Romanian Academy
"Costin C. Kiriţescu" National Institute for Economic Research
"Victor Slăvescu" Centre for Financial and Monetary Research

Financial Studies

Year XXIX - New series - Issue 3/(109)/2025

"VICTOR SLĂVESCU" CENTRE FOR FINANCIAL AND MONETARY RESEARCH

FINANCIAL STUDIES

ROMANIAN ACADEMY
"COSTIN C. KIRIȚESCU" NATIONAL INSTITUTE FOR ECONOMIC RESEARCH
"VICTOR SLĂVESCU" CENTRE FOR FINANCIAL AND MONETARY RESEARCH

FINANCIAL STUDIES

Year XXIX– New series – Issue 3 (109)/2025

ROMANIAN ACADEMY
“COSTIN C. KIRIŢESCU” NATIONAL INSTITUTE FOR ECONOMIC RESEARCH
“VICTOR SLĂVESCU” CENTRE FOR FINANCIAL AND MONETARY RESEARCH

Quarterly journal of financial and monetary studies

Issue 3/2025 (109, Year XXIX)
ISSN 2066 - 6071
ISSN-L 2066 - 6071

Contents

ASSESSMENT OF THE EXCHANGE RATE RISK EXPOSURE IN TUNISIA'S EXTERNAL PUBLIC DEBT PORTFOLIO: A DELTA-NORMAL VAR APPROACH IN THE CONTEXT OF SUSTAINABLE FINANCE DEVELOPMENT 6
Sabrine CHANNOUFI, PhD Candidate

AN ANALYSIS OF THE FOREIGN DEFICIT IN ROMANIA AND IN OTHER EUROPEAN COUNTRIES 30
Camelia MILEA, PhD
Cătălin DRĂGOI

THE SHADOW DEFAULT-FREE REAL RATE OF RETURN 49
Elli KRAIZBERG, PhD

FINANCIAL DEVELOPMENT AND INCOME INEQUALITY NEXUS IN SOUTH AFRICA: AN EMPIRICAL INVESTIGATION 82
Mercy T. MUSAKWA, PhD
Nicholas M. ODHIAMBO, PhD

AN EMPIRICAL STUDY OF PROPERTY AND REAL ESTATE COMPANIES LISTED ON THE INDONESIAN STOCK EXCHANGE.. 101
Hestinuraini USAT, PhD Candidate
Asep Rokhyadi Permana SAPUTRA, PhD
Fety Rochyawati Qudrat MULYA, PhD

ASSESSMENT OF THE EXCHANGE RATE RISK EXPOSURE IN TUNISIA'S EXTERNAL PUBLIC DEBT PORTFOLIO: A DELTA-NORMAL VAR APPROACH IN THE CONTEXT OF SUSTAINABLE FINANCE DEVELOPMENT

Sabrine CHANNOUFI, PhD Candidate*

Abstract

This paper assesses the exchange rate risk exposure of Tunisia’s external public debt portfolio using the delta-normal Value at Risk (VaR) approach. Based on daily data from 2004 to 2019, focusing on the main borrowing currencies (the euro, US dollar, and Japanese yen), the study identifies the riskiest currencies and offers policy recommendations. The findings highlight significant exposure to the Japanese yen, while the US dollar appears to act as a hedge against currency volatility. The research underscores the importance of adjusting the portfolio structure based on currency risk profiles and Tunisia’s trade dynamics. This analysis contributes to the broader objective of sustainable public finance development by promoting more resilient and responsible debt management practices.

Keywords: debt management, currency risk, financial stability, portfolio optimisation

JEL Classification: F31, F34, C53

1. Introduction

In an increasingly environmentally and sustainability-conscious world, our research fits within the context of sustainable finance. While our study does not exclusively focus on ecological aspects, it positions itself within a broader consideration of financial sustainability. Sustainable finance aims to integrate responsible, social, and environmental financial practices into portfolio and risk management. In this regard, the analysis of exchange rate risk in Tunisia's external public debt is relevant within the perspective of economic stability and

* *University of Economics and Management Tunis El Manar, Tunisia. Corresponding author, e-mail: Sabrine.channoufi@fsegt.utm.tn*

prudent public finance management, aligning with the concerns of sustainable finance. Proper management of external public debt plays a crucial role in advancing sustainable finance. Indeed, effective management of external debt has the potential to enhance a country's financial stability, creating a conducive environment for investment and economic growth, both fundamental aspects of sustainable finance. Additionally, proficient debt management grants countries improved sovereign ratings, thus facilitating better access to sustainable capital markets. This, in turn, allows them to issue green or social bonds to finance environmentally friendly and socially responsible projects.

It is worth noting that sustainable development fundamentally hinges on poverty reduction while preserving scarce resources. Prudent debt management offers the opportunity to seek external funding to support poverty alleviation programs, education, healthcare, clean water supply, and the deployment of renewable energy, all of which are major objectives of the Sustainable Development Goals (SDGs). Appropriate management of external public debt can play a vital role in preventing the accumulation of unsustainable debt, which could hinder the capacity to finance long-term sustainable initiatives.

The management of external public debt and the development of sustainable finance are closely intertwined. Through careful and responsible debt management, it can serve as a catalyst for environmentally and socially responsible investments, thereby contributing to progress towards a more sustainable future.

The evaluation of the exposure to exchange rate risk associated with Tunisia's external public debt portfolio is driven by several key factors. Firstly, a deep understanding of this exposure is fundamental for responsible financial management of public debt, thereby preventing potential financial difficulties arising from unfavourable exchange rate fluctuations. Furthermore, assessing and managing exchange rate risk effectively allows for reducing the costs related to servicing public debt. This is of paramount importance for the prudent allocation of budgetary resources to other priority sectors. Indeed, cost reduction coupled with financial risk management forms the core of effective public debt management.

This evaluation will enable us to identify the currency with the least risk within the Tunisian external public debt portfolio. This identification will pave the way for recommendations to the relevant authorities regarding the optimal choice of currency for future borrowing.

In summary, the evaluation of exchange rate risk exposure is a crucial step to ensure responsible financial management, cost reduction, and mitigation of financial risks related to public debt, while contributing to informed decisions about currency borrowing in the future.

The uniqueness and the contribution of this study lie in its in-depth exploration of the underlying causes of the significant increase in Tunisian external public debt, in contrast to most previous works that have focused on the high rate of this debt and its negative implications for growth. One of the primary drivers of this increase is the depreciation of the Tunisian dinar against the major currencies comprising the external debt portfolio. Unlike previous studies, which often remained on the surface of this issue, our approach aims to delve deeper into comprehending the reasons behind this increased risk. This involves a thorough analysis of the factors contributing to the depreciation of the Tunