topic as actual are as follows:

- **Increasing regulatory pressures:** Regulators worldwide are placing growing pressure on environmental protection and the adoption of transparent measurement and reporting practices. On January 5, 2023, the European Union's Corporate Sustainability Reporting Directive (CSRD) came into force. This directive "modernizes and strengthens the rules regarding social and environmental information that companies must report. A broader range of large companies, as well as small and medium-sized enterprises (SMEs) listed on the stock exchange, will now be required to report on sustainability. Additionally, some

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non-EU companies will also have to report if they generate revenues exceeding €150 million in the EU market." (European Commission, 2024). These new rules ensure that investors and other stakeholders have access to the necessary information to assess companies' impacts on people and the environment. Investors will also be able to evaluate financial risks and opportunities arising from climate change and other sustainability issues. Furthermore, reporting costs for companies will be reduced in the medium to long term through the harmonization of required disclosures. The first companies will need to apply the new rules for the financial year 2024, with reports published in 2025.

- **Artificial intelligence integration:** Artificial intelligence (AI) has become a daily component of the lives of individuals involved in the business environment. Whether a simple employee uses a search engine, an investor utilizes a return-on-investment calculation platform, or a company employs interactive visualization tools, it is evident that denying the importance of these tools is impossible. In most cases, they facilitate task execution and help align businesses with external requirements.

The overall aim of this paper is to investigate how the business sector is adapting to new sustainability challenges and to develop conclusions based on the studied materials regarding the optimal ways in which sustainability can be integrated into accounting and reporting processes with the support of artificial intelligence (AI). The research objectives are as follows:

- To review the specialized literature on artificial intelligence tools applied in business;
- To analyze how these tools can be integrated into companies' activities for the purpose of ecosystem accounting and reporting;
- To quantify the benefits and risks associated with the use of these tools.

Methodology and Data

To achieve an empirical analysis of the subject and to derive results as close to reality as possible, several research methods were employed:

- Axiomatic method – used in formulating the thesis;
- Induction and deduction – applied in the process of formulating and demonstrating the hypotheses presented in this report;
- Content analysis method – used for conducting an empirical review of the available specialized literature and collecting historical data;
- Comparison method – employed to differentiate information identified for two different yet comparable areas;
- Indirect observation – observing through available documentation the behaviors of the business sector regarding the adoption of business technologies of environmental impact in the accounting and reporting fields;

Results

The Importance of Artificial Intelligence in the Context of New Business Models

Artificial intelligence (AI) technologies have become indispensable tools in both everyday life and professional settings. Viewed through an optimistic lens, one can confidently state that AI assists in data collection, analysis, and visualization, effortlessly creating data syntheses, identifying patterns, and predicting future trends with unprecedented accuracy. The utility of AI is further validated by statistics regarding the market value of AI services, the rapid adoption of these technologies by organizations, and their impact on employee productivity.

According to Grand View Research, a market research and consulting firm, the global artificial intelligence industry is expected to generate revenues exceeding $1.8 trillion by 2030. Additionally, the industry is projected to experience a compound annual growth rate of 37.3% from 2024 to 2030 [Figure 1].

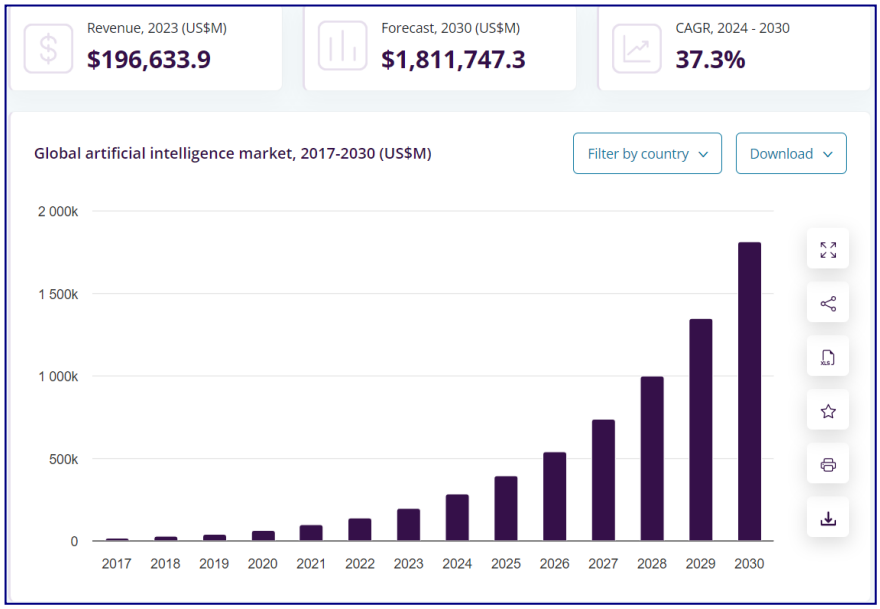

Figure 1: AI market evolution

Source: Grand View Research: Global Artificial Intelligence Market Size & Outlook

Regarding the adoption rate and the openness of individuals and organizations toward new AI tools, OpenAI reported that within less than a week of launching the widely known ChatGPT platform, it had amassed one million users, a figure that grew to 187.4 million monthly users by June 2024 (Similar Web, 2024). According to technology consultancy and research firm Gartner, Inc., surveys and studies conducted between 2015-2019 revealed a 270% increase in the percentage of businesses integrating AI technologies into their practices (Costello, 2019). Regarding employee productivity, AI could have a significant impact of 30%-40% over the coming years, as estimated by Big4 company PricewaterhouseCoopers in its "2024 AI Business Predictions" report (Pricewaterhousecoopers, 2024).

The statistics outlined above support not only the practicality and efficiency of AI but also its versatility. In this context, versatility refers to AI's capacity to continuously evolve and adapt to the needs of companies, market trends, consumer demands, and regulatory requirements. Due to its versatility, artificial intelligence is increasingly seen as a tool that can be seamlessly integrated into accounting and ecosystem reporting practices. While AI may currently represent a costly investment, primarily affordable for top-tier companies, the growing concern for environmental protection and the positive financial outcomes associated with sustainability innovations suggest that AI will become an indispensable asset for any successful business.

A responsible environmental economic behavior is indeed a crucial element that cannot be overlooked by any company aiming for financial and reputational success. To analyze this

hypothesis, we have listed below five economic indicators that can be calibrated based on the level of environmental awareness exhibited by enterprises:

- **Revenue Growth Rate**: In 2023, the global consultancy firm McKinsey & Company published a study on 2,269 public companies, aiming to demonstrate that integrating environmental, social, and governance (ESG) priorities into growth strategies contributes to superior financial performance. The study found that "high-performing triple bottom-line companies (those rated highly on ESG scores, annualized revenue growth, and economic profit) grew their revenues at a median rate of 11% per year—1.4 percentage points higher than the median achieved by profitable companies with weaker ESG performance" (McKinsey & Company, 2023).
- **Profit Growth Rate**: Similar to the first indicator, a sustainable enterprise is expected to show a stable or upward trend in profitability. This is because businesses that focus on environmental awareness often implement energy-efficient practices, waste reduction measures, and sustainable supply chain management, all of which reduce operating costs and increase profitability.
- **Public Image Status**: An article published in the *Journal of Banking and Finance* titled "Corporate Social Responsibility (CSR) and Media Coverage" examines how the public, including investors, customers, and the media, focuses on CSR principles to encourage better economic outcomes: "For firms that demonstrate superior social responsibility and receive favorable media coverage, there is a significant interaction between social responsibility and media favorability, which enhances a firm's equity valuation" (Cahan, 2015).
- **Access to State Subsidies**: Environmental initiatives implemented by companies are often supported by external stakeholders, primarily governments. A prime example is the Greening of Small and Medium-Sized Enterprises (SMEs) Program funded by the Government of the Republic of Moldova and the European Union (EU) through the Organization for Entrepreneurship Development (ODA). The program was approved by Government Decision No. 592/2019 and is "implemented to create favorable conditions and support the business environment in transitioning from a consumption-based economic development model to one that applies greening principles and integrates green economy measures into the production processes of various national economic sectors". Through this project, applicants can receive continuous informational and consultative support, financial assistance in the form of grants up to MDL 500,000, and post-financing monitoring for 24 months from the date of grant transfer.
- **Risk Management Response Quality**: Proactive companies that acknowledge the influence of natural ecosystem factors on their financial performance can anticipate potential future risks and take steps to mitigate them or develop responses that balance the negative impact of these factors.

These indicators reflect the extent to which environmental awareness and responsible behavior can be aligned with economic performance and long-term business success.

Artificial Intelligence Tools for Measuring, Accounting, and Reporting Ecosystem Services

A catalyst that could drive companies to achieve favorable outcomes regarding the aforementioned indicators is the implementation of artificial intelligence tools. These tools would help draw a parallel between their financial viability and environmental behavior, particularly in the areas of measuring, accounting, and reporting ecosystem services. In this context, we have developed a diagram that classifies AI tools that would be useful for these three domains [Figure 2].

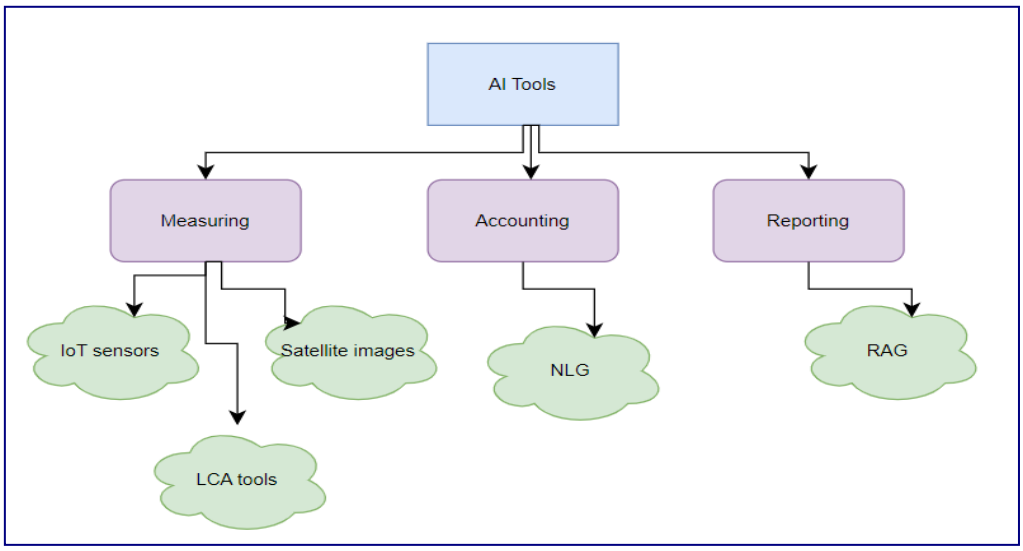

Figure 2: Useful AI tools for the processes of measuring, accounting and reporting ecosystem services

Source: Created by the author

Measuring ecosystem services refers to the quantification of the benefits that natural ecosystems provide to people and businesses, such as clean air, water, soil fertility, land areas, recreational opportunities, and more. This process involves assessing the economic, environmental, and social values of these services to better understand how ecosystems support human well-being and the economy. The importance of this process is highlighted by its role in helping decision-makers, businesses, and communities make informed choices regarding the use and conservation of resources. By recognizing both the tangible and intangible benefits of nature, it becomes possible to prioritize sustainable practices that protect biodiversity and mitigate the effects of climate change. For the "measurement" category, we identified three types of AI-based tools that enhance the efficiency and accuracy of measurements:

1. IoT Sensors (Internet of Things) - IoT sensors are devices that collect and transmit data from the physical environment to other systems via the internet. These sensors are essential components of the IoT ecosystem, enabling a wide range of applications by collecting real-time data related to various parameters such as temperature, humidity, light, motion, pressure, or even chemical composition. The data collected by these sensors are typically analyzed to trigger automated actions, remotely monitor systems, or provide insights for optimizing operations in industries like agriculture, manufacturing, and healthcare. IoT sensors are designed to be compact, energy-efficient, and capable of wireless communication. Currently, there are multiple protocols available for connecting to IoT systems, with functionality depending on data transmission rate, coverage range, and latency [Figure 3].

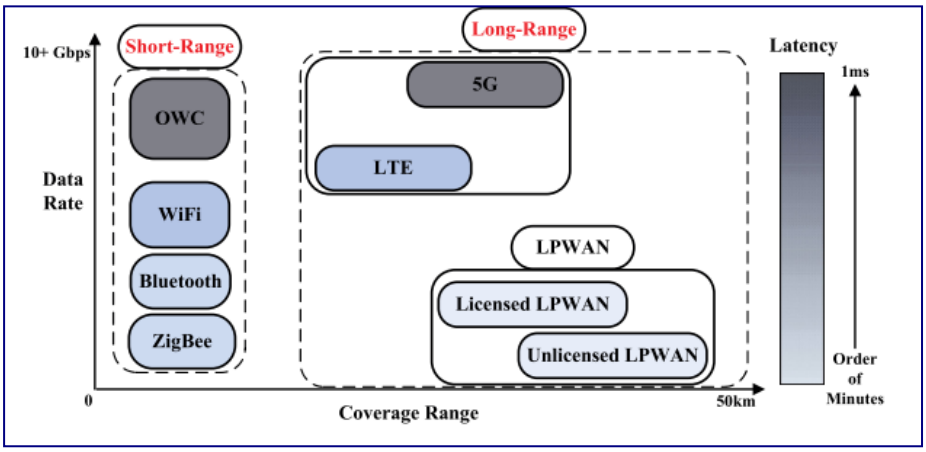

Figure 3: IoT connectivity protocols

Source: Ding, J., Nemati, M., et al., IoT Connectivity Technologies and Applications: A Survey

Currently, the largest share of IoT connections is achieved through Wi-Fi, accounting for 31%. In 2023, three-quarters of devices connected to Wi-Fi globally relied on the latest technologies - Wi-Fi 6 and Wi-Fi 6E - ensuring faster and more reliable wireless connectivity. The adoption of these technologies has made communication between IoT devices more efficient, leading to improved user experience and overall performance. Another 25% of devices use Bluetooth technology, while the remaining 21% rely on cellular technologies such as 4G or 5G. According to IoT Analytics, a global provider of statistical and strategic information on IoT, AI, and other revolutionary technologies, by the end of 2023, 16.6 billion devices were connected to IoT, representing a 15% increase compared to 2022. IoT Analytics projects this figure will grow by another 13%, reaching 18.8 billion devices by the end of 2024. Experts conclude, "This forecast is more modest than in 2023 due to cautious spending by businesses in response to inflation, high interest rates, ongoing chipset supply constraints, and geopolitical conflicts in Eastern Europe and the Middle East. Despite these macroeconomic factors, 51% of businesses adopting these technologies plan to increase their IoT budgets in 2024 (with 22% of companies expecting a budget increase of over 10% compared to 2023)" (Sinha, 2024).

IoT technology is multidimensional and can be applied across various sectors. For the purpose of this thesis, we have analyzed and exemplified four business sectors whose efficiency, productivity, and ability to manage natural resources are significantly improved through the use of these revolutionary tools: agriculture, forestry industry, heavy industries with significant impact on air quality.

- *Agriculture* – IoT has emerged as a transformative technology in agriculture, playing a vital role in protecting and conserving natural resources such as water, soil, and energy. Through real-time monitoring, data collection, and automation, IoT allows farmers to manage resources more efficiently, reducing waste and promoting sustainable practices. This technology is especially crucial as the agricultural sector faces increasing pressure to boost production while minimizing environmental impact in the context of climate change and resource depletion. One of the most important ways IoT contributes to natural resource conservation is through optimal water management. Water scarcity is a growing global concern, with agriculture accounting for approximately 70% of global freshwater use. According to Ayaz (2019), "IoT-based systems can significantly reduce water consumption by enabling precise control over irrigation, which directly contributes to water conservation efforts in agriculture" (Ayaz, 2019). These systems help prevent over-irrigation and reduce

the depletion of water resources while ensuring crops receive the adequate amount of water for growth. Energy conservation is another area where IoT plays a crucial role in agriculture. Automated systems powered by IoT technology can help reduce energy consumption by optimizing the operation of machinery and equipment. For example, smart irrigation systems not only save water but also use energy more efficiently by scheduling irrigation during periods of lower energy demand. This helps farmers reduce their carbon footprint and operational costs. Soil quality protection is another area where IoT contributes to resource conservation. Poor soil management practices can lead to degradation, erosion, and loss of fertility. IoT sensors can monitor soil conditions in real-time, providing data on pH levels, nutrient content, and soil compaction. This allows farmers to apply fertilizers and soil amendments precisely, avoiding over-application that can lead to nutrient runoff and soil degradation. Additionally, IoT enhances resource efficiency through precision agriculture, which uses data to tailor farming practices to specific areas and ecosystems. This not only saves resources like water and fertilizers but also protects biodiversity. For instance, IoT drones equipped with sensors can map fields, identifying areas that need more or fewer resource inputs, thus avoiding excessive application of chemicals that could harm surrounding ecosystems. To illustrate the utility of these technologies in the context of measuring ecosystem services, we can refer to the data published by CropX – a leader in the sensor market and digital platforms used for collecting and interpreting sensor data. CropX is an agricultural technology company specializing in providing IoT-based solutions for precision agriculture. Their platform integrates advanced soil sensors, cloud-based data analytics, and machine learning to help farmers optimize water use, improve soil health, and increase crop productivity. The technology developed by CropX aims to enhance agricultural sustainability while simultaneously increasing the profitability of businesses. According to the company's latest sustainability report, with the help of the implemented technologies, CropX and its clients have managed to reduce water consumption by 25-50%, fertilizer use by 10-20%, fungicide use by 15-25%, greenhouse gas emissions by 9-13%, and energy costs by 10%. Additionally, CropX estimates that thanks to its technologies (especially those focused on irrigation), it is able to annually preserve an amount of water equivalent to the consumption needs of 2 million people (CropX Technologies, 2023).

- *Forestry* – The Internet of Things (IoT) is increasingly used in the forestry industry to help protect and conserve natural resources, playing a crucial role in sustainable forest management. Given the growing concerns about deforestation, forest degradation, and the impact of climate change, IoT technology offers innovative solutions for monitoring forest ecosystems, optimizing resource use, and preventing environmental damage. One of the primary ways IoT contributes to forest protection is through improved health monitoring. Sensors can be deployed across forested areas to track environmental factors such as soil moisture, temperature, and tree growth rates. These connected devices provide data that allows forest managers to detect early signs of diseases, pest infestations, or drought stress. Another significant application of IoT in forestry is the detection and prevention of wildfires. Wildfires are an increasing threat to forests, especially as climate change intensifies. IoT sensors can detect changes in temperature, smoke levels, and humidity, enabling early fire detection. These sensors are often connected to automated alert systems that notify forest managers or local authorities. IoT-based fire detection systems can drastically reduce response times and help prevent large-scale damage to forest ecosystems. This not only protects forest resources but also safeguards biodiversity and the communities that depend on these ecosystems. In addition to monitoring and optimizing forest health and resource management, IoT plays a critical role in tracking illegal activities such as logging and poaching. IoT devices equipped with GPS and motion sensors can be deployed to detect unauthorized access to protected forest areas. By reducing illegal deforestation and poaching, IoT helps conserve natural habitats. Such technologies also assist in understanding the carbon sequestration potential of forests. By measuring tree growth, soil carbon content, and atmospheric conditions, IoT devices provide accurate data on the

amount of carbon a forest can capture and store. IoT-based carbon monitoring systems help quantify forests' carbon sequestration capacities, offering valuable data for climate change mitigation strategies. A notable example in this field is the American company Weyerhaeuser, which owns nearly 12.4 million acres of forestland in the U.S. and manages an additional 14 million acres of forests under long-term licenses in Canada. The company has been producing wood products for over a century. Alongside many other sustainable business practices, the use of IoT has enabled the company to recycle 98% of wood waste, plan to reduce greenhouse gas emissions by 42% by 2030 and eliminate the equivalent of 38 million metric tons of CO2 from its forests and production processes (Weyerhaeuser, 2023).

- *Heavy industries* – Integrating the Internet of Things (IoT) into heavy industries has become essential for protecting air quality and conserving natural resources. These industries, often associated with high levels of air pollution and environmental degradation, are now utilizing IoT technologies to minimize their ecological footprint, optimize energy use, and reduce emissions. One of the primary ways IoT helps maintain air quality is through Continuous Emissions Monitoring Systems (CEMS). These systems use IoT-connected sensors to monitor airborne pollutants such as carbon dioxide (CO2), sulfur dioxide (SO2), nitrogen oxides (NOx), and particulate matter emitted from industrial processes. IoT sensors provide real-time data on emission levels, enabling companies to detect pollution spikes and take immediate corrective actions. Energy efficiency is closely tied to air quality conservation, as energy production often involves burning fossil fuels, which release large amounts of greenhouse gases. Smart grids and IoT-enabled sensors can monitor real-time energy consumption, identifying inefficiencies. By improving energy efficiency, heavy industries can minimize their reliance on fossil fuels. Additionally, IoT significantly contributes to controlling industrial dust and particulate matter, which are major contributors to air pollution. IoT integration in dust suppression systems provides real-time data on air quality, allowing for adaptive control of filtration processes that help reduce particulate emissions, protecting both workers and the environment. Smart air filtration and ventilation systems equipped with IoT sensors can detect airborne particles in factories or industrial sites and automatically adjust the filtration systems to capture and eliminate these particles. This technology is particularly valuable in sectors such as cement manufacturing and metal processing, where dust emissions can have significant health and environmental impacts. An example of a company that has successfully integrated IoT in its heavy industrial operations is Siemens. Focused on industrial automation, energy distribution, transportation, and healthcare technologies, Siemens has reported remarkable performance due to the development and implementation of IoT systems. In its 2023 sustainability report, Siemens highlighted that it achieved a high ranking in the Corporate Sustainability Assessment (CSA) from S&P Global, an annual evaluation of companies' sustainability practices focusing on both industry-specific and financially relevant sustainability criteria. In the fiscal year 2023, Siemens ranked second among its competitors in the Industrial Conglomerates category, with a score of 81/100. Additionally, EcoVadis, which assesses sustainability in global supply chains, awarded Siemens 77 points, placing the company in the top 1% of companies evaluated in the same industry (Siemens, 2023).

An important consideration in the adoption of technologies such as the Internet of Things (IoT) and high-speed internet connections is that, while they offer significant benefits, they also carry potential negative impacts—both for the environment and businesses. One of the primary concerns is security and privacy. IoT devices often collect vast amounts of personal and sensitive data. Without robust security measures, these devices are vulnerable to cyberattacks, which could lead to data breaches or unauthorized access. According to Statista - the German online platform specializing in data collection and visualization, the annual number of IoT malware attacks worldwide surged dramatically from 32.7 million in 2018 to 112.29 million in 2022.

Another challenge businesses face with IoT is the issue of interoperability and the increased complexity of maintenance. Many IoT devices, particularly those from different manufacturers, may not be compatible with one another, making it difficult to manage and integrate them effectively. Furthermore, as the number of connected devices grows, the management and upkeep of the network become more complicated. Organizations may struggle with monitoring device performance, troubleshooting issues, and ensuring timely updates, which can result in operational disruptions.

Perhaps the most significant downside of IoT and related technologies is their environmental impact. While some IoT devices are designed with energy efficiency in mind, the sheer volume of connected devices can lead to increased energy consumption—especially when considering widespread adoption in cities, homes, and businesses. Moreover, the mass production of IoT devices contributes to e-waste, particularly if the devices have short lifespans or are not properly recycled. As noted by the software development company ArtHaus, "the production of these devices sometimes includes rare earth metals. They may harm the environment and aren't easy to acquire sustainably.". Furthermore, the lack of awareness and education about the environmental effects of IoT devices among manufacturers and businesses exacerbates the issue.

Addressing these challenges requires a multifaceted approach, including the implementation of smart waste management solutions, the introduction of regulations on energy consumption and environmental pollution, and the self-education of entrepreneurs. By prioritizing sustainability and adopting best practices, both businesses and governments can mitigate the negative impacts of IoT technologies.

2.Life Cycle Assessment (LCA) Tools - Life Cycle Assessment (LCA) is a systematic methodology used to evaluate the environmental impact associated with all stages of a product's life — from raw material extraction, through production, use, and disposal. By utilizing LCA tools, companies can better manage and account for natural resources and understand their environmental impact. This tool provides valuable insights that allow businesses to make informed decisions regarding sustainability initiatives. LCA comprises four main stages: goal and scope definition, inventory analysis, impact assessment, and interpretation [Figure 4].

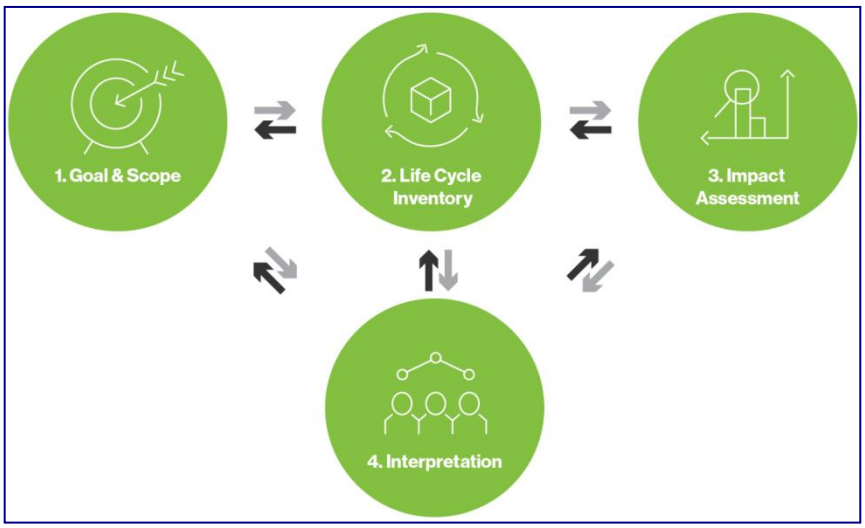

Figure 4: LCA analysis steps

Source: Golisano Institute for Sustainability, What is life cycle assessment (LCA)?

In the first stage, organizations establish the purpose of the assessment, the product system under study, and the boundaries of the analysis. The inventory analysis stage involves quantifying energy consumption, raw materials, emissions, and waste generated throughout the product's life cycle. The impact assessment translates this inventory data into environmental impacts, examining aspects such as greenhouse gas emissions, resource depletion, and ecological toxicity. Finally, the interpretation stage synthesizes the findings to provide actionable insights. By using LCA tools, companies can identify problem areas in processes where resource use is excessive or emissions are high. This information allows them to implement strategies to reduce resource consumption and mitigate environmental impacts. For example, businesses can evaluate alternative materials, optimize production processes, and design for recovery and recycling at the end of the life cycle, thus improving their sustainability profile (Kloppfer, 2016). Additionally, LCA helps meet regulatory requirements and increases transparency in environmental reporting, thereby fostering trust among stakeholders and consumers. LCA tools assist companies in accounting for natural resources by quantifying the environmental impacts of their product systems. For instance, by analyzing input resources at the start of the cycle, such as water, minerals, and energy, organizations can identify areas where they can reduce consumption or switch to more sustainable alternatives. Furthermore, LCA can highlight the benefits of recycling and material recovery, encouraging companies to adopt circular economy practices that minimize resource extraction and waste. Some notable examples of Life Cycle Assessment (LCA) tools developed and used internationally are: SimaPro, GaBi, OpenLCA, LCA Commons. A notable example of a company leveraging LCA for sustainability is Unilever, a multinational consumer goods company. Unilever has implemented LCA across various product lines to assess their environmental impacts and improve resource efficiency. The company uses LCA to evaluate factors such as packaging materials, ingredient sourcing, and product formulations. In 2010, Unilever launched its Sustainable Living Plan, aiming to halve its environmental footprint by 2030. As part of this initiative, Unilever conducted LCAs for several products to identify opportunities to reduce water and energy consumption. For example, their analysis showed that "in total, nearly 60% of Unilever's greenhouse gas emissions come from raw materials and ingredients purchased, and identifying alternatives to fossil fuel-based chemicals will be the biggest challenge in achieving sustainable goals by 2039." To get closer to these sustainable objectives, the company collaborates with supplier partners to drastically reduce the impact of Scope 3 emissions. The most recent example is the collaboration of its Indian subsidiary with leading chemical companies TFL and OCI to test the production of near-zero-emission synthetic soda ash—a key ingredient in laundry powder (Unilever, 2023).

3.Satellite images - Pixel technology has its origins in the 1960s, when American engineer Frederic C. Billingsley first introduced the term "pixel" to describe the elements of images scanned by space probes to the Moon and Mars (Peddie, 2021). At that time, digital image processing and interpretation routines were primarily developed for the Earth sciences community. However, more recently, the practice has expanded and become more accessible to various users such as social scientists, farmers, agricultural companies, local governments, urban developers, and others. It has been established that such data collections "have potential scientific value for studying interactions between the environment and humans, particularly changes in land cover and use" (Liverman, 1998). Satellite imagery has become a powerful tool for companies seeking to measure and account for ecosystem resources in a sustainable way. By providing high-resolution, real-time data on land use, vegetation cover, water resources, and environmental changes, satellite technology enables businesses to make informed decisions that support sustainability goals. There are numerous subdomains where satellite imaging tools can be used, including: Environmental monitoring:

Table 1

The subdomains in which satellite imaging can be used

Subdomain	Description
Monitoring land use and land cover	Satellite imagery allows for comprehensive monitoring of land-use changes over time. Companies can use this information to assess the impact of their operations on ecosystems. For example, agricultural companies can analyze the expansion of farmland and its effects on surrounding habitats. These data can inform land management practices, enabling organizations to minimize ecological disruption and optimize land use for sustainable productivity.
Assessing vegetation and biodiversity:	Satellite images can be used to monitor vegetation health and biodiversity. Remote sensing technologies capture spectral data that indicate plant health, species distribution, and ecosystem resilience. Companies involved in forestry or agriculture can assess the health of crops or forests, allowing them to implement timely interventions to improve productivity while conserving biodiversity (Turner, 2015).
Water resource management	Monitoring water bodies and surrounding ecosystems is crucial for the sustainable management of resources. Satellite imagery can track changes in water levels, assess water quality, and detect pollution events. This capability is particularly important for industries dependent on water, such as agriculture and manufacturing. By understanding water availability and quality, companies can implement practices that reduce water consumption and mitigate environmental impacts.
Estimating carbon footprint:	Satellite data can play a significant role in estimating greenhouse gas emissions and carbon sequestration potential. Remote sensing provides insights into land cover changes and biomass estimates, which are essential for calculating carbon stocks and understanding the carbon footprint of various operations. For example, energy companies can use satellite imagery to monitor reforestation efforts and calculate associated carbon offsets (Pettorelli, 2014).

Source: Created by the author

The opportunities to create such images are numerous, as the digital imaging and data analysis industries have significantly developed in recent years. One example would be the Sentinel Hub. The Sentinel mission encompasses a series of Earth observation satellites that collect various types of data, including images, for environmental monitoring, land management, and more. Sentinel-1, Sentinel-2, and Sentinel-3 are the main satellite missions within the Copernicus program, providing different types of data.

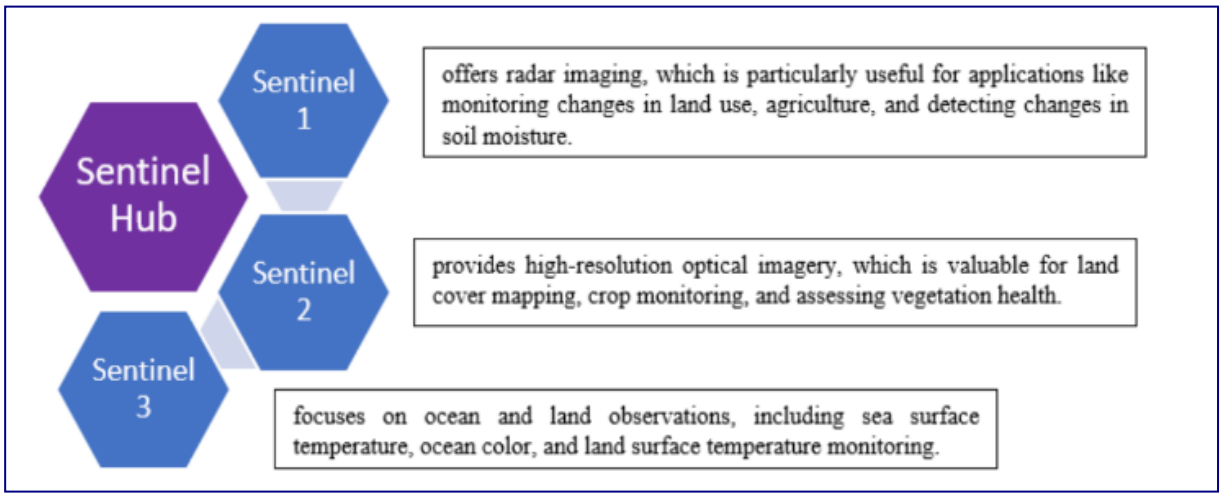

Figure 6: Copernicus satellite mission data

Source: Europe's eyes on Earth: the EU's Copernicus Programme

Accounting and **reporting** of ecosystem services involve introducing the measured data into the company's accounting systems and reports. Effective accounting and reporting help raise awareness about the importance of ecosystem services, promote sustainable practices, and support policies aimed at conserving natural resources for future generations. AI tools that are determined to aid businesses in the processes of ecosystem accounting and reporting are: Natural Language Generation (NLG) and Retrieval Augmented-Generation (RAG). Natural Language Generation (NLG) and Retrieval-Augmented Generation (RAG) are innovative technologies that can significantly enhance how companies account for natural resources and conduct sustainability reporting. As organizations face increasing pressure to demonstrate environmental responsibility, these tools facilitate the efficient processing of large datasets, generating clear narratives and improving communication with stakeholders. By utilizing NLG and RAG, companies can bolster their sustainability practices and provide transparent reporting on resource management. Some of the most common applications of NLG and RAG are:

- Automated Reporting: NLG automates the generation of sustainability reports, transforming complex data into easily readable text. Companies can use NLG to summarize resource consumption, emissions, and waste management practices in a structured format that complies with regulatory requirements. For instance, automated reporting helps organizations meet the demands of frameworks like the Global Reporting Initiative (GRI) and the Carbon Disclosure Project (CDP).
- Data Interpretation and Analysis: NLG can enhance data interpretation by generating insights from large datasets related to natural resource consumption. By translating data analysis into coherent narratives, organizations can identify trends, anomalies, and optimization opportunities. This understanding enables decision-makers to implement targeted strategies to improve resource use efficiency.
- Scenario Analysis: Companies can employ NLG to simulate various resource management scenarios, allowing them to understand the potential impacts of different strategies. NLG can generate narratives that explain the implications of adopting renewable energy sources or implementing waste reduction initiatives, helping organizations assess potential benefits and trade-offs.

The role of Retrieval-Augmented Generation (RAG) enhances NLG capabilities by integrating external knowledge sources into the narrative generation process. This hybrid approach combines generative models with retrieval mechanisms, enabling organizations to access updated information and contextual data from various databases.

- Contextualized Reporting: RAG can enhance sustainability reporting by integrating relevant data from multiple sources, including scientific studies, regulatory documents, and industry benchmarks. This ensures that reports are not only accurate but also rich in context.
- Enhanced Decision Support: By providing access to the latest information and research, RAG supports more informed decision-making. Companies can leverage this technology to identify best practices in sustainability, benchmark their performance against industry standards, and discover innovative solutions for resource management.
- Increased Transparency: The enhanced reporting capabilities promote transparency in resource management practices, positively influencing relationships with stakeholders and enhancing corporate reputation.

Conclusions

Artificial Intelligence (AI) tools, including machine learning algorithms, Natural Language Generation (NLG), and data-driven modeling, have proven essential for measuring, accounting for, and reporting ecosystem services. Ecosystem services refer to the benefits that humans derive from nature, such as clean air, water filtration, and carbon sequestration, and are recognized as critical for both environmental sustainability and economic growth. AI technologies offer innovative solutions to the challenges of quantifying and managing these services by automating data collection, improving resource accounting accuracy, and enhancing sustainability reporting quality. AI tools, such as satellite imagery, remote sensing, and machine learning algorithms, can process large-scale environmental data in real-time. This capability is particularly beneficial for monitoring complex and dynamic ecosystem processes, such as changes in forest cover, water quality, or biodiversity. AI enables more accurate and continuous monitoring of ecosystem services, which is essential for both conservation efforts and resource management. Additionally, AI tools enhance the quantification of ecosystem services by integrating multiple data streams and providing sophisticated predictive models. Machine learning algorithms can analyze historical data and environmental variables to estimate the value of ecosystem services, including carbon sequestration potential, pollination services, and water purification. These models provide reliable estimates of the economic and environmental benefits offered by ecosystems, which can inform decision-making for land use planning, resource allocation, and regulatory compliance. Moreover, AI can automate sustainability reporting through tools like NLG. By converting data into clear and coherent narratives, NLG allows organizations to produce accurate reports that comply with regulatory requirements and demonstrate transparency to stakeholders. These automated reports can track key performance indicators related to ecosystem services, such as greenhouse gas emission reductions or improvements in water quality, facilitating the communication of companies' environmental performance and their alignment with sustainability goals.

Despite their transformative potential, AI tools are not without limitations. One major limitation is the quality and availability of data. AI systems rely on large volumes of high-quality data to function effectively. In many regions, particularly in developing countries, there may be insufficient data on ecosystem services or inadequate technological infrastructure to support monitoring efforts. This can lead to gaps in AI models, reducing their accuracy and reliability. Addressing this issue requires investments in data collection infrastructure, especially in areas where ecosystems are most vulnerable. Another concern is algorithmic bias. AI systems can perpetuate or even amplify existing biases if trained on skewed or incomplete datasets. To mitigate this risk, implementing rigorous validation processes and combining AI results with human expertise is essential to ensure balanced and equitable decision-making. Interpretability and transparency also present challenges. AI models, especially deep learning algorithms, are often described as "black boxes" due to their complexity and lack of transparency. Stakeholders may struggle to understand how AI arrives at specific conclusions or predictions, making it difficult to trust the results. This lack of transparency can be problematic in sustainability reporting, where accountability is crucial. Lastly, ethical considerations must also be taken into account. The implementation of AI tools in managing ecosystem services raises questions about potential unintended consequences, such as job losses in industries reliant on manual environmental monitoring or the misuse of AI

technologies to artificially enhance environmental outcomes (greenwashing). Companies must ensure that the adoption of AI aligns with ethical standards and contributes significantly to authentic sustainability outcomes. To overcome these challenges, a multifaceted approach is needed. First, improving data accessibility and quality is essential. Governments, companies, and NGOs should invest in developing open, high-quality environmental databases that can be used to train AI systems. Collaborations between academic institutions, industry, and public agencies can help fill data gaps. Second, ensuring algorithmic fairness and inclusivity is critical. This can be achieved by adopting diverse datasets that represent a wide range of ecosystems and integrating feedback from local stakeholders in data-scarce regions. Involving environmental scientists and experts in AI development can help address bias and equity issues. Finally, promoting transparency and accountability is crucial. Companies should prioritize the use of explainable AI models that allow stakeholders to understand how decisions are made. Additionally, AI outcomes should be validated by human experts to ensure accuracy and ethical compliance. Integrating human oversight into AI-based decision-making processes will not only enhance trust in technology but also lead to more responsible management of natural resources.

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NAVIGATING SUSTAINABILITY AND GROWTH: AFRICA'S PATH TO A RESILIENT FUTURE

Eduard MARINOV [33]

Abstract:

The pursuit of sustainable development in Africa is becoming increasingly critical in light of the exacerbation of environmental vulnerabilities resulting from climate change. Despite contributing less than 4% of global greenhouse gas emissions, the continent faces significant challenges, including droughts and energy access issues that threaten economic stability. This article examines the interdependent relationship between sustainability efforts and economic growth in Africa, proposing that a transition towards renewable energy can stimulate industrial growth and generate employment opportunities. A SWOT analysis is employed to facilitate a systematic evaluation of the benefits and challenges associated with the green transition, with particular attention paid to the potential barriers. The article presents some policy recommendations for integrating sustainability into national strategies and urges the global community to enhance support for Africa's green transition, with the objective of achieving a resilient future.

Keywords: *Sustainability, Economic Growth, Renewable Energy, Climate Change, Africa*

JEL classification: *O55, Q01, Q5*

Introduction

As the impacts of climate change intensify worldwide, the pursuit of sustainable development has become a pressing concern for nations, particularly in Africa, which remains one of the most vulnerable regions to climate-related threats. Despite representing less than 4% of global greenhouse gas emissions (AJLabs, 2023), Africa is confronted with significant environmental challenges, including rising temperatures, extreme weather events, and a decline in agricultural productivity. These challenges have the potential to jeopardise the continent's ecological health, economic growth and social stability, with the result that millions of people are pushed further into poverty.

In the context of these pressing issues, African nations are confronted with the dual imperative of fostering economic growth while embracing sustainability. This balancing act is complex; traditional models of development often rely on the extraction of natural resources, which may prove detrimental to long-term sustainability goals. Nevertheless, a transition towards more environmentally-friendly practices and renewable energy sources could facilitate new avenues for economic growth, generate employment opportunities and enhance resilience against climate change.

This article examines the complex interrelationship between Africa's sustainability endeavours and economic growth, elucidating how these two elements can act as both impediments and avenues towards a more prosperous future. A SWOT analysis is employed in the paper to identify the strengths, weaknesses, opportunities and threats associated with

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the green transition in Africa. Furthermore, the analysis examines the current status of Africa's sustainability journey, the potential for future growth, and the implications of these transitions for local communities and global stakeholders.

By investigating these dynamics, this paper aims to provide a comprehensive understanding of the opportunities and challenges that lie ahead for Africa in navigating its path toward a sustainable and economically viable future. The analysis is based on a comprehensive review of existing literature, policies, and reports related to Africa's sustainability efforts. It synthesises insights and evidence regarding the current state of sustainability challenges on the continent. This comprehensive perspective will facilitate a balanced discussion of the inherent opportunities and challenges associated with Africa's pursuit of sustainable development and economic resilience.

This article is structured into several principal sections, which systematically explore the sustainability efforts of Africa and their implications for economic growth. Subsequently, Section 1 considers the wider context of sustainability and environmental challenges as determinants of structural change in the global economy. Section 2 explores the intricate relationship between economic growth and sustainability in Africa, elucidating the distinctive challenges and prospects that the continent is confronted with. Section 3 delineates prospective outcomes, emphasising the potential for gas resources and renewable energy to converge with economic advancement. Finally, Section 4 examines the advantages and disadvantages of the green transition for Africa, culminating in a synthesis of the findings and recommendations for African policymakers and the international community.

Sustainability and environmental challenges as determinants of structural change in the world economy

In order to gain insight into the particular dynamics at play in Africa, it is first necessary to examine the broader context of sustainability and environmental challenges as determinants of structural change in the global economy.

The growing awareness of the importance of environmental sustainability is exerting an influence on the structure of world trade. The adoption of sustainable practices is becoming a pivotal consideration for both businesses and consumers (Bobeva et al., 2023). Environmental sustainability is emerging as a significant factor influencing the configuration of trade patterns.

The ascendance of green trade policies and regulations reflects a global commitment to addressing climate change and advancing sustainable development (Zhelyazkova, 2020). Adoption of environmentally responsible practices confers a competitive advantage on countries and businesses in the international marketplace (Spasova, 2024; Zhelyazkova, 2024). An analysis of the nexus between environmental considerations and trade structures offers insight into the evolving landscape of global trade, where sustainable practices are becoming an integral part of decision-making processes by businesses and policymakers (Sabotinova, 2020).

The global supply chain is becoming increasingly susceptible to environmental challenges, including climate change, extreme weather events and resource scarcity. In order to enhance resilience and offset the effects of environmental uncertainty, businesses and nations are modifying their strategies for engaging in supply chains. The development of the circular economy, responsible sourcing practices and green logistics solutions represent measures taken to address environmental risks in global supply chains (Zhelyazkova, 2017).

Global awareness related to environmental sustainability is increasingly influencing the structure of international trade. Businesses and nations are coming to recognise the need to

adopt sustainable practices that minimise environmental impacts (Georgieva and Brunzova, 2024). The term "sustainable practices" encompasses a range of activities, including the utilisation of environmentally friendly production methods, the implementation of energy-efficient transportation solutions, and compliance with rigorous environmental regulations. The concept of sustainability is becoming an increasingly significant factor in the development of trade policy models.

The adoption of sustainable practices is becoming a strategic imperative for businesses seeking to align themselves with consumer preferences and meet evolving regulatory standards (Angelova, 2024). The integration of sustainability into production processes and supply chains represents not only a response to market demands, but also a proactive measure to mitigate environmental risks.

The global supply chains, which function as the primary conduits of international trade, are becoming increasingly vulnerable to environmental challenges. The occurrence of climate change, extreme weather events and resource scarcity creates a risk of disruption to the flow of goods across borders.

Sustainability strategies encompass the development of green and circular business models, responsible sourcing practices, and the implementation of environmentally friendly logistics solutions (Dimova and Karpuzova, 2024). A circular economy is one which prioritises the reduction of waste and the maximisation of product life cycles. This contributes to a more sustainable and resource-efficient approach to both production and consumption. Responsible sourcing practices are associated with ethical and environmentally conscious sourcing decisions, thereby ensuring that supply chains adhere to high sustainability standards.

The significance of integrating sustainability into business strategic planning and national policy formulation is growing. By promoting sustainable supply chains that address environmental risks, stakeholders can contribute to the development of a more sustainable and resilient global trading system. In an era characterised by heightened environmental awareness, integrating these considerations not only confers a competitive advantage but also constitutes an indispensable aspect of responsible and forward-thinking production and trade practices (Karpuzova, 2022).

Having established the role of sustainability in global trade as a foundational concept, we now direct our attention to Africa. In this region, the interplay between economic growth and sustainability reveals both unique challenges and opportunities.

Africa’s path between economic growth and sustainability: Current state of play

Despite Africa accounting for less than 4% of all global greenhouse gas emissions (AJLabs, 2023), numerous countries in the continent are confronted with considerable challenges posed by climate change. These include increased occurrences of droughts, floods, heat waves, and potential crop failures (Nartey, 2024). The financial impact of climate change on the continent is estimated to be between USD 5 billion and USD 7 billion annually, with projections indicating a potential increase to USD 50 billion by 2030 (AfDB, 2024). It is estimated that the impact of climate change could push 50 million Africans below the poverty line, while 100 million are at risk of being displaced. Concurrently, approximately 600 million individuals in Africa remain without access to energy, a prerequisite for economic advancement (WB, 2021).

It is of the utmost importance to address the dual challenges of sustainable development – ensuring the fulfilment of present needs in a manner that does not compromise the future –

and economic growth in Africa. This was a central theme at the inaugural Africa Climate Summit, held in Nairobi last September. However, these challenges are typically regarded as being mutually exclusive. Such matters are frequently discussed in isolation. It is imperative that this discourse undergoes a transformation. It is imperative to recognise that sustainable development and economic growth are inextricably linked, with one being inconceivable without the other (Nartey, 2024).

In light of Nartey's research into the role of multinational firms in the development of emerging markets, it can be argued that the debates surrounding the relationship between economic growth and sustainable development in commodity-rich African countries have lacked a crucial element: an acknowledgement of the interdependence of these two objectives. The question, therefore, remains: should these countries prioritise the utilisation of their natural resources for economic growth, potentially at the expense of the environment, or should they pursue alternative avenues that recognise the intrinsic link between sustainable development and economic growth?

Africa is highly dependent on the extraction of natural resources for its economy, including oil, gas, and minerals such as copper, cobalt, gold, and diamonds. Indeed, 45 African economies are already reliant on commodity exports, including fossil fuels (UNCTAD, 2021). Nevertheless, they are confronted with mounting pressure to eschew this potentially lucrative revenue stream.

It is imperative that the discussion of bypassing simplistic answers to this issue be given due consideration. It is not unreasonable for people across Africa to demand the same economic opportunities that are already enjoyed by those in the global north. In order to achieve this, many African countries believe that the most obvious solution is to adopt the economic development model employed by currently developed countries, which involves exploiting their relatively untapped natural resources. It is a fundamental reality in many African countries that the utilisation of the natural materials that are found within their borders is of paramount importance if they are to sustain their economic development.

It has been asserted that Africa has the potential to become a significant contributor to the global effort towards decarbonisation, with the capacity to leverage its renewable energy resources as a green industrial hub (MIF, 2023). Nevertheless, the realisation of this technological transformation is contingent upon the availability of raw materials. It is imperative that companies identify more sustainable methods of extracting resources, while ensuring minimal environmental impact. Fortunately, this is already occurring. Mining companies such as KoBold Metals, which is backed by the Microsoft founder Bill Gates, are utilising artificial intelligence to forecast the location of deposits, thereby reducing the adverse environmental impact of exploratory drilling (Nartey, 2024). Furthermore, firms are investigating the potential of keyhole mining technology to reduce the necessity for open mines, which have significant environmental consequences.

Contextual considerations also play a pivotal role. For a green revolution to succeed, it is essential to have sufficient financial resources, innovative solutions, and cutting-edge technology. However, recent reports have highlighted that green technology has predominantly been designed, tested, and implemented in developed countries, which presents significant challenges in its application in developing countries. Furthermore, ambitious sustainable solutions, such as wind farms, public transport networks, or geothermal plants, often encounter obstacles due to the urgent need for immediate energy solutions at the local level.

It is noteworthy that at the Africa Climate Summit in September 2023, stakeholders acknowledged the necessity of effectively engaging the appropriate stakeholders. It is imperative that the development of environmentally-friendly initiatives benefits as many local stakeholders as possible. Although there is an expectation that governments will spearhead

this discourse, it is imperative that companies assume a commensurate responsibility and possess a nuanced comprehension of the local context and needs.

Notwithstanding these encouraging indications, obstacles persist. The current state of energy access in Africa provides an illustrative example of the complexities that persist in this field. It is estimated that over 600 million people in Africa lack access to electricity, while the 46 percent of the population that does utilise less energy than all of Spain combined (Tobin and Sparkman, 2022). The lack of energy access impedes economic growth and constrains the continent's potential in comparison to other developing regions. As the population continues to grow at a rapid pace, the demand for reliable energy, secure employment opportunities and a sustainable future will continue to increase, making energy accessibility a critical issue.

The United Nations Economic Commission for Africa (UNECA) has set forth the necessity of establishing a Just and Sustainable Transition (JST) for Africa. To this end, the Commission has proposed an investment framework designed to capitalise on the continent's rich natural resources while transitioning towards renewable energy and achieving universal energy access (UNECA, 2024). The report highlights the potential of Africa's youthful population, arable land, strategic mineral deposits and latecomer advantages in technology to drive a sustainable energy transition. Nevertheless, the realisation of these prospects hinges on substantial enhancements in investment, infrastructure development and the integration of sustainability into national economic strategies.

As discussions progress, it becomes evident that the strategies implemented at this juncture will have a profound impact on Africa's trajectory in terms of growth, energy access, and sustainability in the future. The current state of affairs entails navigating the intricate interrelationship between resource dependence, climate impacts, and aspirations for a sustainable and economically resilient future.

What to expect: For Africa, economic growth and sustainability intersect

Having examined the present situation with regard to Africa's sustainability initiatives and their relationship to economic growth, we may now turn our attention to future expectations, with a particular focus on the potential of gas resources and renewable energy to stimulate economic development.

The development of Africa's rich gas resources has become a topic of contention in the context of the global drive to reduce emissions and mitigate climate change. The development of African gas has the potential to facilitate the growth of Africa's broader industrial economy and support the transition to renewable sources, as well as the electrification of end-use sectors. In the near term, the development of gas resources offers an opportunity for the continent to industrialise, thereby increasing the economic growth and industrialisation necessary for the construction of renewable energy infrastructure and the attraction of investment through a cleaner pathway than that of coal-based industrialisation, which was the route taken by developed economies to achieve their current levels of prosperity.

The International Energy Agency's (IEA) Africa Energy Outlook 2022 identifies energy access in Africa as a critical enabler of economic growth. According to IEA Executive Director Fatih Birol, the most significant obstacle to economic development in Africa is the lack of energy access (IEA, 2023). Over the past decade, the global community has identified the expansion of energy access in Africa as a priority area of concern. However, the economic pressures resulting from the pandemic on unstable power markets and the rising costs of liquefied petroleum gas (LPG) have led to a 4 percent decrease in modern

energy services (electricity and clean cooking fuels) between 2019 and 2021. This reversal of progress in meeting UN Sustainable Development Goal 7 – affordable, reliable, sustainable, and modern energy for all – should be regarded as a significant cause for concern with regard to Africa's sustainable growth aspirations. It is therefore imperative that global policymakers and financiers pay close attention to this issue in advance of COP27.

In recent years, international institutions have articulated commitments to divest entirely from fossil fuel infrastructure projects. Notable examples include the US Department of the Treasury's response to President Biden's Executive Order 14008, which terminated direct investments in coal and oil projects abroad, and the European Investment Bank's Energy Lending Policy, which gradually ceased to provide financial assistance for energy projects that relied on unabated fossil fuels (Tobin and Sparkman, 2022). This has prompted debate on the feasibility of immediate transition to renewable power generation in energy-poor sub-Saharan African nations, which lack both stable baseload generation and scaled transmission infrastructure. Furthermore, the question of whether it is possible to decarbonise industrial and agricultural processes in these countries is a particularly problematic aspect of this debate.

The answer to this conundrum is not straightforward. It is evident that there are considerable differences in energy needs and resources across the continent. Households represent the largest source of electricity demand in Africa and are an area where off-grid renewable solutions offer significant and immediate promise, particularly via distributed solar. This offers the opportunity for rural communities with little to no near-term hope for interconnection to develop localised power. Conversely, substantial proportions of grid-supplied power in sub-Saharan nations such as Kenya and Ethiopia have come from carbon-free baseload generation due to abundant geothermal and hydroelectric resources.

However, the availability of resources for the deployment of non-intermittent renewable energy in Africa is unfortunately not ubiquitous. Although resources such as solar and wind are becoming increasingly cost-competitive and hold significant potential, their intermittency continues to present a challenge. In the absence of a substantial expansion of solutions for baseload generation or the deployment of enabling technologies such as battery storage and transmission, it is not yet feasible for renewables to provide sufficient power to guarantee consistent meeting of demand. This dynamic is particularly evident in sub-Saharan Africa, where well-developed transmission systems frequently experience outages and where cost-recoverability issues deter investment.

Nevertheless, the possibility of an African continent with dependable access to energy in accordance with the IEA's net-zero scenario is more imminent than one might assume. The optimal solution to achieve the IEA's Sustainable Africa Scenario (SAS), which represents Africa's pathway for meeting the global net-zero scenario, is not to immediately cease all forms of fossil fuel production. Instead, it is to permit the continent to fuel its economic growth with natural gas in the near term while accelerating renewable energy deployment in tandem, with the objective of transitioning to an increasingly renewable mix in the medium to long term. The discovery of gas in Africa between 2010 and 2020 represented 40% of all global gas discoveries, raising the continent's undeveloped reserves to over 5 trillion cubic metres (tcm) and placing several African nations among the top 15 in terms of proven reserves. It is also noteworthy that the development of all of Africa's untapped gas resources would result in a marginal increase in the continent's emissions, raising them from less than 3% to just 3.5% of global energy-related CO2 emissions since 1890 (IEA, 2023).

The industrialisation of developing countries without reliance on natural gas presents a number of challenges, particularly in light of the "green premium" that developed nations may afford. The production of industrial process heat is contingent upon natural gas, which is also a vital input for fertilisers and other chemicals. This enables Africa to establish an industrial

sector that drives economic development and enhances agricultural self-reliance in the context of global food insecurity. It is estimated that projects in localities including Mozambique, the Democratic Republic of the Congo, Tanzania, Angola, Senegal, and Mauritania could yield 90 billion cubic metres (bcm) of gas, 30 bcm of which is projected to be available for export. This would generate additional revenue for sub-Saharan governments that are increasingly burdened by debt (Tobin and Sparkman, 2022).

Nevertheless, the natural gas development path will not result in Africa reaching its climate or development goals without further measures being taken. It is also imperative that renewable energy be employed to facilitate the expansion of energy access to communities that are currently underserved and to reinforce Africa's position as a key contributor to a global net-zero future. In accordance with the SAS, it is imperative that 80 percent of Africa's primary energy generation be derived from renewable sources. Given that Africa possesses 60 percent of the world's most favourable solar resources, there is an opportunity to reshape its energy sector into one that is low-emissions and reliable. Nevertheless, despite this potential, the proportion of global installed solar capacity currently located in Africa is only 1 percent (IEA, 2023).

The most significant obstacle to the construction of the requisite infrastructure for the realisation of the SAS is undoubtedly the lack of access to capital. Not all markets in Africa are yet prepared for substantial investments in intermittent renewable energy systems due to a dearth of supporting infrastructure. Consequently, there is an urgent need to prioritise the fostering of economic development in sub-Saharan nations through industrial growth and enhanced electricity access. Such growth will facilitate the development of the necessary infrastructure to stimulate energy demand and build economies of scale, while prioritising the utilisation of low-carbon and reliable energy sources.

In order to facilitate this transition, it is imperative that natural gas is utilised as a source of baseload generation and industrial process heat. This will provide Africa with a clear impetus to develop its gas resources in order to fuel its growth. A flourishing industrial Africa has the potential to reinforce investor confidence, thereby attracting the international capital essential for the deployment of the renewable energy systems that are vital for achieving an 80-percent-renewables future.

In response to these challenges, the private sector has played a significant role in the deployment of renewable energy projects across the continent. In communities that are difficult to access, micro-hydro or mini-grid projects offer a more viable and promising means of increasing energy access than large-scale grid generation. To illustrate, since the inception of South Africa's Renewable Energy Independent Power Producer Procurement (REIPPP) programme, independent power producers have initiated 95 renewable energy projects, with an estimated combined capacity of 3.27 gigawatts (GW) upon full operation. Similarly, the GET FiT programmes in East African countries have facilitated the deployment of renewable energy in Uganda and Zambia (Tobin and Sparkman, 2022).

On a larger scale, there are the 2.4 GW Batoka Gorge hydroelectric power project, which serves Zambia and Zimbabwe, as well as the 6.45-GW Grand Ethiopian Renaissance Dam. In Morocco, the objective is to generate 52 percent of its generation capacity from renewable energy by 2030. In Kenya, renewable energy already accounts for approximately 90 percent of the country's power (Tobin and Sparkman, 2022).

Nevertheless, the realisation of these individual successes on a continent-wide scale will be contingent upon the availability of financial resources. It is evident that the private sector will have a more prominent role in the future. In 2018, only 12% of the continent's infrastructure financing was provided by the private sector, whereas African governments themselves exceeded this level of investment by threefold. The full realisation of the SAS will necessitate a substantial increase in investor confidence in African markets, which will in turn facilitate a

significant expansion in Africa's access to international capital for energy infrastructure development. It is estimated that an annual increase to a figure of USD190 billion between 2026 and 2030 would enable Africa to meet the provisions of the SAS by reaching an energy mix of at least 80 percent renewable sources, supplemented by gas for industry and baseload power. In light of the projected growth in primary energy demand in Africa, which is expected to reach up to fivefold by 2050 (Bel, 2023), the costs associated with postponing these investments are likely to be significant.

The pros and cons of green transition for Africa

As we consider the future of Africa's energy landscape, it is crucial to weigh the pros and cons of the green transition, which presents a complex range of opportunities and challenges that must be navigated thoughtfully. The green transition in Africa presents both opportunities and challenges that must be navigated thoughtfully to ensure sustainable economic growth and environmental protection. An analysis of these pros and cons (Table 1) provides a clearer view of the implications for the continent.

Table 1

The Pros and Cons of the Green Transition for Africa

Pros of the Green Transition	Cons of the Green Transition
Economic Opportunities	Inadequate Infrastructure
Alignment with Global Goals	Rising Energy Access Inequality
Resilience Against Climate Change	Reliance on Resource Extraction
Diverse Employment Opportunities	Contextual Challenges

Source: Created by the author

The green transition offers Africa a substantial economic opportunity through the advancement of renewable energy resources, which can stimulate industrial expansion, generate employment, and align with global sustainability goals:

- The transition towards renewable energy sources presents Africa with a significant opportunity to utilise its abundant solar, wind and hydro resources. With 60 percent of the world's most favourable solar resources, Africa has the potential to significantly transform its energy sector into a low-emissions and dependable system (IEA, 2023). Furthermore, this transition could result in a reduction in dependence on fossil fuels, thereby creating an environment conducive to investment in renewable energy infrastructure, which can support industrial growth and job creation.
- The green transition enables African countries to align with global sustainability objectives and climate change agreements, thereby enhancing international cooperation and support. By committing to sustainable practices, African nations may potentially gain access to climate finance and technology transfer agreements that facilitate their development goals (UNECA, 2024).
- The implementation of renewable energy technologies serves to mitigate the risks posed by climate change, which has a disproportionate impact on Africa despite its relatively low contribution to global emissions (AJLabs, 2023). As evidenced in the discussions around climate vulnerability, green transitions can serve to enhance resilience against extreme weather events, such as droughts and floods, which have the potential to threaten agricultural productivity and economic stability (AfDB, 2024).
- A shift towards a greener economy has the potential to create a significant number of employment opportunities in new sectors, including renewable energy, sustainable

agriculture and green technologies. For instance, independent power producers in South Africa have initiated numerous projects under the Renewable Energy Independent Power Producer Procurement (REIPPP) programme, resulting in substantial advances in renewable energy capacity (Tobin and Sparkman, 2022).

Nevertheless, obstacles such as insufficient infrastructure, financial limitations, growing disparities in energy access, and the dependence on resource extraction for renewable technology present considerable threats to the successful realisation of a sustainable green transition in Africa:

- One of the most significant challenges to the green transition is the lack of adequate infrastructure and financing mechanisms. It is not yet feasible to make large-scale investments in renewable energy systems in all African markets due to the lack of adequate infrastructure (Bel, 2023). The estimated annual investment requirement of USD190 billion for the period 2026 to 2030 underscores the financial gap that must be bridged to support this transition (Bel, 2023).
- While the objective is to achieve a green energy future, there is a risk that energy access may become more unequal. It is estimated that over 600 million people in Africa currently lack access to electricity. Without careful planning, the push towards large-scale renewable projects may exacerbate existing inequalities, particularly in rural and underserved communities (Tobin and Sparkman, 2022).
- It is possible that the green transition may necessitate the continued reliance on the extraction of critical minerals, which are required for the construction of renewable energy technologies, including batteries and solar panels. Those countries that are highly dependent on the extraction of oil, gas and minerals may be required to balance economic growth against environmental sustainability, which could result in conflicts between their development paths and green commitments (Nartey, 2024).
- The transition to green technologies frequently necessitates the development of sophisticated infrastructure and the expansion of human capital, which can impose considerable pressure on economies that are already contending with a multitude of developmental challenges. Green technologies are frequently designed and tested in developed nations and may not align adequately with the specific contexts of Africa, potentially leading to implementation failures (Ikejemba et al., 2017).

In order to provide a comprehensive overview of the potential implications of the green transition for Africa, an attempt has been made to summarise these implications in the form of a SWOT analysis (Table 2).

This framework offers a comprehensive overview of the internal capabilities and external challenges that Africa is confronted with as it strives to align its sustainability endeavours with economic growth. By identifying the pivotal factors that shape the transition to renewable energy, stakeholders can gain a deeper understanding of how to harness Africa's abundant resources and innovative potential, while addressing critical barriers such as inadequate infrastructure and energy access disparities. The SWOT table encapsulates these dynamics, offering insights that can inform policymakers, businesses, and the global community in fostering a sustainable future for Africa.

The SWOT analysis illuminates the complex and multifaceted landscape of Africa's green transition, elucidating both significant potential and notable challenges. On a positive note, Africa's rich natural resources, particularly those related to renewable energy, such as solar, wind, and hydro, provide a robust foundation for economic growth and an opportunity to align with global sustainability goals. This presents an opportunity for the creation of new employment opportunities and the development of industrial capacity, which could play a pivotal role in addressing the continent's high unemployment rates. Moreover, the growing

global focus on climate change has opened up avenues for international collaboration and financial assistance, thereby strengthening local initiatives to adopt sustainable practices.

Table 2

SWOT Analysis on Africa's Green Transition

Strengths:	**Weaknesses:**
Potential for Economic Growth: The green transition promises substantial job creation and industrial growth through renewable energy initiatives ***Alignment with Global Climate Goals***: Commitment to sustainability can enhance international cooperation and access to climate finance ***Diverse Resource Availability***: Abundant natural resources, especially solar, wind, and hydro power, position Africa favorably for renewable energy development	***Inadequate Infrastructure***: Many African countries lack the necessary infrastructure for large-scale renewable energy investments, hindering progress ***Energy Access Inequality***: Over 600 million people still lack electricity, which raises concerns about equity in energy access during the transition ***Implementation Risks***: Green technologies often require advanced infrastructure and may not be suitable for local contexts, leading to potential failures
Opportunities:	**Threats:**
Technological Advancements: Innovations in renewable technologies present opportunities for sustainable practices to be implemented effectively across the continent ***Global Support***: Enhanced international focus on climate change can lead to increased funding and technological assistance for African nations ***Capacity Building***: There is an opportunity to develop local expertise and infrastructure for sustainable energy systems, fostering economic self-reliance	***Resource Dependence***: Continued reliance on natural resource extraction raises environmental sustainability concerns and may lead to conflicts over resource use ***Global Economic Pressures***: Fluctuating global energy markets and the withdrawal of financial support for fossil fuel projects could impact economic stability ***Climate Vulnerability***: Africa remains highly vulnerable to climate change impacts, which can undermine development gains and hinder the transition to greener practices

Source: Created by the author

Conversely, the analysis identifies several weaknesses and threats that must be addressed in order to ensure the success of the transition. Inadequate infrastructure and disparities in energy access present substantial obstacles to the implementation of large-scale renewable energy projects. The risk of exacerbating existing inequalities is heightened by the fact that over 600 million people lack access to electricity, and the transition must therefore be carefully managed. Furthermore, the dependence on natural resource exploitation gives rise to concerns regarding environmental sustainability and may give rise to potential conflicts over the allocation of resources. The susceptibility to climate impacts serves to further complicate the landscape, with the potential to undermine development efforts. It is therefore imperative to address these weaknesses while leveraging the continent's strengths and opportunities in order to foster a resilient and economically viable green transition.

In conclusion, while the green transition offers significant potential for economic growth, environmental sustainability, and alignment with global climate goals in Africa, it also presents considerable challenges that must be addressed. It is therefore essential to strike a balance between these pros and cons in order to maximise the benefits of a green transition while minimising adverse impacts on the continent's development trajectory.

Conclusion

In conclusion, an objective assessment of the merits and disadvantages of the green transition reveals a broader insight into the future of Africa's pursuit of sustainable economic growth. The African continent finds itself at a pivotal juncture in its pursuit of sustainability and economic advancement. This article emphasises that although the continent contributes a negligible proportion of global greenhouse gas emissions, it is disproportionately affected by climate change, experiencing severe droughts, floods and resource scarcity. It is of the utmost importance to recognise that sustainable development and economic growth are interdependent if we are to create a more prosperous future. The green transition offers substantial prospects for leveraging Africa's substantial renewable energy resources, stimulating industrial growth, and expanding employment opportunities. However, these opportunities must be considered with caution, given the challenges posed by inadequate infrastructure, financial constraints, and the complexities of resource extraction.

In order to achieve a sustainable and economically resilient future, it is imperative that African policymakers prioritise investments in both renewable energy infrastructure and technologies that promote sustainability. Enhanced collaboration with international partners can facilitate access to climate finance and technology transfer, which are essential for implementing innovative projects. Furthermore, leveraging Africa's youthful population and rich natural resources can drive economic diversification while addressing energy disparities. It is of the utmost importance to involve local stakeholders in the development process to ensure that solutions are tailored to the unique contexts and needs of different communities. By fostering inclusive development that integrates sustainability into national policies, African nations can set an example for the rest of the world of balancing economic growth with environmental responsibility, paving the way for a more equitable and sustainable future.

It is imperative that international institutions and the global community acknowledge the distinctive challenges and prospects of Africa in the context of the green transition. This entails the provision of targeted financial assistance and incentives that prioritise investments in sustainable energy projects, in addition to the facilitation of capacity-building initiatives with the objective of enhancing local expertise and infrastructure development. Furthermore, global stakeholders should advocate for the equitable inclusion of African nations in international dialogues on climate change and sustainable development, ensuring that their voices are heard and their specific needs are addressed in the formulation of global policies. A collective, supportive approach will be essential to fostering a sustainable future for Africa and the world.

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ASSESSING THE IMPACT OF DIGITAL SUSTAINABILITY ON INCLUSIVE ECONOMIC GROWTH: A COMPREHENSIVE REVIEW

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Abstract:

This study investigates the potential of digital sustainability in fostering inclusive economic growth through a systematic literature review of 150 studies published from 2002 to 2023. Through a rigorous content analysis, we identified 28 highly relevant studies illustrating how digital technologies can bridge socioeconomic divides, enhance access to resources, facilitate job creation and skill development, and improve urban planning, ultimately fostering a more supportive and inclusive societal ecosystem. However, a notable gap persists: the economic inclusive effects of digital sustainability are still underrepresented in existing literature. This underscores the necessity for a targeted research agenda to define theoretical frameworks and actionable managerial strategies that align digital sustainability efforts with inclusive growth goals. We advocate for future research to prioritize understanding the mechanisms enabling effective outcomes and evaluating long-term impacts, ultimately contributing to a more equitable digital economy.

Keywords: *Digital sustainability, Inclusive economic growth, Digital technologies, Systematic Literature Review, Content analysis*

JEL classification: *O32, O33, D63*

Introduction

In the contemporary era, digital technologies have become essential drivers of economic and social development, shaping various aspects of daily life, business operations, and governance structures. The concept of digital sustainability has emerged as a framework that emphasizes the responsible and equitable use of digital technologies to promote environmental protection and social inclusivity (Floridi, 2020; Radu, 2023). This approach aims to ensure that rapid advancements in digital tools and platforms contribute positively to sustainable development goals (SDGs), particularly by fostering inclusive economic growth (United Nations, 2022).

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Inclusive economic growth refers to an expansion of economic activity that is equitably distributed across society, providing opportunities for all individuals to participate in and benefit from economic progress (World Bank, 2021). Participate in the economic progress means “that the effort to advance a country’s growth and development should be produced with the contribution of all citizens without excluding an important group of the society” (Cabeza- García et al., 2018), as women or marginalized communities. Benefit from economic growth implies delivering progress to society as a whole, which means that “the benefits of increased prosperity and productivity are shared more evenly between people and translate into an increase in well-being across society” (Brys et al., 2016).

The integration of digital technologies across various sectors holds significant potential to bridge socioeconomic divides, improve access to essential services, and create new opportunities for employment and skills development (OECD, 2023). Existing research highlights how digital technologies, such as artificial intelligence (AI), big data, blockchain, and the Internet of Things (IoT), can drive sustainability and economic progress (European Commission, 2022; Gholami et al., 2023). For instance, mobile banking and digital financial platforms have facilitated financial inclusion for marginalized communities, particularly in developing economies, by offering access to banking services where traditional financial infrastructure is lacking (Demirgüç-Kunt et al., 2022). However, as Daud et al. (2023) emphasize, achieving widespread financial inclusion through digital solutions remains challenging due to multiple structural barriers, including inadequate financial infrastructure, cultural and social constraints, disparities in financial literacy, and systemic exclusions based on demographic factors such as race, gender, and socioeconomic background. Addressing these obstacles requires targeted policies and digital innovations that ensure equitable access to financial services.

Beyond financial inclusion, digital transformation has also enhance access to education and skills development through online learning platforms and digital training programs, which have been particularly effective in bridging educational gaps in underserved regions (Gottschalk and Weise, 2023). Moreover, the expansion of e-commerce and digital entrepreneurship has enabled small and medium-sized enterprises (SMEs) to reach broader markets, reducing entry barriers for women and minority-owned businesses (Gloria et al., 2017). Additionally, remote work and digital labor platforms have created new employment opportunities for individuals in rural areas and for those facing mobility constraints, such as persons with disabilities (ILO, 2023). Similarly, smart cities and digital governance initiatives have optimized urban planning, reduced energy consumption, and improved public service accessibility, enhancing economic opportunities in both urban and rural contexts (Shao and Min, 2025).

However, the relationship between digital sustainability and inclusive economic growth remains complex and requires a more systematic examination (Zuboff, 2019). While numerous studies have examined the environmental benefits of digital technologies (GeSI, 2021) or their impact on economic expansion in general (Brennen & Kreiss, 2016), relatively few have explicitly explored how these technologies contribute to reducing income disparities or enhancing economic participation (Ferrari and Salazar, 2022). This gap limits our understanding of the mechanisms through which digital sustainability can be leveraged to foster more fair economic opportunities.

The present study aims to address this gap by systematically reviewing existing literature on the concept of digital sustainability. By analyzing 150 studies published between 2002 and 2023, we identify key pathways through which digital technologies support an equitable growth and highlight critical areas that require further empirical and theoretical investigation. In particular, this study focuses on: i) the role of digital technologies in bridging socioeconomic divides, with a focus on access to financial, healthcare, and educational resources; ii) the contribution of digital sustainability to job creation and workforce

development, especially in the context of upskilling and reskilling for the digital economy; iii) the impact of smart cities and digital infrastructure on urban inclusivity, examining how digital planning tools improve economic opportunities for marginalized populations; iv) the need for managerial and policy frameworks that align corporate digital sustainability strategies with inclusive growth objectives.

Additionally, the study provides a foundation for future studies that seek to develop theoretical models and actionable managerial strategies that ensure digital transformation initiatives are aligned with broader social and economic inclusion goals (Gurumurthy & Chami, 2021).

Description of the Problem

The rapid expansion of digital technologies has revolutionized economies worldwide, significantly impacting various sectors, from finance to healthcare and education. While digital transformation has created new opportunities, it has also raised concerns regarding its role in exacerbating existing socioeconomic inequalities. Digital divides persist across various demographic groups, particularly affecting marginalized communities in low-income regions (Demirgüç-Kunt et al., 2022). Limited access to digital tools and connectivity exacerbates economic exclusion, reinforcing systemic inequalities and restricting upward mobility. Despite increasing global internet penetration, disparities in digital access and affordability remain significant barriers to inclusive growth (World Bank, 2021).

The digital divide manifests in multiple dimensions, including infrastructural, economic, and cognitive barriers (van Dijk, 2020). A lack of broadband infrastructure in rural and underserved areas prevents equal participation in the digital economy (Robinson et al., 2015), while affordability constraints disproportionately affect lower-income populations, limiting their ability to benefit from digital financial services and e-learning platforms (Galperin & Viecens, 2017). Additionally, disparities in digital literacy further entrench social stratification, as individuals without adequate digital skills face challenges in accessing online opportunities for employment and education (Lutz, 2019).

Moreover, the intersection of digital exclusion with existing social inequalities—such as gender, ethnicity, and disability—creates compounded disadvantages (Ragnedda & Muschert, 2018). Women, particularly in developing economies, encounter structural barriers to digital access due to cultural norms, lower financial autonomy, and limited participation in STEM education (Hilbert, 2011). Similarly, linguistic and accessibility barriers restrict digital participation for minority groups and individuals with disabilities (Goggin, 2020). Addressing these disparities requires multi-stakeholder collaboration, where governments, private sector actors, and civil society organizations work together to implement policies that promote equitable digital access and skills development (UNESCO, 2022).

While initiatives such as community-based internet access programs, affordable digital devices, and targeted digital literacy training have demonstrated positive impacts (Napoli & Obar, 2014), systemic interventions are needed to ensure that digital sustainability does not exacerbate existing socioeconomic inequalities. Policymakers and businesses often prioritize short-term gains over long-term inclusivity, leading to digital strategies that fail to address systemic inequalities (Brennen & Kreiss, 2016; Radu, 2023). Bridging the digital divide must go beyond infrastructural expansion to include regulatory frameworks that support fair digital labor markets, data protection policies that safeguard marginalized communities, and inclusive digital governance structures that amplify diverse voices in decision-making (Eubanks, 2018).

Digital sustainability, which emphasizes the responsible use of digital technologies to support

environmental, social, and economic well-being, presents a potential pathway to addressing these disparities. However, these aspects remain insufficiently explored, both in theory and practice (Gholami et al., 2023; OECD, 2023).

Challenges in Defining and Measuring Digital Sustainability

One of the primary issues surrounding digital sustainability is its conceptual ambiguity. Scholars and policymakers have provided varying definitions, often focusing on environmental impacts, such as reducing carbon footprints and improving energy efficiency (GeSI, 2021; European Commission, 2022). However, as Covucci et al. (2024) demonstrate through an in-depth systematic review of the literature on digital sustainability, two dominant perspectives emerge: one that focuses on the preservation of digital resources for future generations (Bradley, 2007) and another that emphasizes the role of digital technologies in advancing sustainable development goals (George et al., 2021; Sparviero and Ragnedda, 2021). While much of the literature on digital sustainability has focused on its environmental dimension, particularly in relation to climate change mitigation and resource efficiency (Pan et al., 2022), its social and economic implications remain significantly underexplored (Covucci et al., 2024). The social dimension has largely been examined through a sociological lens, emphasizing issues such as digital literacy, the digital divide, and digital inclusion (Sá et al., 2021). However, the economic dimension has received limited scholarly attention.

Existing research predominantly examines the broader economic benefits of digitalization, such as increased productivity and efficiency gains. However, there is a notable gap in studies specifically investigating how digital sustainability contributes to inclusive economic growth. While some research highlights the potential of digital technologies to generate employment and enhance workforce skills (Ferrari and Salazar, 2022), it rarely considers how these benefits are distributed across different socioeconomic groups or whether they help reduce structural economic inequalities.

To fully realize its potential, digital sustainability must go beyond ecological concerns and actively promote equitable access to digital infrastructure, foster digital skills development, and create economic opportunities for all. This requires recognizing the complex interplay between governments, institutions, and the broader public in shaping policies and initiatives that ensure digital sustainability supports fair advancements (UN-Habitat, 2023; United Nations, 2022).

By analyzing relevant academic contributions, we aim to clarify how digital sustainability initiatives can serve as catalysts for reducing socioeconomic disparities. The findings of this study will provide valuable insights for scholars, policymakers, and business leaders striving to create a more equitable digital economy.

Methodology and Data

To ensure the rigor and validity of our study, we employed a systematic literature review (SLR) methodology, which allows for a structured and replicable synthesis of existing research. This approach is particularly useful for consolidating knowledge in emerging fields like digital sustainability and inclusive economic growth, where fragmented and interdisciplinary studies require a comprehensive assessment (Tranfield et al., 2003).

Literature selection process

The literature review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework (Welch et al., 2012), ensuring transparency and

reproducibility. The PRISMA guidelines were applied at every stage, including study identification, screening, eligibility assessment, and final inclusion. To reduce bias, all selection steps were documented, and discrepancies were resolved through discussion between researchers.

We conducted a comprehensive search of relevant studies on "digital sustainability" using two of the major academic databases: Scopus and Web of Science (Core collection). The search covered the period from 2002—when the concept of digital sustainability started gaining traction—to 2023. To refine our selection, we applied the following inclusion criteria:

- Peer-reviewed journal articles, conference proceedings, and book chapters;
- studies written in English to ensure accessibility and comparability;
- research explicitly addressing digital sustainability, with a focus on its relationship to inclusive economic growth.

The final dataset contained 150 studies. After an initial screening of titles and abstracts, 68 papers were shortlisted for full-text analysis. Among these, the studies were excluded if they lacked empirical or theoretical depth, were duplicates and focused predominantly on environmental sustainability without discussing economic inclusivity.

Thematic analysis and coding process

The thematic analysis was conducted by two independent researchers to enhance objectivity and reliability. Both researchers independently coded the studies, classifying them as either "relevant" or "non-relevant" based on their consideration of digital sustainability's role in fostering inclusive growth. A study was deemed relevant not only if it explicitly discussed mechanisms through which digital sustainability contributes to economic inclusion, but also if its findings allowed for implications to be drawn in this regard. Even when the primary focus of a study was not directly on this relationship, it was included if its results provided meaningful insights for understanding it. Disagreements between researchers were resolved through iterative discussion to ensure consensus and minimize subjective bias.

Data Extraction and analysis

To facilitate the analysis and coding process, we used NVivo, a qualitative data analysis software that supports systematic classification and retrieval of text-based data. NVivo was employed to categorize key themes, identify patterns across studies, and ensure consistency in coding decisions. The software's query functions enabled us to cross-check coding accuracy and assess agreement levels among the three researchers. To evaluate inter-rater reliability, we calculated Cohen's kappa, which resulted in a value of 0.75, indicating substantial agreement.

We extracted key information from the selected studies, including research objectives, methodologies, key findings, and identified gaps. To ensure robustness, we conducted a cross-validation process, comparing and synthesizing findings across different studies. Ultimately, 28 studies were deemed highly relevant based on their contribution to understanding the intersections between digital sustainability and inclusive economic growth, either through direct discussion or inferred implications.

Results

Digital sustainability plays a critical role in fostering inclusive economic growth by leveraging technological advancements to bridge gaps in accessibility, participation, and long-term value creation across multiple sectors. Various studies within the reviewed dataset are demonstrating how digital technologies contribute to resilient and equitable development.

Abaku et al. (2021) highlight how Estonia's e-Residency program exemplifies the potential of digital sustainability in economic inclusion by providing entrepreneurs from developing countries with access to European markets. Similarly, Erturk & Purdon (2022) illustrate how digital sustainability initiatives in New Zealand enhance digital inclusion for lower-income groups, thereby improving employability and economic participation. The role of sustainable digital entrepreneurs is also explored by Isensee et al. (2023), who identify resilience factors that allow startups and SMEs to integrate sustainability into their business models, reinforcing the link between digital innovation and economic viability.

In urban development, Canesi and Marella (2022) propose digital sustainability indicators for measuring economic resilience in marginalized regions, while Pee and Pan (2022) investigate how digitally-enabled climate-smart cities drive economic transformation through new job creation and innovation in green and digital sectors. These insights align with findings from Zhang et al. (2022), who explore the role of big data in smart city initiatives supporting SDG 11, emphasizing how data orchestration enhances sustainable urban development and inclusive growth. Xing and Li (2010) further contribute to this discussion by demonstrating how urban design, viewed through a digital and ecological lens, fosters inclusive economic growth by integrating social, environmental, and economic factors in urban planning.

From a business perspective, Hidiroğlu (2022) discusses how digital sustainability drives competitive advantages by optimizing internal processes and fostering innovation. This aligns with Bencsik et al. (2023), who analyze business models for digital sustainability in smart city services, and Verma et al. (2024), who examine the potential of emerging digital technologies—such as AI, IoT, and blockchain—in addressing sustainability challenges while fostering economic opportunities. Furthermore, Busch (2011) underscores the importance of corporate responsibility in bridging digital divides, ensuring that digital sustainability extends beyond business efficiency to address social equity. The study by Human and Kazzazi (2021) on digital consent highlights the ethical considerations in digital regulations, reinforcing the importance of responsible data practices in creating a sustainable digital economy that promotes equitable access and participation.

The financial sector also benefits from digital sustainability, as demonstrated by Cokçetin (2017), who explores its role in financial inclusion by improving accessibility for the unbanked. Similarly, Bruneckiene et al. (2019) employ AI and neural networks to assess investment attractiveness, linking digitalization with economic competitiveness. The broader implications for multinational enterprises are considered by the study on digital transformation, sustainability, and purpose in MNEs, which highlights how businesses navigate technological advancements while aligning with stakeholder expectations.

In agriculture, digital sustainability ensures equitable access to technological advancements. Marinello et al. (2019) introduce the Digitization Footprint as a measure of digital resource usage, ensuring technological benefits are equitably distributed. Sacco et al. (2021) further examine the economic implications of digital agriculture, emphasizing the role of ICT solutions in rural development. Kruk et al. (2021) extend this discussion by exploring digital governance models that enhance smallholder participation in sustainable food production, reinforcing the potential of digital sustainability in democratizing economic benefits in agriculture.

The industrial sector benefits from digital sustainability through enhanced transparency and circular economy initiatives. Mogos and Fragapane (2022) highlight how blockchain-based assessments ensure sustainability in textile and clothing value chains, promoting inclusive and ethical economic practices. Wurster and Reis (2022) explore recommendation software supporting sustainability-oriented product decisions, aligning with EU circular economy goals. Meanwhile, Bajic et al. (2023) investigate human-centric Industry 5.0 frameworks, demonstrating how optimized digital processes improve job opportunities and working conditions. The study by Gervasi et al. (2022) further emphasizes the role of digitalization in cultural heritage management, showing how technological advancements can promote local tourism and economic recovery, particularly in regions reliant on heritage-driven economies.

Governance models integrating digital sustainability principles also influence global value chains. Kruk et al. (2024) explore digital sustainability assurance mechanisms in aquaculture, illustrating how governance innovations promote inclusive participation in sustainable economic activities. Braun et al. (2022) examine the role of digital transformation in construction, linking resource efficiency with economic sustainability.

Education is another crucial area where digital sustainability fosters long-term economic inclusivity. AlDhaen (2023) and Lampoltshammer et al. (2021) emphasize the importance of integrating digital sustainability into business education, preparing future leaders to incorporate sustainability into economic strategies. By ensuring that knowledge transfer includes sustainability principles, these studies reinforce the long-term potential of digital literacy in shaping an inclusive and sustainable economy. Skulimowski (2019) adds to this perspective by examining the strategic planning of AI-based learning platforms, demonstrating their role in fostering educational accessibility in knowledge-based societies.

The intersection of digital sustainability and health is also significant, as shown by McBride et al. (2020), whose study on smartphone apps for hypertension management illustrates how digital tools improve health outcomes and workforce productivity, further reinforcing the link between health equity and inclusive economic progress. Finally, Ciacci et al. (2024) provide a comprehensive framework for measuring digital sustainability through the Digital Development Index (DDI), demonstrating how digital transformation intersects with economic, social, and environmental dimensions across European countries. Their findings reveal disparities in digital sustainability, particularly between Western and Northern Europe and other regions, emphasizing the need for targeted policies to bridge these gaps.

Across these diverse contributions, three dominant perspectives emerge in assessing how digital sustainability contributes to a more equitable economy First, digital technologies play a key role in bridging socioeconomic divides, as evidenced by studies on digital financial inclusion (Cokçetin, 2017), e-Residency programs (Abaku et al., 2021), and corporate responsibility in closing digital gaps (Busch, 2011). Second, the link between digital sustainability and job creation, workforce transformation, and skill development is evident in research on smart city innovations (Pee & Pan, 2022; Zhang et al., 2022), digital entrepreneurship (Isensee et al., 2023), and human-centric Industry 5.0 frameworks (Bajic et al., 2023). Finally, digital sustainability contributes significantly to improving urban planning and infrastructure, as demonstrated by studies on sustainable urban design (Canesi & Marella, 2022), big data-driven urban solutions (Zhang et al., 2022), and governance models for resilient cities (Braun et al., 2022). These three perspectives offer an integrated framework for analyzing how digital sustainability fosters equitable and lasting economic development.

Conclusions

The findings of this study underscore the transformative potential of digital sustainability in fostering inclusive economic growth through three interconnected pathways: bridging socioeconomic divides, facilitating job creation and skill development, and enhancing urban

planning and infrastructure. By leveraging digital technologies, marginalized communities gain access to essential services, financial opportunities, and educational resources, reducing structural inequalities. Simultaneously, the rise of sustainable digital entrepreneurship and green technologies creates new employment prospects, emphasizing the need for workforce adaptation and continuous learning. Additionally, smart city initiatives demonstrate how data-driven governance can optimize urban resilience, making infrastructure more efficient and inclusive. However, while digital sustainability presents vast opportunities, its success depends on equitable policy frameworks, ethical governance, and targeted interventions that address existing disparities.

Despite these promising insights, the body of literature directly addressing the influence of digital sustainability on an inclusive economic growth remains relatively limited given the significance of the topic. This highlights the need for a more targeted research agenda aimed at defining robust theoretical frameworks and actionable managerial strategies in this direction.

Future Directions

Future research should focus on developing theoretical frameworks that clarify how digital sustainability interacts with economic inclusion, addressing factors such as equitable access to digital infrastructure, digital literacy, and the role of digital platforms in reducing socioeconomic disparities. Empirical studies are needed to examine the mechanisms through which digital sustainability initiatives drive inclusive growth, including longitudinal analyses of digital upskilling programs, case studies on sustainable digital entrepreneurship, and sector-specific investigations into job creation, particularly for marginalized populations. Additionally, research should explore how regulatory frameworks and business strategies can align digital sustainability efforts with inclusive economic outcomes, assessing the effectiveness of digital inclusion policies and corporate strategies that integrate sustainability into digital business models. This research agenda should prioritize interdisciplinary approaches that integrate technological, economic, and social perspectives, ultimately contributing to a more equitable and sustainable digital economy.

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THEORETICAL ASPECTS OF DIGITAL TRANSFORMATION OF THE ECONOMY IN THE NEW GLOBAL REALITIES

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Abstract:
The digital transformation of the economy is associated with profound structural changes in such areas of production as the construction of new value chains with a local and regional focus based on new technologies (technological algorithms, artificial intelligence, blockchain technologies, the Internet of Things, cloud technologies, etc.), digital business models and digital investment solutions (Accelerated Digital Transformation Program, WEF, 2020). Important advantages of technological transformation include optimization of the production management process, decentralization, transparency, reduction of operating costs, etc. However, these processes pose serious challenges to SMEs, which require attracting significant financial resources for readjustment (in terms of resource productivity) to new technological realities and the new digital paradigm for business functioning in the Fourth Industrial Revolution.

Keywords: *digital transformation, innovation, economic consequences*
JEL classification: *032, 033, 038*

Introduction

Academic research establishing a link between innovation and economic growth provides support for the role of endogenous growth models (Romer, 1986). Technological innovations are created in the process of research and development, using human capital and an existing stock of knowledge. In particular, Ulku (2004) found that a 1% increase in innovation (in terms of patent data, researc and development expenditure) increases GDP per capita by about 0.05% in both OECD and non-OECD countries. According to a study by Frontier Economics (2013), venture-backed companies provide less than 6% of total private sector employment in Europe, yet they generate about 12% of all industrial innovation and their research and development expenditure accounts for 8% of all industrial R&D expenditure. The total economic value of patents granted to these firms in Europe over a five-year period is over €350 billion.

Description of the problem

The traditional explanation for the positive relationship between innovation and firm performance is established by Schumpeter (1934). According to him, innovative new products encounter limited competition and allow firms to realize relatively high profits. The fact that innovative firms consistently generate higher profits is the result of improved knowledge-based capabilities and the realization of dynamic economies of scale. Using data from the Australian Stock Exchange, Bosworth & Rogers (1998) find that research and development and intangible assets have a positive relationship with the market value of firms.

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The creation of a favorable environment for digital transformation and SME entrepreneurship depends on formal and informal institutions, which according to Baumol (1990) can be assessed at the macroeconomic, regional and firm levels. Macro-level drivers of digital transformation in SME entrepreneurship include GDP growth, employment, gross domestic investment, spending levels, inflation and interest rates. Public sector activities – including direct spending and public capital raising – in education, infrastructure and healthcare are also catalytic factors. For Murphy et al. (1999), the protection of property rights and the provision of balanced incentive structures for the public and private sectors are of particular importance. Government regulation of market entry suppresses levels of entrepreneurship (Ciccone et al., 2006). Strict labour market regulations negatively affect market entry and impose restrictions on firm entrepreneurship. According to Djankov et al. (2008), the administrative burden associated with taxes similarly reduces SME entrepreneurship. In a study by Free Network (2021) on Ukraine's integration into the EU's Digital Single Market, digital connectivity is expected to help increase exports of goods and services to the EU by between 1.8 % and 17%, respectively, and to provide positive effects on productivity and economic growth by around 0.42%. On the other hand, a study by McKinsey (2019) found that the implementation of cutting-edge technologies such as artificial intelligence (AI), the Internet of Things, quantum computing, blockchain technologies, etc. has the potential to provide more than 1 percentage point of productivity growth (due to lower production costs along the entire value chain), as well as due to the provision of R&D subsidies in certain technologies (IMF, 2021). For the World Economic Forum (2021), the transition to a digital economy (or the so-called "great reset") requires businesses to adapt to a new global model for value creation in localized and digitalized supply chains; an increasing role of all stakeholders in systemic transformation through active collaboration in the innovation process of digitizing economies in Industry 4.0. The fusion/combination of different technologies (e.g. artificial intelligence, mobile applications, cloud technologies, big data analytics, etc.) marks the transition from the Third to the Fourth Industrial Revolution.

On the other hand, regional factors for the digital transformation of SME entrepreneurship include: operating costs, localization and mobility of human capital, extensive R&D, availability of financial capital (Bartik, 1989), population and employment density, income growth, B2B service provision between firms, standard of living, technology and knowledge transfer and faster process of new firm creation. For Ejermo (2009), a key determinant of regional digital innovation is quality-adjusted patent data, and its relationship with regional R&D. For example, ninety percent of regional differences in economic growth (measured by total factor productivity) are associated with the accumulation of knowledge stock (patent activity) and the formation of regionally operating firms. Thus firms operating in geographically distant regions are more likely to adopt digital technologies intensively to provide greater market coverage and reduce their operating costs. A study by Lueckgen (2004) on entrepreneurial activity shows that the German regions with the highest number of entrepreneurial start-ups are Cologne, West Saxony/Leipzig, Munich, Emscher-Lippe and Middle Mecklenburg/Rostock. Wach (2012) conducted a survey of 109 SMEs in two provinces in southern Poland as part of the Regional Entrepreneurship Monitoring Project and found strong correlations between the availability of regional capital, the quality of entrepreneurial infrastructure, the speed of formation and the development of SMEs.

Industry-level factors driving the digital transformation of SMEs include profit potential, the presence of entry and exit barriers, supply and demand forces, and agglomeration of production structures (Reynolds, 1992). Industry profits, growth, and size are positively related to enterprise formation according to the Swedish Entrepreneurship Forum (2016). Firm entry and exit can serve as a proxy for the entrepreneurial environment at the industry

level; However, this fluidity can be influenced by internal (organizational and managerial) or external factors (including the threat of entry). In technologically advanced industries with complex network infrastructures, the entry of foreign firms can serve to catalyze entrepreneurial activities and technological transition.

Firm-level entrepreneurial activity factors include human capital – which Evans & Leighton (1990) characterize as a prerequisite – as well as the availability of equity capital and visibility in social networks. The latter two variables further promote lower transaction costs (Williamson, 1971). According to Fonseca et al. (2001), high start-up costs and high taxes reduce levels of entrepreneurship. For Glaeser et al. (2009), the higher share of small and independent firms increases entrepreneurial activity due to, among other aspects, their access to skilled labor and finance, as well as higher profit margins and the ability to use knowledge derived from internal and external networks.

Economic consequences of digital transformation of the economy

Digital transformation requires the establishment and maintenance of a digital innovation "ecosystem", which according to WEF (2018) includes the promotion of digital entrepreneurship through investments in human capital and R&D&I based on an established digital strategic framework and policy. The innovation environment is particularly sensitive to the adequacy of the legal framework for the protection of intellectual property rights, the scope of tax incentives for innovation, competition policies, market regulations, the development of financial markets, the efficiency of trade and investment. In addition, stable macroeconomic conditions and low interest rates directly affect the levels of digital innovation activity. The structure of the national innovation system includes the pillars of knowledge generation (e.g. human capital and R&D spending), dissemination capacity (e.g. the existence of connections between different knowledge transfer networks), the capacity for accumulating knowledge of companies (e.g. resources for participating in innovation), the demand for innovation in the economy and the management of innovation (e.g. fiscal incentives, innovation funds and favorable legislation). Among the state incentives to promote digital entrepreneurship, investments in the construction of technology zones focused on the implementation of the goals of sustainable and digital economic development stand out. In such zones, the provision of tax incentives for companies is based on the fulfillment of certain conditions for achieving employment, investment commitment, export potential, and the implementation of social and environmental standards (OECD, 2020). NUI Galway and Whitaker Institute (2015) introduces the concept of the "triple helix" in the process of assessing the innovation environment. This approach focuses on the links between universities, public research organizations, the private sector and government at different points in the innovation process. The development of national innovation systems requires effective partnerships between these entities.

In the EU, the innovation environment of EU Member States is measured using the Innovation Scoreboard, with the European Commission publishing an annual innovation report for each Member State based on indicators and data from national statistical agencies. At EU level, the most innovative countries Finland, Sweden, Denmark share characteristics within their national innovation systems, including the importance of business R&D activities (especially patent applications), educational outcomes and efficient resource mobilization. As for Finland, the country has the highest R&D intensity in the EU (3.55% of GDP, compared to 2.07% for the EU-28 and 2.79% for the US) and the highest performance in terms of business R&D expenditure (2.44% of GDP). The Finnish government is accelerating reforms of the national research and innovation systems by providing various tax incentives for SMEs and especially start-ups, in order to increase the size of the internal market for venture

capital. The Finnish Research and Innovation Action Plan emphasizes the need to increase the number of innovative SMEs with high growth potential, improve the quality and internationalization of Finnish SMEs, accelerate the process of public-private partnerships in the formation of industrial clusters, and ensure smart specialization through the Innovative Cities Programme.

As for the innovation-lagging countries in the EU - Romania (R&D intensity of 0.49% of GDP), Bulgaria (0.64% of GDP) and the Slovak Republic (0.82% of GDP) - these countries share such characteristics as a low level of economic competitiveness, fragmentation of public R&D systems, insufficient number of patent applications, lack of active cooperation links between public research centers and the private sector, inadequate level of public spending on innovation, weak commercialization of research results, problematic implementation of intellectual property legislation, etc.

Using a composite innovation index (combining input, process and output innovation indicators), Carayannis (2010) presents the various efficiency factors and an overall assessment of the levels of firm innovation. As a result of the correlation analysis, Carayannis finds that R&D expenditure correlates with the percentage of sales for firms that are radical innovators, and that innovation correlates with the level of invested venture capital provided for innovation needs. The number of patents correlates only with revenue and expected sales.

At the microeconomic level, various studies find that SMEs and large corporations innovate differently (Vossen, 2010). The relative strength of large corporations is linked to sufficient resources (Nooteboom, 1994) to finance R&D (including internal funds). Large corporations have high production and synergy potential, a diversified portfolio of R&D projects, well-developed marketing channels and realize economies of scale and scope in the R&D process due to higher productivity, division of labor and risk sharing. In terms of SMEs, their innovative strengths lie in the higher motivation of management and employees, effective and fast communication, specialized knowledge and skills, high flexibility. Most empirical findings suggest that SMEs, rather than large corporations, conduct R&D more effectively (Vossen, 2010) and benefit more effectively from knowledge spillovers from corporate R&D. According to Cohen and Klepper (1992), large corporations are better positioned to undertake large-scale fundamental and technological innovations with higher average economic value, while SMEs undertake mainly product innovations, driven by their flexibility and proximity to the market.

For example, at 3M Corporation, the R&D process is organized at three levels: 1) fundamental research on new materials in collaboration with universities and research centers; 2) technological and process innovation; and 3) R&D focused on product development. These differences in the innovation models of SMEs and large corporations point to the potential for collaborative open innovation between them by integrating SMEs into various technological innovation networks and systems. However, Stuart (2000) demonstrates that large organizations benefit less from these forms of collaboration, as large firms have the resources (financial, material, organizational, technological, etc.) to actively carry out digital innovations (i.e. to implement a product, process or business innovation model using ICT) and sustainable digital innovations (i.e. those that support the dual transition to a green and low-carbon digital economy and the realization of economic, social, environmental and climate impacts or a 3P approach (“profit”, “people”, “planet”). According to Yousaf et al. (2021), SMEs can undertake sustainable digital innovations through an approach to digital orientation of activities based on the active use of the (industrial) Internet

of Things and digital phantomization. According to WEF (2020), this type of innovation activity of SMEs is expected to significantly support the achievement of the UN Sustainable Development Goals (SDGs) by 2030 and in particular the goal of “universal and accessible digital infrastructure for all” (WEF, 2018).

According to Neuss (2021), important prerequisites for the digital transformation of the economy are related to changes in relative prices in individual sectors and in real aggregate income; the relationship between inputs and final products, as well as the role of international trade. Changes in relative prices in different sectors are due to different levels of use of technological innovations, which leads to differences in realized productivity due to the substitution effect between the factors of capital and labor. With an increase in real incomes in highly intensive sectors, demand increases due to changes in the structure of consumer demand towards goods/services that satisfy needs that are higher in the hierarchy for consumers. With a change in specialization and the strengthening of international trade relations, companies in vertical value chains compete for the performance of certain activities (e.g. service support, consulting activities, etc.), which creates a prerequisite for technological improvement of activities and “denationalization” of competitive advantages. Companies that achieve high levels of digital innovation activity achieve significant integration of ICT into their business activities with a developed long-term strategy for managing technological innovations.

Regarding the economic consequences of the digital transformation of economies, theoretical studies outline a positive association (Qiang et al., 2011) between the introduction of broadband connectivity and growth in GDP per capita in a study of 120 countries for the period 1980-2006, as well as between the use of ICT and GDP, especially for countries with high per capita income. In a study by Accenture (2017), a 10% increase in broadband penetration is associated with an additional GDP growth of 1.21 percentage points in developed countries and 1.38 percentage points in developing countries; increase in labor productivity (Banga & te Velde, 2020) by 10% on average in low-income countries due to increased specialization, increased employment (due to the creation of new professions (Mastilo, 2017)), emergence of new economic sectors and services, business innovations. A positive relationship between the growth of real GDP per capita and ICT is also established using the aggregated method of moments and panel data for the period 2000-2009. A 10% increase in fixed and mobile broadband Internet in Europe leads to a growth of 2.1% and 0.46% GDP, while broadband coverage correlates with a GDP growth of 3.2% in 26 Latin American countries. According to Deloitte (2018), a 10% increase in the switch from 2G to 3G correlates with an average increase in GDP per capita of 0.25% across 96 countries, with a doubling of mobile data traffic speed being associated with a 0.5 percentage point increase in the same indicator.

Jalava & Pohjola (2002) find that ICTs contributed to an increase in GDP in Finland from 0.3 % to 0.7% in the 1990s. In the short term, the impact of ICTs on economic growth can even be negative (Kiley, 1999) due to the costs of adjusting the economy. A study (Matijevic & Solaja, 2015) using the Technology Map of Europe identifies three groups of countries according to ICT spending and GDP growth. The first (UK, Germany and France, Denmark, Sweden, the Netherlands, Finland, Austria, Belgium) reports high levels of both indicators. In the group of Mediterranean countries (Italy, Spain, Greece), average values of the indicators are established, while there is a serious lag in CEE and SEE. A special characteristic of developing countries in the digital transformation is the so-called “structural dualism”, in which technologically advanced sectors register increasing productivity and innovation levels, while traditional industries maintain low levels of these indicators.

Academic research establishes a positive association between the level of computerization and employment of personnel with low and high levels of professional skills and a negative association in professions with medium levels of professional skills. Among the factors that mitigate the risk of technological unemployment (La Grandeur and Hughes, 2017) are improving the qualifications of employees and training students in ICT and STEAM (science, technology, engineering, creativity and mathematics) specialties; creating a favorable economic environment for entrepreneurial activity; building an ICT supporting infrastructure. It should be borne in mind that less developed regions in a country are expected to be more vulnerable to the digital transformation of the economy, due to the possibility of accelerated automation of the prevailing economic activities there (mainly in sectors such as retail, agriculture, transport, etc. low-tech activities). In economically developed regions of a country, digital transformation has a particularly strong impact on the manufacturing industry through its accelerated automation, and this is associated with lower social consequences due to the high percentage of the urbanized population with higher education, entrepreneurial activities of high-tech start-ups, etc.

In countries like Bulgaria, characterized by significant regional differences in socio-economic development, there are social and digital inequalities (so-called dualization/polarization of the labor market, “digital divide”OECD), which will deepen in the course of the digital transformation of the economy due to such reasons as the absence of equal access to the Internet, social inequalities in the standard of living and differences in educational level, age, skills, etc. with humanity's transition to an “economy of dehumanization” and the displacement of human labor by AI (Harari, 2017). A Eurobarometer survey (2020) found that four EU countries are characterized by the highest level of digitally vulnerable population, namely Hungary, Greece, Romania and Bulgaria, and these countries have a common characteristic: these are low-income countries with a GDP below the EU average (Hungary 62.4%, Greece 82.4%, Romania 50.4% and Bulgaria 49.5%), which requires changes in education systems with a focus on stimulating the innovative potential, creativity, adaptability and digital literacy of the population (i.e. a focus on intellectual and social capital as a mechanism for competitive advantage of nations). The technologically developed Sofia region is characterized by a high potential for increasing employment through the creation of new professions in new technological sectors, using digital technologies. For the USA, a positive association is found between employment in high-tech sectors of the economy and the concentration of highly educated specialists in them. A similarly strong positive relationship is measured by Berg et al. (2018) between the number of employees engaged in R&D, the number of patents issued, and the level of ICT use in a regional context. Therefore, high innovation activity in a given region suggests the potential for the emergence of new technological and digital-based industries and activities with an increasing role of the so-called “digital” capital, integrating artificial intelligence in value generation in all spheres of the production process.

In a global perspective, various initiatives are theoretically studied to mitigate the adverse effects of digital transformation on technological unemployment and the elimination of routine activities as a result of the accelerated automation of labor in all spheres of material and intangible production. Among them are the introduction of a technology tax (the so-called “robot tax”) to provide social transfers in favor of a segment of the unemployed formed as a result of the accelerated robotization of activities. Other initiatives are the introduction of a reduced working week, a remote or hybrid employment model, a universal basic income, the development of regional programs for digital transition, supporting entrepreneurial activity and its financing through venture capital funds.

The digital transformation and especially the changes that occurred after Covid-19 lead to the emergence of non-standard forms of employment (self-employment, remote work, digital outsourcing, etc.), which constitute over 1/3 of total employment in OECD countries, but vary depending on the economic sector (predominant in scientific activity, technical, financial activities, insurance, etc. service sectors). In particular, self-employment has seen a significant increase due to tax incentives in the Netherlands, the Czech Republic and Slovakia and is associated with a trend towards starting entrepreneurial ventures. According to the Online Labor Index (Oxford Internet Institute), during the Covid-19 pandemic, there has been an increase of around 30% in the demand for employees on online platforms. Challenges with the remote form of work are associated with a lower level of protection for employees (e.g. in terms of the use of paid leave, collective bargaining, guaranteed social and health protection, opportunities for professional growth), which is why the Council Recommendation on access to social protection for workers and the self-employed (2019) is in force in the EU, providing opportunities for the transfer of social benefits between different forms of employment and transparency of the different social protection schemes in non-standard forms of employment in the EU. EU countries are undertaking new policies to minimize the negative consequences of digital technologies (such as AI) on the labor market, related to the disappearance of professions through professional retraining programs, for example, in Finland, the acquisition of basic AI skills by the entire population is defined as a civic competence.

Positive association between digital transformation and trade facilitation has been established (Meijers, 2014) in low-income countries; reduction of transaction costs (Lendle et al., 2012) and change in trade patterns in global value chains. Specifically, Meijers (2014) focuses on examining the causal relationship between ICT and economic growth in middle-income countries around the world and finds that ICT indirectly affects GDP growth through trade growth. Thus, according to him, a 10 percentage point increase in Internet use is associated with an increase in the trade openness coefficient by 3.12 percentage points in developed countries and 5.2 percentage points in developed countries, GDP growth of 0.15% (developed countries) and 0.27% (developing countries). For Bulgaria, as a country characterized by trade specialization in low-tech traditional industries, the digital transformation process is expected to take place at a slower pace due to the trends of deglobalization (localization) of production in the aftermath of the global Covid-19 pandemic and the growing external challenges from the military conflict in Ukraine (rising energy prices and an uncertain environment with expectations of high inflation).

In developing countries, in particular, there are institutional and infrastructural weaknesses for the digital transformation of their economies, which deepens the technological gap with developed industrial countries and creates limitations to their trade integration. The holistic approach to building a digital economy requires structural transformations in the institutional structure, a new strategic framework for innovation and digital transition with a focus on mitigating social inequalities (the so-called “digital divide”) and realizing greater positive impacts for achieving the goals of sustainable and inclusive development. Thus, developing countries, through the “leapfrogging” mechanism, have the opportunity to build the potential to catch up with digitally advanced countries only if the following preconditions are met: access to technological equipment and know-how for the productive use of ICT; ability to implement new digital-based technologies; integration capabilities downstream in the value chain (such as developing and expanding the domestic market through improved marketing, logistics, etc. capabilities).

A WEF study (2020) found that the technologies that will have the most tangible impact on international trade in the short to medium term are the Internet of Things, e-commerce, digital

payments, cloud computing and digital services. In the long term, robotics, 3D printing and virtual reality models, as well as artificial intelligence, are expected to have a strong impact on trade. The main positive impacts of the implementation of new technologies in trade flow are related to trade facilitation and improvements in the supply chain (over 63%), the emergence of new digital products and services (55%), higher efficiency in logistics coordination (49%), reduction of carbon dioxide emissions in supply chains and environmental labeling of products. In addition, digitizing the workflow in international trade creates opportunities for easier access for companies to trade finance through fintech infrastructure and electronic platforms (such as blockchain and digital registers), providing a high degree of transparency and automation in end-to-end supply chains. The implementation of artificial intelligence in international trade data exchange greatly reduces the comparative advantages of developing countries as low-cost locations due to facilitating and promoting trade by improving the management of risks in the supply chain and in customs control (e.g. undervaluing the value of imports). By using technology based on the Internet of Things and robotic automation, it is possible to track cargo in the logistics of international trade, manage inventory levels and high security in the supply chain, but according to WEF (2020) estimates, only 3% of container terminals in the supply chain are automated. Among the significant challenges facing the entry of digital technologies into international trade are the protection of data in the supply chain; the interchangeability between these technologies, the standardization of the data exchange format and the differences in their regulation, the customs valuation of technological products and the protection of intellectual property rights for trademarks and designs. To overcome these challenges in global trade, various international initiatives are being undertaken at the level of the World Customs Organization, the UN Center for Trade Facilitation and Electronic Business, the G-20 to harmonize the technological “eco” system in the post-pandemic Covid world.

In particular, at the company level, technological innovations lead to the shortening of global value chains and the deglobalization of production; the rapid rate of appearance and disappearance of companies, industries, productions, products, professions, which results in structural imbalances between demand and supply. Other important consequences of the technological transition at the firm level are:

- a decrease in the marginal costs of production with an increase in the digital component of goods, increasing profits and increasing production efficiency. Firms operating in digitally intensive sectors achieve higher productivity (Atkinson et al., 2009), higher profits for the last 30 years (McKinsey, 2015), generate direct and indirect network effects and economies of scale and scope, increasing market concentration;
- a qualitative leap in production using augmented reality technologies and dematerialization of product characteristics;
- an acceleration of the transition to a circular economy and recycling production through high resource efficiency;
- information becomes a driving factor of production, embodied in technological innovations through forms of artificial intelligence;
- increased efficiency of consumption in the sharing economy and a growing share of intangible assets in the conditions of deindustrialization, strengthening the role of services in the economy.

In addition to the above-outlined changes in theoretical terms at the macroeconomic and company level, the technological transition and the adaptation of institutional mechanisms in the knowledge economy are also associated with changes in:

• the market mechanism - digitalization in the exchange process leads to direct connections between participants and a reduction in transaction costs in the various interaction channels (business-business; business-retail consumer; consumer-consumer, machine-machine, etc.). Digital networks form new digital markets (operating in the form of technological platforms), on which the price mechanism is implemented through algorithms based on large data sets.

• the distribution mechanism - due to mass bankruptcies of small companies in the technological transition, technological unemployment (as a subtype of structural unemployment) increases, which deepens social stratification with a tendency towards a shrinking middle class in society and polarization in incomes. The process of robotization is associated with a decrease in the absolute and relative share of labor in the newly produced final product, an increase in corporate profits, a greater concentration of capital, the emergence of new flexible forms of labor, etc.

• the mechanism of consumption - consumers are profiled and individualized based on preferences and habits through various big data algorithms and the emergence of the so-called "prosumer" (i.e. the producer is also a consumer) in the course of using augmented reality technologies.

• regulatory mechanisms of states - with the technological transition, the degree of uncertainty, potential for generating risks, destabilization, digital crime, disinformation, etc. increases. This requires an increasing role of state intervention in the market mechanism for the protection of personal data in the shared digital economy under conditions of innovative mercantilism by promoting inclusive/inclusive/direct digital democracy in the new global virtual space.

Conclusions

The successful transition to a technological-digital economy requires the creation of a favorable environment for digital transformation through structural changes in the institutional framework and the business environment, which should be quantitatively and qualitatively assessed at the macroeconomic, regional and company levels. An important element in the digital transition is the construction and maintenance of an innovation “ecosystem”, which is associated with measures to promote digital entrepreneurship through investments in human capital, R&D and innovation based on an established digital strategic framework and policy.

The digital transformation of the economy implies the introduction of digital technologies in Industry 4.0 (artificial intelligence, industrial Internet of Things, big data, blockchain technologies, 5G technologies, three-dimensional printing, industrial robots, etc.) in all spheres of socio-economic life, taking into account the various aspects of the socio-economic impact of digitalization. Theoretical studies have identified positive impacts of the digitalization of the economy on GDP per capita growth, growth in labor productivity, increased employment at a high level of professional skills in economically highly developed countries, and changes in trade patterns in global value chains. For developing countries, including Bulgaria, theoretical studies report a deepening of social inequalities in the course of the transition to a digital economy of “dehumanization” and the replacement of human labor by forms of artificial intelligence with the resulting unfavorable trends in the social sphere (such as the erasure of the middle class and the deepening of social inequalities) and a decrease in welfare in society, which necessitates strengthening the market and institutional framework with a view to promoting entrepreneurship and competitiveness while preserving the rule of law and democracy with control over corruption. To mitigate the negative social effects of digitalization in the long term, a study by the Bulgarian Industrial Chamber and the Friedrich Ebert Foundation (2021) proposes measures such as the potential for part of employees' income to be formed from ownership of capital, rather than

from labor - e.g. ownership of shares in enterprises or the right to shares in capital (stock options).

At the European Union level, a new integration mechanism has been established for the transition to a technological-digital economy and the construction of a Single EU Digital Market with the aim of increasing the competitiveness of European SMEs by mitigating restrictions on their commercial activities and deepening their internationalization in the new global realities after the pandemic Covid-19 crisis. The regulatory framework for the construction of the Single Digital Market provides for the creation of conditions for the facilitated movement of people, goods, services and capital through digital means while strictly applying the principles of free competition, mitigating various technological risks and providing a high level of protection of personal data. The new strategic and regulatory framework for the Digital Single Market sets specific quantitative and qualitative targets for the transition to the digital economy over the next decade to 2030, which relate to the building of a civil society with digital skills, a secure and sustainable digital infrastructure, a digital transformation of the economy and the digitalization of public services.

Significant benefits are expected for the EU from the transition to a technological-digital economy in terms of dynamizing economic growth, social and environmental impacts with the offer of new innovative products/services with increased transparency of the market mechanism, improved quality in supply chains with higher competition in digital markets. Against the background of these positive expectations, problematic areas are reported in the construction of the Digital Single Market, such as the future deepening of the fragmentation of the digital space in the EU as a structural flaw due to the extremely restrictive business environment, regulatory burden, which will slow down the transition to digital leadership of the EU in the new deglobalizing world.

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PERSPECTIVES FOR DEVELOPMENT AGRICULTURAL VALUE CHAINS: A PATH TOWARDS SUSTAINABILITY

Dumitru STRATAN [37]

Abstract:

The agricultural sector is a cornerstone of Moldova's economy, accounting for over 13% of GDP and employing more than 30% of the workforce, especially within rural communities. However, the sector faces numerous challenges, including climate change, limited infrastructure, and market access barriers, which particularly affect smallholder farmers. This article examines the potential for developing Moldova's agricultural value chains by analyzing various sub-sectors through economic, environmental, and social criteria. Key findings highlight promising opportunities in horticulture, medicinal and aromatic plants, and animal husbandry. These value chains show strong potential for sustainable growth through strategic interventions, such as enhanced processing infrastructure, cooperative farming, and expanded market access. The study recommends targeted support in finance, capacity building, and policy reforms to foster a competitive, resilient agricultural sector in Moldova that can meet both local and international market demands. The article was developed within the framework of Subprogram 030101 „Strengthening the resilience, competitiveness, and sustainability of the economy of the Republic of Moldova in the context of the accession process to the European Union", institutional funding.

Keywords: *Agricultural value chains, sustainability, horticulture, medicinal plants, animal husbandry, economic development, infrastructure, cooperative farming.*

JEL classification: Q 10, *Q13, R10.*

Introduction

The agricultural sector is crucial to Moldova's economy, providing income and food security, particularly for rural communities. Agriculture employs over 30% of the workforce and contributes nearly 13% to the country's GDP. However, the sector faces significant challenges, such as climate change, limited infrastructure, lack of trust among various ecosystem stakeholders and barriers to accessing international markets. Smallholder farmers, who constitute a large part of the agricultural workforce, often find themselves at a disadvantage due to a lack of resources and the economies of scale enjoyed by larger enterprises.

This paper presents a detailed analysis of Moldova's agricultural value chains, identifying the most promising sub-sectors for sustainable development. The analysis evaluates various agricultural sub-sectors indicators based on their feasibility and impact. The objective is to propose strategic interventions that can enhance the competitiveness of Moldova's agricultural sector and promote long-term growth. Moreover, the report highlights the most promising and with perspectives value chains and sub-sectors that will be booming with right strategies and interventions.

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Methodology and Data

The pre-selection of value chains followed a rigorous methodology involving a comprehensive evaluation matrix that incorporated economic, environmental, and social criteria. The analysis used both primary data (gathered from interviews and consultations) and secondary data (from national statistics and market studies).

Eighteen agricultural sub-sectors were assessed using the evaluation matrix, which ranked them based on market demand, scalability, environmental resilience, and social equity. The sectors that scored highest were prioritized for development. The analysis also took into account existing support mechanisms, such as government programs and international donor initiatives, to highlight areas where further intervention could enhance the efficiency of these value chains. One important finding is that those value chains and sub-sectors which benefited of donors and state support continuously achieved remarkable targets and metrics, achieving highly valued competitive advantage.

Results

Key Findings: Value Chains Verticals

1. Horticultural Value Chains

Moldova's horticultural sector plays a significant role in the agricultural economy, particularly in fruit production. **Apple production** leads the sector, with a total area of 468 hectares under cultivation. In 2023, small and medium-sized farms accounted for 69.3% of the total production of apples, which reached 5,176 thousand tons. Apple exports represent a large portion of Moldova's agricultural trade, particularly to European Union markets, where demand for high-quality apples remains strong.

Plums are another major crop, with 61.6% of production coming from smallholder farms. Moldova's total plum output in 2023 was 1,503 thousand tons, with a significant portion destined for export. The plum value chain has potential for further development, particularly through value-added processing (e.g., dried plums, jams, and juices), which could increase profitability.

Cherries and **apricots** are also important crops, though they require further investment in infrastructure and technology to maximize their potential. In 2023, cherry production totaled 160 thousand tons, with smallholders contributing 57% of this output. Investments in cold storage and processing facilities would enable farmers to extend the shelf life of their produce and enter new markets with value-added products like preserved cherries and apricot jam.

Vegetable production is another high-potential area, especially for crops like tomatoes, cucumbers, and bell peppers. Vegetables are grown both in open fields and in protected environments, such as greenhouses. Greenhouse production, in particular, offers high profitability, with gross profit margins as high as 1166% when using two cropping cycles annually. In 2023, Moldova produced 229 thousand tons of vegetables, with tomatoes accounting for 28% of total production.

Investments in **post-harvest infrastructure**, such as cold storage facilities, would allow farmers to store their products for longer periods and sell them during off-peak times when

prices are higher. This would help mitigate the volatility of market prices during the harvest season and increase profitability.

2. Medicinal and Aromatic Plants

The cultivation of **medicinal and aromatic plants** presents a promising opportunity for diversification within Moldova's agricultural sector. Plants like lavender, mint, and rosemary are increasingly in demand for essential oils, herbal teas, and natural cosmetics. These crops are well-suited to Moldova's climate, and they can be grown using sustainable farming practices that promote biodiversity and reduce the need for chemical inputs.

In 2023, the cultivation of aromatic plants covered 53 hectares, with production concentrated in small and medium-sized farms (the data are provided by National Bureau of Statistics that are not clear enough). The **integration of apiculture (beekeeping)** with aromatic plant cultivation provides additional benefits. Bees that pollinate these plants produce higher-quality honey, which is in high demand both locally and internationally. Honey production is a low-cost, high-reward activity that can be easily integrated into existing farming operations, providing additional income streams for smallholder farmers. In 2023, beekeepers with 100 bee colonies earned an annual profit of 306,780 lei.

The **apiculture sector** also has strong potential for growth. Moldova's beekeepers produce high-quality honey, much of which is exported to European markets. In 2023, honey production reached 473.1 tons, and beekeepers earned an average profit of 306,780 lei per 100 bee colonies. The integration of apiculture with medicinal plant cultivation enhances both crop yields and honey quality, making it a highly sustainable and profitable value chain for smallholder farmers.

Berry production is another important component of the medicinal and aromatic plant value chain. In 2023, 85.1% of berry production in Moldova was concentrated in small and medium-sized farms, with **strawberries, raspberries, and blackcurrants** being the most commonly cultivated varieties. These berries are sold primarily in local markets, but there is significant potential for value-added products like jams, juices, and dried berries, especially for export.

3. Animal Husbandry

Small-scale animal husbandry, particularly sheep and goat farming, has significant untapped potential in Moldova. Sheep and goats are well-adapted to Moldova's rural landscape, where pastureland is abundant but underutilized. The production of **artisanal cheeses** and high-quality meat has strong demand in both local and export markets. In 2023, a typical sheep farm with 100 head of sheep generated an annual profit of 480,500 lei, with a return on investment of 87.5%. Goat farming offers similar potential, particularly for producing premium dairy products like goat cheese, which is increasingly popular in urban markets.

Economic Feasibility and Environmental Sustainability

The value chains selected for development are not only economically viable but also environmentally sustainable. The horticultural and vegetable sectors have strong export potential, particularly to the European Union, where Moldova's agricultural products are in high demand. **Apple production**, for example, accounted for 30% of Moldova's agricultural exports in 2023, with much of the fruit destined for Romania, Poland, and Germany.

Plum production is also highly export-oriented, with 80% of Moldova's plums being sold to international markets. There is growing demand for value-added plum products, such as dried plums and plum-based beverages, which could further enhance the profitability of the plum value chain.

The **vegetable sector** is similarly promising. In 2023, Moldova produced 65 tons of tomatoes per hectare, with a significant portion of this output exported to neighboring countries. Expanding greenhouse production would enable Moldova to produce vegetables year-round, reducing reliance on imports during the winter months and improving food security.

Environmental sustainability is a key consideration in the development of these value chains. **Medicinal and aromatic plant cultivation** is inherently sustainable, as these crops require minimal water and chemical inputs. Moreover, they can be grown organically, which increases their value in international markets where demand for organic products is rising.

Protected vegetable cultivation also contributes to environmental sustainability by conserving water and reducing the use of chemical fertilizers and pesticides. Greenhouses allow farmers to control the growing environment, resulting in higher yields and better-quality produce. This method of cultivation minimizes the environmental impact of farming and makes Moldova's agricultural sector more resilient to climate change.

Potential for supporting selected value chains as strategic initiatives

1. Fruit and Vegetable Processing

Description: The fruit and vegetable processing industry has high potential due to Moldova's diverse agricultural production. Developing processing infrastructure like canning, freezing, and drying will extend product shelf life and enable exports.

2. Dairy and Cheese Production

Description: Developing the dairy industry, particularly focused on producing high-quality cheeses, can boost both local consumption and exports. Moldova's pasture-based dairy farming supports the production of organic and artisanal dairy products.

3. Meat Processing (Sheep, Goat, and Beef)

Description: Investments in meat processing, particularly for sheep and goat products, can help diversify Moldova's agricultural economy. Exporting premium cuts and processed meats could enhance profitability.

4. Medicinal and Aromatic Plants

Description: Growing demand for medicinal herbs and aromatic plants like lavender and rosemary offers an opportunity to develop this niche. Processing plants for essential oils and teas can tap into global markets.

5. Honey and Beekeeping

Description: Honey production is well-suited for Moldova's rural regions. Improving processing, quality control, and marketing can increase export opportunities for high-quality organic honey.

6. Cereal Processing

Description: Moldova's cereal production can be expanded through value-added processing for both domestic consumption and export, including the production of flour, oils, and other food ingredients.

7. Wine and Grape Products

Description: Moldova's wine industry is already renowned, but expanding production and introducing new grape-derived products like juices and vinegars will open additional markets.

8. Nuts (Walnuts and Almonds)

Description: Walnuts are a major export for Moldova. Expanding production and adding value through processing (e.g., walnut oil, packaged products) will boost exports.

9. Poultry Production

Description: Developing the poultry sector, especially for organic or free-range chicken, offers potential in both local and regional markets. Modernizing production and processing facilities can increase competitiveness.

10. Sunflower Oil

Description: Sunflower seed production is traditional in Moldova. Developing the processing sector for sunflower oil can cater to the growing global demand for organic and cold-pressed oils.

Support Mechanisms and Development Interventions

To realize the potential of Moldova's agricultural sector, targeted interventions are needed in several key areas:

1. **Access to Finance**: Many smallholder farmers in Moldova lack access to affordable credit and grants, which limits their ability to invest in modern agricultural technologies such as irrigation systems and greenhouses. Providing farmers with access to low-interest loans or grant programs would enable them to invest in the infrastructure and technologies needed to increase productivity and profitability.
2. **Cooperative Farming**: Encouraging the formation of farmer cooperatives would help smallholders pool their resources, reduce production costs, and gain access to larger markets. Cooperatives also enhance farmers' bargaining power, allowing them to negotiate better prices with buyers and suppliers. Additionally, cooperatives facilitate knowledge sharing and the adoption of modern farming techniques, which is particularly important in value chains like horticulture and medicinal plant cultivation.
3. **Training and Capacity Building**: Farmers need training in modern agricultural techniques, including organic farming, water management, and pest control. Capacity-building programs should focus on sustainable farming practices that increase yields while minimizing environmental impacts. Financial literacy training is also important, helping farmers manage their finances and make informed investment decisions.
4. **Infrastructure Development**: Investment in post-harvest infrastructure, such as cold storage facilities and processing plants, is essential for improving the efficiency of Moldova's value chains. Without adequate infrastructure, farmers are forced to sell their produce at lower prices during the harvest season, reducing profitability. Government and international development agencies should prioritize infrastructure investments to support Moldova's agricultural growth.
5. **Market Access**: Expanding access to local and international markets is critical for the success of Moldova's agricultural sector. Moldova's proximity to the European Union provides significant export opportunities, but farmers must meet strict quality standards to compete in these markets. Support programs that help farmers obtain certifications and improve product.

Conclusions

In conclusion, the development of Moldova's agricultural value chains holds significant promise for fostering a more competitive and sustainable sector. Key areas such as horticulture, medicinal plants, and animal husbandry show strong potential for growth through targeted investments and strategic interventions. Enhancing infrastructure, promoting cooperative farming, and increasing access to finance can empower smallholder farmers and unlock economic opportunities. Sustainable practices and alignment with international standards will position Moldova to better access local and global markets. Prioritizing these initiatives will contribute to resilience and long-term prosperity in the country's agricultural landscape.

The article was developed within the framework of Subprogram 030101 „Strengthening the resilience, competitiveness, and sustainability of the economy of the Republic of Moldova in the context of the accession process to the European Union", institutional funding.

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STATISTICAL TOOLS IN THE FUNCTION OF SUSTAINABLE ECONOMIC DEVELOPMENT

Brankica TODOROVIC[38]

Abstract:

Sustainable economic development as a global tendency for the progress of economies towards climate-neutral, inclusive and more equitable societies, is based in the EU on several strategic documents. Among these documents, Agenda 2030 plays a key role, with 17 Sustainable Development Goals (SDG), 169 targets and 247 indicators based on which progress in achieving the Goals is monitored.
The objectives of the research in the paper are:
1) Analysis of the Sustainable Development Goals Reports from the aspect of statistical indicators of progress in achieving sustainable economic development,
2) Overview of available UNSD and Eurostat models of textual and visual presentation of the SDG and
3) Online statistical tools, further possibilities and contributions of statistical indicators to the achievement of the SDGs.

Keywords: *sustainable economic development, SDG, statistics, statistical tools*

JEL classification: *C40, O11, Q56*

Introduction

Achieving the Sustainable Development Goals (SDG) is an integral part of the 2030 Agenda as a development path toward sustainable economies starting from 2030 (UN, 2015). The Agenda includes goals, targets, and indicators based on which progress in achieving the goals is monitored. Since 2016, statistical reports have been published on the progress made in achieving the SDGs. However, statistical systems face numerous challenges. First of all, the global indicator framework was developed by the Inter-Agency and expert Group on SDG Indicators (IAG-SDGs) and adopted by the United Nations Statistical Commission in March 2017 and by the United Nations General Assembly in July 2017 (Report of the Inter-agency and Expert Group on Sustainable Development Goal Indicators, 2017). As decided by the Statistical Commission and in accordance with United Nations Economic and Social Council resolution 2006/6, estimates used for the compilation of global indicators are to be produced in full consultation with national statistical authorities (ECOSOC Resolution 2006/6). Reports show gaps in the data, which does not diminish the value of the goals or prioritize one goal over another, but rather indicates the insufficient development of the system and the capacity to track indicators.

The SDG goals have created an opportunity for other institutions and systems to incorporate them into their consideration and analysis. This is how the document 2030 Agenda is organized around four linked SDG clusters: People, Planet, Prosperity and Sustainable infrastructure. Each cluster covers specific goals - People SDG: 2,3,4,5 and 11; Planet SDG:

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12,13,14 and 15; Prosperity SDG: 1,8,10,16 and Sustainable infrastructure SDF: 6,7,9 (Asian Development Bank, 2024).

SDG statistical system Eurostat provides a lot of information about the SDGs for different groups of users. This information is categorized into different groups and presented through text, graphics, tables, and interactive maps. The system has been enhanced with Environmental Statistics, which provides a visual interactive data framework. This system is designed for beginners in statistics, aiming to provide useful information and develop an interest in environmental issues.

In addition, the SDG statistical system provides information on economic indicators; however, they must be related and contextualized with environmental indicators in order for the analysis to be more comprehensive and clearer.

Analysis of the Sustainable Development Goals Reports

SDG Progress Report is published by the UN Secretary-General and provides a global-level monitoring of the progress towards the achievement of the SDGs. They are published annually, starting from 2016, and are available online on the platform https://unstats.un.org/sdgs#. The reports are compiled based on the global indicator framework and data produced by national statistical systems and information collected at the regional level. **Seven** progress reports on the Sustainable Development Goals (SDGs) have been published, starting from 2016, 9 SDG Progress Report:

- SDG Progress Report (2016)
- SDG Progress Report (2017)
- SDG Progress Report (2018)
- SDG Progress Report (2019)
- SDG Progress Report (2020)
- SDG Progress Report (2021)
- SDG Progress Report (2022)
- SDG Progress Report (2023)
- SDG Progress Report (2024).

So far, **seven** SDG Progress Reports have been published, starting from 2016 and two the Global Sustainable Development Report which is produced once every four years to inform the quadrennial SDG review deliberations at the General Assembly:

- Global Sustainable Development Report (2019) and
- Global Sustainable Development Report (2023).

General common characteristics SDG Progress Reports:

- The use of aggregate weighted numbers in the international statistical system ensures international comparability. All goals, targets, and indicators are equally important, although the first reports do not contain data on all goals. These data are adjusted for comparability and, when unavailable, estimated.
- Aggregate weighted numbers: The use of weighted averages allows for better international comparability of data, taking into account differences in population size

and country specifics.

- Equal importance of goals and indicators: All goals, targets, and indicators are equally important in the context of sustainable development, with no prioritization, ensuring a balanced approach.
- Lack of data in early reports: While all goals and indicators are equally important, early progress reports may have data gaps, as not all goals and indicators were available in the initial stages.
- International comparability: Through standardized methodologies and international collaboration, data is adjusted for comparability, enabling global progress tracking.

- Collaboration among organizations: The reports are based on contributions from more than 50 international and regional organizations, ensuring a broad range of data and insights.

Individual characteristics SDG Progress Report:

1) SDG Progress Report 2016: The information presented in this report is based on selected indicators of the global SDG framework.
2) SDG Progress Report 2017: The information presented in this report is based on selected indicators of the global SDG framework. All goals and targets are equally important and will need to be addressed by the appropriate indicators.
3) SDG Progress Report 2018: Report is based on the latest available data as of May 2018 on selected indicators of the global SDG framework.
4) SDG Progress Report 2019: The indicators included in the report do not prioritize any specific SDG target and these indicators provide insight into global progress.
5) SDG Progress Report 2020: The choice of indicators for this report does not represent a prioritization of targets, since all goals and targets are equally important.
6) SDG Progress Report 2021: The information presented in this report is based on the latest available data on selected indicators in the global indicator framework for the SDGs.
7) SDG Progress Report 2022: The choice of indicators used in the report does not represent a prioritization of targets, since all goals and targets are equally important.
8) SDG Progress Report 2023: Owing to the emergence of new data and revised methodologies, data series presented in report may not be comparable with previous data series.
9) SDG Progress Report 2024: The Report provides a global overview of progress towards the Sustainable Development Goals using inputs from more than 50 international and regional organizations.

Key problems in statistical data coverage through the global framework for the Sustainable Development Goals include:

1) Lack of standardized methodologies: Different countries use various methodologies for data collection and processing, which complicates international comparability. Global monitoring should be based on comparable and standardized national data obtained through well-established reporting mechanisms from countries to the international statistical system. But, the lack, of adequate data to assess national trends and to inform and monitor the implementation of development policies.

2) Limited capacity of national statistical systems: Many countries lack sufficiently developed systems for data collection or do not have adequate resources, leading to data gaps or issues with accuracy. In resolution 70/1, Member States recognized the crucial role of strengthened data collection and capacity-building and committed to addressing the data gap (paragraph 57) (Resolution 70/1).

3) Lack of data in certain areas: While all goals and indicators are equally important, some goals and indicators may be underreported or omitted due to a lack of resources, technological infrastructure, or political challenges. The data disaggregation as one of the ways to address inequalities in the past 2015 agenda because setting targets to reduce gap between social and economic groups will ensure that the most deprived are not left until last (Cristian, 2015). By disaggregating data by factors like income, gender, age, disability, geography, and other social categories, it becomes possible to identify the most marginalized or disadvantaged groups. This allows policymakers and organizations to target interventions more effectively and ensures that resources and efforts reach those who need them the most. Setting targets based on disaggregated data is crucial for closing the gap between different social and economic groups.

   Also, It is observed a lack of research or studies focused on consumers goods, agricultural, fishery and forestry sectors (Abdullah & Khatib, 2024)

4) Coordination issues between organizations: Despite collaboration between international organizations, challenges in coordinating between different levels of statistical systems (national, regional, and global) can lead to delays in data collection or inconsistencies.

5) Geographical and demographic variations: Differences in the geographical and demographic characteristics of countries can make it difficult to accurately collect data that can be compared at the global level. Such that attention and action are directed on the most marginalized from the outset, making it harder to simply focus on the easy wins, leave the difficult work to later or revert to the status quo (Bantekas & Seatzu, 2023).

6) Lack of reliable administrative infrastructure: In many countries, statistical data is not adequately collected or archived due to the lack of administrative infrastructure that would enable long-term and accurate record-keeping.

7) Development science plays an important role for sustainable development. The 2030 Agenda provides an opportunity for developmental scientists in the policy framework to provide the necessary evidence-based innovative and creative inputs (Petersen & Verma, 2018). The UN Global Sustainable Development Report recognized the importance of science and technology in advancing sustainable development (SDG Progress Report, 2019).

8) Changes in methodology and data updates: Due to the development of new data collection methods and changes in definitions or categories, the use of newer data may not be compatible with older data series, making it difficult to analyze long-term progress.

UN Data: Integration of Artificial Intelligence and Statistical Framework

The UNSD framework provides support in achieving the SDGs in various ways. It publishes reports: The System of Environmental - Economic Accounting - Ecosystem Accounting (SEEA EA) as an integrated and comprehensive statistical framework for organizing data about habitats and landscapes, measuring the ecosystem services, tracking changes in ecosystem assets, and linking information to economic and other human activity. This

System is a statistical framework that helps organize and analyze data about natural ecosystems for:

1) Monitoring habitats and landscapes – how natural areas and environments change over time.
2) Measuring ecosystem services – the services nature provides to humans, such as water purification, food production, or flood protection.
3) Tracking changes in ecosystem assets – how natural resources (like forests, rivers, or land) change over time.
4) Linking this information to economic and other human activities – understanding how ecological changes impact the economy and society, and vice versa.

The importance of this system is reflected in the new UN Data platform launched jointly by UNDESA and Google.org in September 2023 at the SDG Summit (UNSDWebsite). This tool will optimize data access for policy action and data-driven decision-making, by allowing users to ask questions and simultaneously use data from multiple sources. Also, ensures that users can effortlessly explore and actively engage information from diverse UN datasets, all in one place (UNSTATS).

UN Data platform covers 12 thematic areas: Children and Youth, Climate and Environment, Disasters, Economic development, Education and Culture, Equality and Human Rights, Governance and peace, Health, Population and Demography, Poverty and Food Security, Urbanization and Water, Sanitation and Hygiene. Each of the mentioned areas offers opportunities for deeper analysis according to different criteria.

The second platform is directly linked to the SDGs and is called SDG Global Database. The global indicator framework includes 231 unique indicators. The metadata available in this repository reflects the latest reference metadata information provided by the UN System and other international organizations. Within this system, fiscal points are defined for each of the indicators concerning questions on definitions, methods of computation, data or other issues.

The platform contains a page: E-Handbook on Sustainable Development Goals Indicators that focuses on key aspects such as concepts, definition, sources, calculations (SDGE-Handbook).

Analysis of the Presentation of Statistical Data in the Eurostat System: the SDG context

The analysis of Eurostat's statistical system has been done on several levels:

1) Conceptual framework of the system that answers the question of what the database provides to the users of information about the SDGs,

2) The variety of statistical publications on the SDGs that can indicate the possibilities of using the data for different stakeholders and

3) Presentation of a special part of the SDG statistical system: Environmental statistics.

The analysis of the conceptual framework of the Eurostat system was conducted based on the SDG search filters. The results show that the total number of information provided by Eurostat is 538, all of which are related to the SDG. The mentioned information is divided into three categories: data, news and publications (Table 1 and Figure 1).

Table 1

The structure of the statistical system from the perspective of SDGs

Categories	Number	%
Data	181	33,64
News	94	17,47
Publications	263	48,89

Source: Author, Based on Eurostat

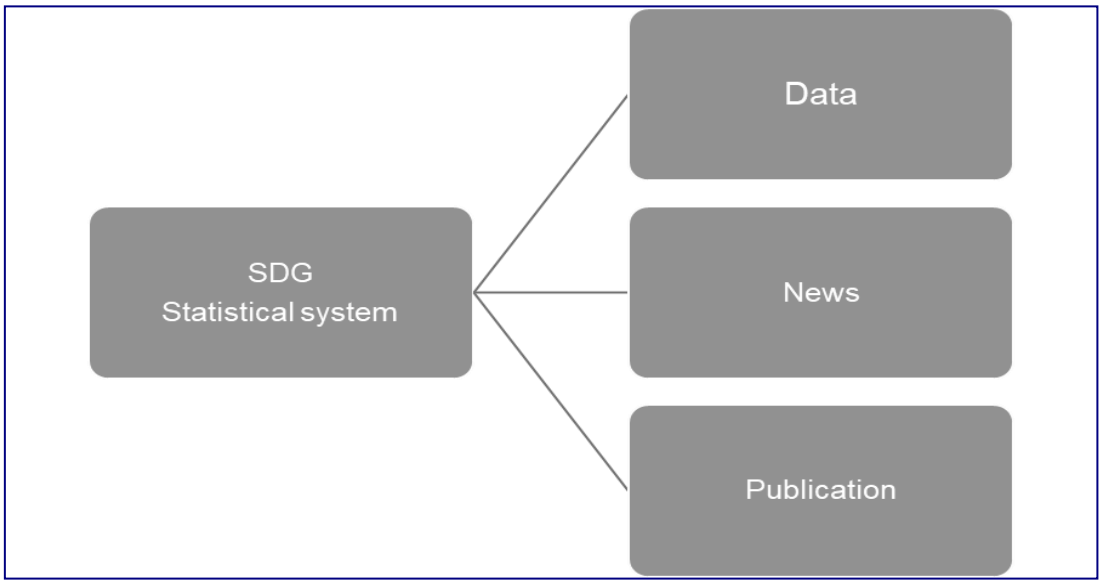

Figure 1 – The structure of the statistical system from the perspective of SDGs

The data in the statistical system is classified into two subcategories: Datasets (119) and Thematic sections (62). A total of 119 datasets have been published so far, covering individual SDGs. The analysis shows that there are no significant fluctuations in the representation of individual goals in terms of reporting. The largest number of datasets is 8, related to SDG1, SDG8, SDG12 i SDG13 (Table 2 and Figure 2).

Table 2

The structure of the statistical system from the perspective of concrete SDGs

SDG	Number datasets
SDG 1	8
SDG 2	6
SDG 3	7
SDG 4	7
SDG 5	6
SDG 6	6
SDG 7	7

SDG 8	8
SDG 9	6
SDG 10	6
SDG 11	7
SDG 12	8
SDG 13	8
SDG 14	6
SDG 15	7
SDG 16	7
SDG 17	6

Source: Author, Based on Eurostat

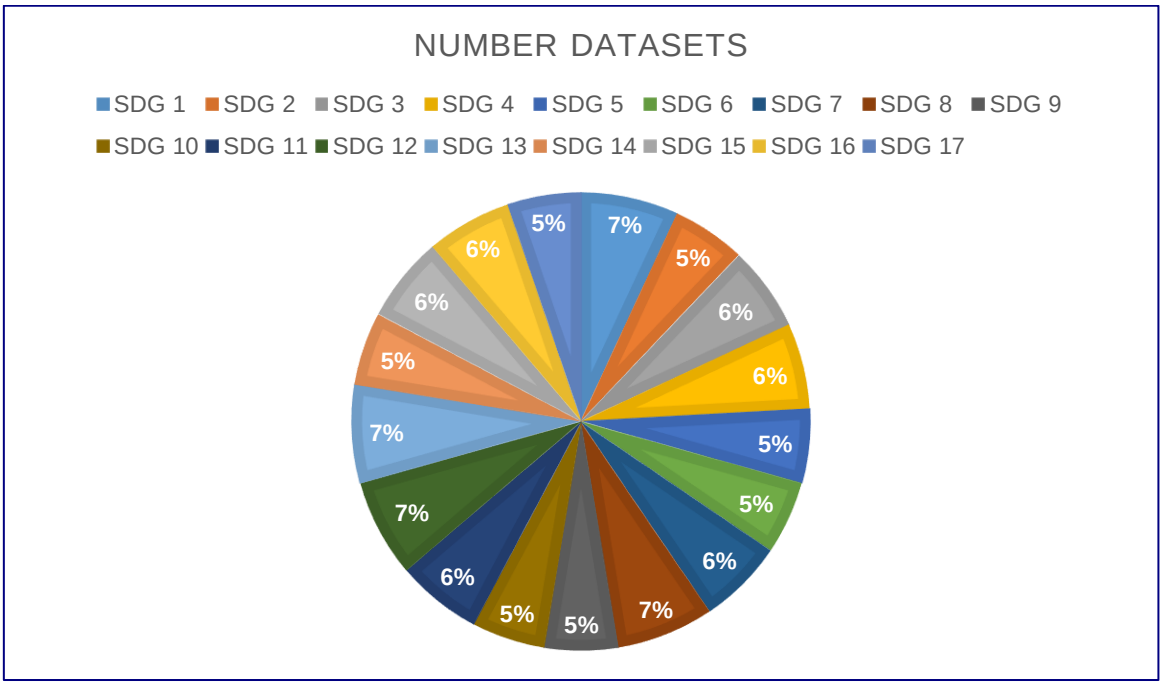

Figure 2 – Number datasets in the SDG Statistical system

The second subcategory within the Data category of the SDG Statistical System is Thematic sections. As previously mentioned, this subcategory contains 62 pages, which are classified into the following categories: SDG, Eurostat, Population and social conditions, Environment and energy, Agriculture, poverty and fisheries, General and regional statistics (Table 3).

Table 3

Thematic sections from perspective of SDGs

Thematic sections	Number	%
Sustainable development goals	10	45.45
Eurostat	3	13.64
Population and social conditions	4	18.18
Environment and energy	2	9.09
Agriculture, poverty and fisheries	1	4.55
General and regional statistics	2	9.09

Source: Author, Based on Eurostat

Visual representations in the SDG Statistical System

In the SDG statistical system, publications have the largest share (49%). The system has developed various types of publications, which are grouped into 11 categories: Statistics Explained articles, Manuals and guidelines, Glossary, Flagship publications, Statistical books/Pocketbooks, Leaflets and other brochures, Statistical working papers, Statistical reports, Interactive publications, Key figures and Statistics 4 beginners.

Table 4

Structure of publications o SDGs

Types of publications	Number	%
Statistics Explained articles	117	44.5
Manuals and guidelines	35	13.31
Glossary	26	9.89
Flagship publications	19	7.22
Statistical books/Pocketbooks	19	7.22
Leaflets and other brochures	18	6.84
Statistical working papers	13	4.94
Statistical reports	8	3.04
Interactive publications	5	1.9
Key figures	2	0.76
Statistics 4 beginners	1	0.38

Source: Author, Based on Eurostat

Key figures includes two publications "Key figures on the European food chain" which provides intuitive visualizations accompanied by concise texts, offering a comprehensive overview of the European food chain. Publications provides a selection of recent data from the domains of agriculture and fisheries statistics, as well as, a chapter on environmental issues related to some of the stages of the food chain.
Statistics 4 beginners contains a developed system Environmental statistic which provide information on the mutual relationship between natural resources and human activities and give information about a wide range of phenomena, ranging from the emission of greenhouse gases to data on biodiversity. The environment statistics data generally come from national statistical offices, national environment agencies or other administrative bodies in the EU Member States and the EFTA countries.

Key characteristics of the system Environmental statistic (EC, 2025):

- Eurostat's environmental accounts, including the air emissions accounts, energy accounts and environmental taxes, as well as the forest statistics,
- Environmental accounts support the ambition of making the European Union carbon neutral by 2050,
- The material flow accounts describe how materials move through the economy, from the extraction and trade of raw materials to the transformation processes, until their disposal as waste,
- Air emissions accounts provide information on the substances released in the atmosphere by human activities,
- Water statistics describe how much groundwater and surface water is available, they display how much water is abstracted and used for different human activities,
- The environmental accounts are built on the same principles as the national accounts

for the economy, and use the same framework and

- Statistics on biodiversity and ecosystems provide important information on the status of the natural environment and of different habitats.

Figure 3 – Environmental Statistics

Source: EC, 2025. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Beginners:Environment

Statistical Indicators in the Context of SDG and Finance

By cross-referencing indicators for SDG and finance, the statistical system provides information on two indicators: General government gross debt and Real GDP per capita.
The Treaty on the Functioning of the European Union defines General government gross debt as the ratio of government debt outstanding at the end of the year to gross domestic product at current market prices.
Basic information about indicator: General government gross debt (Eurostat, 2024)

- Overall data coverage: 2000 - 2023
- Number of values: 1440
- Theme: Economy and finance
- SDG code 17_40

The significance of the indicator: key measure of a country's fiscal health and It is used to assess the sustainability of public finances
The significance of the indicator for the national economy: A high debt-to-GDP ratio may indicate that a government has taken on a significant amount of debt, which could be a concern for investors or policymakers which may indicate a high level of investment risk, especially if economic growth does not keep pace with debt accumulation.

The significance of the indicator for the fiscal administration of the European Union: specific limits on government debt are established under the Maastricht criteria which ensure that member states maintain sound public finances and avoid excessive deficits and debt levels. The data in the table show % government gross debt in 2023 and indicate a problem in several countries: Greece, Spain, France, Italy and Belgium (Table 5 and Figure 4).

Table 5

General government gross debt in 2023

Country	%
European Union - 27 countries (from 2020)	80,8
Euro area – 20 countries (from 2023)	87,4
Euro area - 19 countries (2015-2022)	87,5
Belgium	103,1
Bulgaria	22,9
Czechia	42,4
Denmark	33,6
Germany	62,9
Estonia	20,2
Ireland	43,3
Greece	163,9
Spain	105,1
France	109,9
Croatia	61,8
Italy	134,8
Cyprus	73,6
Latvia	45,0
Lithuania	37,3
Luxembourg	25,5
Hungary	73,4
Malta	47,4
Netherlands	45,1
Austria	78,6
Poland	49,7
Portugal	97,9
Romania	48,9
Slovenia	68,4
Slovakia	56,1
Finland	77,1
Sweden	31,5

Source: https://ec.europa.eu/eurostat/databrowser/view/sdg_17_40/default/table?lang=en

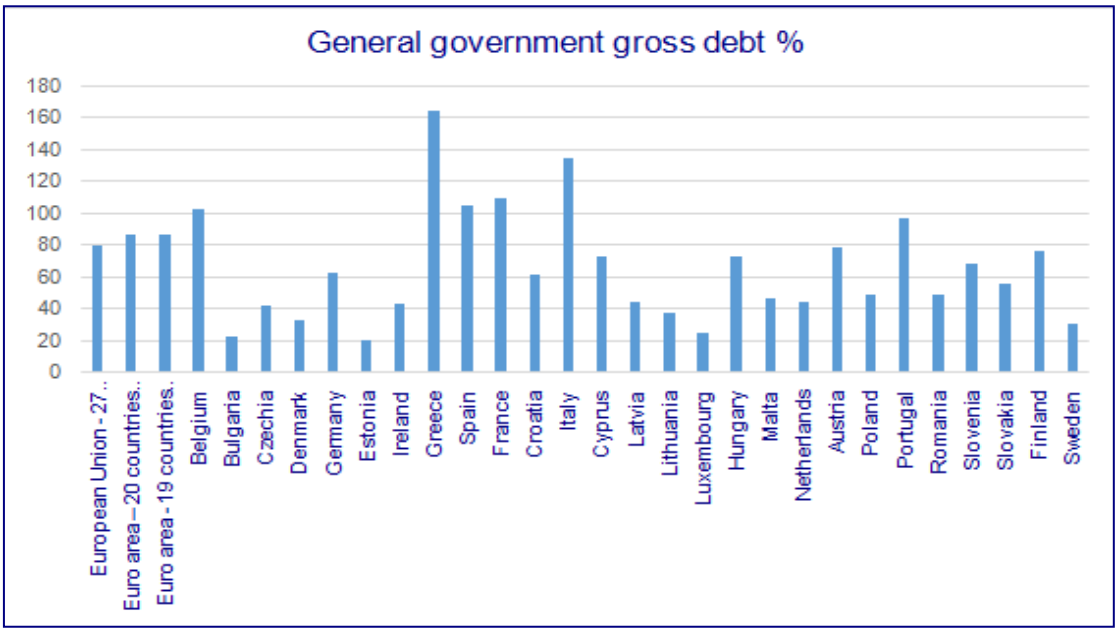

Figure 4 – General government gross debt (%)

Source: https://ec.europa.eu/eurostat/databrowser/view/sdg_17_40/default/table?lang=en

2) Real GDP per capita is calculated as the ratio of real GDP to the average population of a specific year.
Basic information about indicator: Real GDP per capita (Eurostat, 2025)

- Overall data coverage: 2000 - 2023
- Number of values: 1847
- Theme: Economy and finance
- SDG code 08_10

The data show that the countries with a Real GDP per capita above the EU 27 average are: Belgium, Denmark, Ireland, France, Luxembourg, Netherlands, Austria, Finland and Sweden (Table 6).

Table 6

Real GDP per capita in 2023

Country	Euro per capita
European Union - 27 countries (from 2020)	31.030
Euro area – 20 countries (from 2023)	34.100
Euro area - 19 countries (2015-2022)	-
Belgium	40.340
Bulgaria	8.850
Czechia	18.240
Denmark	55.280
Germany	39.380
Estonia	18.200
Ireland	82.780
Greece	18.800
Spain	25.730
France	35.260
Croatia	14.970
Italy	30.730
Cyprus	29.150

Latvia	15.020
Lithuania	16.840
Luxembourg	95.660
Hungary	14.740
Malta	29.500
Netherlands	46.240
Austria	41.770
Poland	15.280
Portugal	20.090
Romania	11.170
Slovenia	23.170
Slovakia	17.240
Finland	40.810
Sweden	48.850

Source: https://ec.europa.eu/eurostat/databrowser/view/tipsna40/default/table?lang=en

The use of the indicator is limited because it does not take into account social well-being or environmental sustainability, which is why it should be analyzed alongside other indicators.

Conclusions

The adoption of the 2030 Agenda marked the beginning of a transformative path for national economies towards sustainable and inclusive development. A key step in tracking the progress of economies towards a sustainable development model is the definition of 17 Sustainable Development Goals, with targets and indicators. As early as 2016, the first SDG Progress Report was published, with an established practice of releasing one report annually. The report includes statistical indicators as aggregate measures of achievements.

Analysis of the reports reveals the existence of numerous gaps; for example, the first reports did not cover all SDGs, and statistical systems had not developed mechanisms to monitor all indicators, among other issues.

Official statistical platforms present data on SDGs and the progress in achieving them. The UNSD platform enables the use of AI to generate responses for interested parties. Additionally, there is a dedicated SDG platform that allows for the monitoring of indicators from the 2030 Agenda.

The Eurostat platform provides a wide range of statistical data on the SDGs for various stakeholders. The data is presented in textual, graphical, and tabular formats. The platform offers the possibility to search across different indicators that can be cross-referenced, allowing for reports such as SDG and Finance. When using financial data, users are advised to consider several different indicators, such as environmental and social ones, to provide a more realistic view of development progress. The advantage of the Eurostat statistical system lies in the existence of a platform Environmental Statistics that offers visually appealing and graphically accessible insights into key indicators in this area.

In addition to the developed statistical framework for covering data within the SDG statistics, there are still gaps in terms of coverage and representation of all indicators. While statistical platforms provide different approaches to SDG data, enabling broader public access, this is important for the purposes of informing, analyzing data, and improving reporting.

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SUSTAINABLE FINANCING AS A DRIVER OF BETTER LIFE CONDITIONS

Brankica TODOROVIC[39]

Abstract

Environmental conditions are damaged by numerous factors that include unsustainable financing of economic development. Environmental conditions are increasingly important because they have a direct and indirect impact on the lives of people. Substantial sustainability is part of EU policies as part of the circular and bio-economy, climate and energy policies and sustainable financing. One of the ways of sustainable financing economy is related to carbon finance, carbon market and environmental portfolio. Carbon finances enable direct investment in the shares of companies that should benefit from the changed climatic conditions.

The goals of the research in the paper are:
1. Analysis of the development of the carbon market in terms of key performance and characteristics,
2. Analysis of the Climate Change Performance Index and
3. Indicators of quality of life from the aspect of environment: EU-SILC and EQLS.

Keywords: carbon market, environment, quality of life, sustainable finance

JEL Classification: Q01, Q54, Q56, I31

INTRODUCTION

One of the main challenges we face today is dealing with the consequences of climate change and the greenhouse gas effect (Luo & Wu, 2016). Because of this, it is becoming increasingly important carbon finance and carbon market. Carbon finance represents a trading and investment activity based on "carbon emission rights" and their derivatives, which differs from traditional financial activities (Li et. al, 2011).

Climate change is one of the key Sustainable Development Goals (SDGs), and financing solutions for SDGs are evolving, with significant attention being given to carbon markets and green bonds. Financial activity in the context of adverse climate changes plays a crucial role in mobilizing financial resources and allocating them effectively. In this regard, the role of the European Investment Bank (EIB) stands out, as it supports national economies in efforts to achieve the SDGs. The EIB provides financing and expertise to help tackle climate change and promote sustainable development across Europe and beyond, facilitating investments in green projects and initiatives that align with the global sustainability agenda.

A number of indicators have been developed to measure progress in achieving the climate transition. The Climate Change Performance Index (CCPI) shows progress in achieving four sub-indices: GHG emissions, Renewable energy, Energy use and Climate policy. The Index, also, highlights the gaps that arise in achieving climate goals and the opportunities to close them, emphasizing the role of researchers who are beginning to explore how urban green spaces affect human health. Green space may filter air, remove pollution, attenuate noise, cool temperatures, infiltrate storm water, and replenish groundwater (Escobedo et al., 2011). Studies on human health responses to urban green spaces, according to Kondo et al., encompass 68 analyses of the relationship between green space and health. Most studies

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used a vegetation index derived from satellite imagery, such as the Normalized Difference Vegetation Index to indicate amount of green space surrounding participant residences. In most studies, is emphasized the significance Geographic Information Systems (GIS) to measure accessibility to green space (Oh & Jeong, 2007). On the other hand, Eurostat has developed a statistical framework within which statistical indicators show the quality of life based on several different indicators, including climate conditions and the impact of greening on well-being.

1. ANALYSIS OF THE DEVELOPMENT OF THE CARBON MARKET

SDGs represent a framework for solving the most significant social, economic and environmental challenges until 2030. The carbon market is developing in the context of financial solutions and sources to promote the achievement of SDGs, as well as, investments in Climate Awareness Bonds and Sustainability Awareness Bonds.

1.1. Financing solutions for SDGs

The financing needed to achieve the SDGs will be raised from the large amounts of (mostly private) investable resources available globally. Financing solutions provide strategies and means to sources of finance toward realizing the SDGs (Financing for the Sustainable Development Goals (SDGs) and the Paris Climate Agreement: The UN Ecosystem of Initiatives on Private Sector Finance, 2024) (Table 1):

Table 1.

Financing solutions for SDGs

Financing solutions for SDGs	Meaning of financial solution for SDGs
Biodiversity offsets	Measurable conservation outcomes resulting from actions that compensate for significant residual adverse biodiversity impacts arising from development projects.
Bioprospecting	Systematic search for biochemical and genetic information in nature in order to develop commercially valuable products and applications.
Carbon markets	Carbon markets aim to reduce greenhouse gas emissions cost-effectively by setting limits on emissions and enabling the trading of emission units.
Climate credit mechanisms	Market mechanisms that enable entities, for which the cost of reducing emissions is high, to pay low-cost emitters for carbon credits that they can use to meet emission-reduction obligations.
Concessions (protected areas)	Concessions allow people to use land or property in a protected area or natural site for a specified purpose, usually in exchange for a fee.
Crowdfunding	Approach for projects, organizations, entrepreneurs, and start-ups to raise money for their causes from multiple individual donors or investors.
Debt for nature swaps	An agreement that reduces a developing country's debt stock or service in exchange for a commitment to protect nature.
Disaster risk insurance	Insurance schemes covering against a premium the costs incurred by the insured entity from extreme weather and natural disasters.
Ecological fiscal transfers	Integrating ecological services means making conservation indices (e.g., size of protected areas) part of the fiscal allocation formula to reward investments in conservation.
Enterprise challenge funds	Funding instrument that distributes grants to profit-seeking projects on a

	competitive basis.
Entrance and activity fees	Tourists pay fees for access to a protected area.
Environmental trust funds	Legal entity and investment vehicle to help mobilizing, blending, and overseeing the collection and allocation of financial resources for environmental purposes.
Green bonds	Bonds where proceeds are invested exclusively in projects that generate climate or other environmental benefits.
Impact investment	Investments made with the intention of generating a measurable social and environmental impact alongside a financial return.
Lotteries	Governments and civil society use lotteries to raise funds for benevolent purposes such as education, health, and nature conservation.
Payments for ecosystem services	Payments for ecosystem services occur when a beneficiary or user of an ecosystem service makes a direct or indirect payment to the provider of that service.
Public guarantees	Guarantees can mobilize and leverage commercial financing by mitigating and/or protecting risks, notably commercial default or political risks.
Remittances	Private unrequited transfers sent from abroad to families and communities in a worker's country of origin.
Social and development impact bonds	A public-private partnership that allows private (impact) investors to upfront capital for public projects that deliver social and environmental outcomes in exchange for a financial interest
Taxes on fuel	The sale tax any individual or firm who purchases fuel for his/her automobile or home heating pays.
Taxes on pesticides and chemical fertilizers	Taxes on certain pesticides and chemical fertilizers can mobilize fiscal revenues while mitigating the negative effects associated with pesticide/fertilizer application and promoting sustainable agriculture practices.
Taxes on renewable natural capital	Any fee, charge, or tax charged on the extraction and/or use of renewable natural capital (e.g., timber or water).
Taxes on tobacco	Excise taxes on tobacco products can raise fiscal revenues, improve health and well-being, and address market failures.
Voluntary standards (finance)	Standards applicable to the financial sector that capture good practices and encourage the achievement and monitoring of social and environmental outcomes.

The role of the EIB in achieving the SDGs

The EIB is responsible for financial stability is understood as “a condition in which the financial system which comprises financial intermediaries, markets and market infrastructures is capable of withstanding shocks and the unravelling of financial imbalances” (ECB, 2021), but seeks to contribute greening the financial system.

The EIB Group has been tracking and reporting how its investments contribute to the SDGs since 2016. The EIB Group’s activities have a particular impact on the SDGs related to climate and the environment. The table contains several indicators from EIB-only projects signed in 2022 and how their impact is expected to contribute to specific SDGs (Table 2).

Table 2.

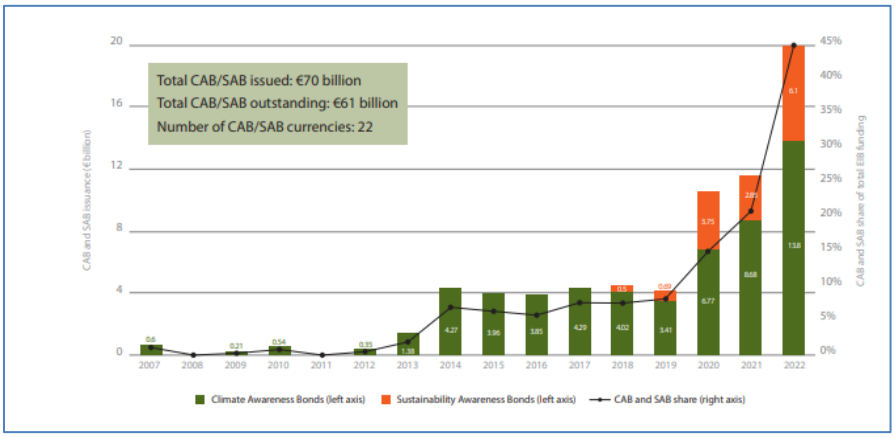
Contribution EIB SDG in 2022 (Excerpt)

Selected project indicator	EU + non-EU	SDGs
Number of SMEs/mid-caps supported	430 000	SDG 8 SDG 10
Number of jobs sustained in SMEs/mid-caps	5.3 million	SDG 8

		SDG 10
Annual energy savings expected	2 million MWh	SDG 7
Electricity generation capacity from renewable energy sources	15 800 MW	SDG 7 SDG 9
Electricity produced from renewable energy sources	31 300 GWh	SDG 7 SDG 9
Power lines installed/upgraded	28 300 km	SDG 7 SDG 9

Source: EIB, 2023.

The EIB is committed to playing a key role in further shaping the green bond market and to fostering its development by supporting market liquidity. In 2022, the EIB issued €20 billion (or 45% of its funding program) of Climate Awareness Bonds and Sustainability Awareness Bonds. The EIB has issued €70 billion worth of Climate and Sustainability Awareness Bonds since 2007 (across 22 currencies) (EIB, 2023) (Graph 1).



Graph 1. A growing share of EIB funding comes from Climate and Sustainablity Awareness Bonds

Source: EIB, 2023. p. 41.

1.2. Characteristics of green bonds in the EU

Green bonds are loans provided by an investor to a borrower which are used to fund projects or activities that promote climate change mitigation or adaptation or other environmental objectives. Two of the most widely accepted standards for green bonds are (Climate Bond Initiative, 2025):

1. International Capital Market Association (ICMA) Green Bond Principles (GBP): These are voluntary guidelines that establish a framework for the issuance of green bonds. The core components of the ICMA GBP include:
   - Use of Proceeds: The funds raised through green bonds must be allocated exclusively to projects that contribute to environmental objectives.
   - Process for Project Evaluation and Selection: Issuers must have a transparent process for selecting projects that meet environmental criteria.
   - Management of Proceeds: The funds raised from the bonds must be tracked and allocated to eligible projects.
   - Reporting: Issuers are required to provide regular reports on the use of proceeds and the environmental impact of the financed projects.
2. Climate Bonds Initiative (CBI) Certification: The CBI provides a certification scheme that ensures the bond aligns with specific climate-related criteria. Certified bonds must

demonstrate that the proceeds will finance projects that contribute to climate change mitigation or adaptation.
Rate of adoption of green bonds captures the pace of growth in sustainable finance and is calculated by taking the gross issuance of green bonds as a percentage of the potential net issuance, which is represented by the change in debt.

At the end of 2022, the overall face value stock of green bonds issued by EU general governments was €266 billion, equivalent to 1.7% of EU GDP. This compares to €85 billion (0.6% of EU GDP) at the end of 2019. France and Germany had the highest end-2022 stocks of green bonds, at €94.7 billion and €63.1 billion, representing 59.2% of the total amounts outstanding of EU governments. Spain (€22.9 billion), Belgium (€22.2 billion), Italy (€21.5 billion) and the Netherlands (€15.7 billion) followed, with these six Members States representing 90% of EU outstanding amounts of green bonds (Eurostat, 2023a).

Over the period 2019-2022, the highest rate of adoption of green bonds as a percentage of the change in total debt is observed for Sweden (42.5 %), followed by Luxembourg (22.5%), Denmark (21.5%), the Netherlands (21.1%), Ireland (20.4%), and Belgium (14.5%) (Eurostat, 2023b) (Table 3).

Table 3.

New issuance of green bonds, cumulated 2019-2022

Country	Issuance of green bonds as a % of change in gross debt	Issuance of green bonds as a % of change in stock of debt securities
Sweden	42.5	-10.7
Luxembourg	22.5	20.0
Denmark	21.5	20.1
Netherlands	21.1	27.4
Ireland	20.4	21.7
Belgium	14.5	17.4
Slovenia	13.8	15.8
Germany	11.9	15.7
Latvia	11.6	11.5
France	11.0	12.3
Hungary	9.1	9.8
Austria	7.7	9.5
Spain	7.2	7.5
Italy	5.7	6.9
Poland	2.1	3.2
Lithuania	0.5	0.6

Source: Eurostat, 2023b.

2. ANALYSIS OF THE CLIMATE CHANGE PERFORMANCE INDEX

The Climate Change Perfomance Index (CCPI) compares the climate change mitigation efforts of 63 countries and the EU (account for over 90% of the world's GHG emissions). The

table shows the overall ranking and performance in the four Index categories: GHG emissions, Renewable energy, Energy use and Climate policy (Table 4). From EU countries Denmark remains the top-ranked country but falls short of an overall very high rating. Sixteen EU countries are among the high and medium performers, with Denmark (4th) and the Netherlands (5th) leading the overall ranking. Finland plunges 11 spots to 37th, mainly due to its poorer showing in Climate Policy (Table 4).

Table 4.

Climate Change Performance Index 2025 in EU countries

Rank	Country	GHG emissions (40% weighting)	Renewable energy (20% weighting)	Energy use (20% weighting)	Climate Policy (20% weighting)	Rating
4	Denmark	29.09	15.73	13.69	19.86	High
5	Netherlands	27.29	12.12	12.91	17.28	High
11	Sweden	31.79	15.89	11.41	8.52	High
13	Luxembourg	34.13	9.61	13.58	9.97	High
14	Estonia	29.90	11.56	15.81	9.51	High
15	Portugal	28.11	9.50	14.80	14.19	High
16	Germany	26.81	8.24	14.14	15.71	Medium
18	Lithuania	25.83	11.29	15.30	10.62	Medium
19	Spain	26.02	8.44	14.22	12.90	Medium
22	Greece	25.15	9.86	14.65	9.74	Medium
23	Austria	24.25	9.13	11.24	14.78	Medium
25	France	26.34	7.83	13.90	11.11	Medium
29	Ireland	21.92	8.81	13.22	13.22	Medium
30	Slovenia	25.58	6.72	12.35	12.51	Medium
32	Romania	27.26	5.47	15.38	8.34	Medium
34	Malta	25.80	4.92	15.01	10.05	Medium
35	Belgium	26.03	5.92	11.59	11.35	Low
36	Latvia	16.35	13.87	13.85	10.28	Low
37	Finland	25.90	13.59	6.93	7.82	Low
40	Croatia	21.14	11.14	12.46	7.09	Low
43	Italy	23.34	6.98	13.46	6.04	Low
44	Cyprus	23.35	7.49	14.34	4.28	Low
45	Hungary	24.48	6.80	12.64	4.52	Low
46	Slovakia	26.89	4.00	12.94	4.62	Low
47	Poland	21.58	6.32	12.46	7.50	Low
49	Czech Republic	22.32	5.56	11.81	7.88	Low
50	Bulgaria	19.29	8.68	11.07	8.09	Low

Source: CCPI, 2025.

Analysis CCPI based on the four Index categories:

1)GHG emissions
Luxembourg is the best performing EU country, at 5th, though Sweden, Estonia, Denmark, Portugal, the Netherlands, Romania, and Slovakia also rate high. Latvia is the only EU country receiving a very low in this category.

2)Renewable energy
Norway receives a very high in this category, but for the first time, Sweden and Denmark receive a very high as well, but Malta and Slovakia perform very low.

3)Energy use
Estonia, Romania, Lithuania, and Malta are the only EU countries performing high, while Belgium, Sweden, Austria, Bulgaria, and Finland receive a very low.

4)Climate policy
Denmark leads the Climate Policy ranking, nineteen EU countries receive a low or very low but Slovakia, Hungary, and Cyprus are the countries with a very low performance.

The CCPI identifies two critical factors: implementation gaps and ambition gaps reductions in global greenhouse gas (GHG) emissions (CCPI, 2025a). Implementation gaps: CCPI countries have emissions that exceed the Paris temperature target. In EU countries, CCPI does not exceeding the Paris temperature goal. The Renewable Energy rating results therefore indicate substantial room for more greatly mitigating emissions by more rapidly deploying renewable energy. Ambition gaps: EU's climate goal of reducing GHG emissions by 55%+ by 2030 compared with 1990 levels (Fit for 55 package) trought increasing renewable energy and pushing for more energy efficiency. Current climate targets and their implementation cannot contain global warming within 1.5°C.

The international system of trade in emission units of harmful gases in the EU operates on the principle of "cap and trade", where cap is the total amount of certain gases that give the greenhouse effect and are emitted by factories, power plants and other economic entities.

Companies get allowances that they can trade with each other. When a company reduces its annual emissions, it has the right to keep the rest and use the remaining units to meet future needs or sell them. In this way, the aim is to achieve zero carbon dioxide emissions. The money paid by the emitter in this way is sent back to the organization or the government that manages the ecosystem, in order to preserve it and leave it protected.

3. INDICATORS OF QUALITY OF LIFE FROM ASPECT OF ENVIRONMENT: EU-SILC and EQLS

The quality of life can be defined as the general well-being of people living in society which encompasses a number of dimensions, both objective factors (material resources, health, working status, living conditions and so on) and the population's subjective perceptions (Eurostat, 2023c).

Eurostat provides a framework for measuring the quality of life in cities. The conceptual basis of EU-SILC and EQLS measurement is established by defining the Urban Agenda. The Urban Agenda was launched in 2016 with the Pact of Amsterdam to promotes cooperation between EU countries, the EC, cities and other stakeholders to

stimulate growth (Urban Agenda, 2016). The Urban Agenda has defined 14 partnerships, covering areas: air quality, the circular economy, climate adaptation, culture and cultural heritage, the digital transition, the energy transition, housing, the inclusion of migrants and refugees, innovative and responsible public procurement, jobs and skills in the local

economy, sustainable use of land and nature-based solutions, urban mobility, urban poverty and security in public spaces. In November 2020, the New Leipzig Charter on the transformative power of cities for the common good was adopted, it provides a framework for integrated urban development following: Sustainable Development Goal 11, the Paris Agreement, the European Green Deal and the Urban Agenda.

In addition, Agenda 2030, which contains 17 SDGs, represents a global policy framework for sustainable, inclusive and equitable development (UN, 2015). Within the framework of the SDGs, attention is, also, paid to cities, urban and rural areas that have a crucial role for many policy areas underlying the SDGs such as eradicating poverty and hunger, housing, transport, infrastructure, land use or climate change.

Cities may be simultaneously the source of many of today's economic, social and environmental challenges but they face a range of social and environmental challenges.

Therefore, the quality of life in cities is affected by the presence of green spaces because they have environmental benefits, facilitating climate change adaptation or mitigation, supporting the conservation of biodiversity and improve physical and mental health. Access to green spaces makes urban residents more satisfied with their city green spaces in cities have a great potential to boost human health and well-being.

Open public spaces in urban areas foster inclusive cities but only 44 per cent of urban residents have an open public space conveniently located within a 400-metre walk, according to 2020 data from 1,365 cities across 187 countries (The SDG Report, 2024).

In the Malmö, 91.7% of the population was rather satisfied or very satisfied with the green spaces in their city. High shares were also recorded in München (90.8%) and Hamburg (88.8%), Helsinki (89.4%) and Groningen (89.3%) (Urban-rural Europe-quality of life in cities, 2024).

According to the survey on quality of life in European cities in 2023, around 76 % of European urban residents were satisfied with green spaces available within their city. Geneva, Malmö, Oslo and Munich received the highest scores from their residents, with more than 90 % of the people surveyed in these cities stating satisfaction with their green spaces. Among the Member States, southern countries showed lower than average satisfaction with green spaces, with rates below 60 % (Eurostat, SDG 11 - Sustainable cities and communities, 2024).

CONCLUSION

Sustainable economic development has become the essence of the development of modern economies. In order to monitor progress in its realization, Agenda 2030 and SDGs represent the framework for EU development policy. Although emissions of air pollutants have fallen, almost 20 percent of the EU's urban population lives in areas where the concentration of air pollutants is above at least one EU air quality standard. It is therefore necessary to involve different policies and actors in order to enable systemic changes in production, consumption, and lifestyle, as well as, the implementation of policies at EU and national level. One of the ways of sustainable financing is related to carbon finance and carbon market.

Carbon finances enable direct investment in the shares of companies that should benefit from the changed climatic conditions. There are several indicators in this area that point to the efforts of society and individuals to reduce the impact of climate change on the environment.

However, researchers are increasingly pointing to a more pronounced gap between subjective and objective indicators that describe society, which is why it is necessary to measure quality of life issues. Eurostat provides an overview of quality of life indicators related to the functional capabilities that citizens should have in order to effectively achieve personal well-being. Environmental conditions have a direct and indirect impact on an individual's life. Urban residents in Europe with greater access to green spaces tend to be more satisfied with the cities they live in. Universal accessibility to these green spaces that are safe, inclusive and open is thus essential for personal well-being and progress in achieving the SDG 11.

The paper emphasizes the importance and role of financial instruments for encouraging the achievement of the SDGs. Among them, green bonds play an important role as funds for the mobilization of funds and then for their allocation. Sustainable financing is a necessity for establishing a framework for the sustainable development of national economies and cities that are increasingly turning to greening.

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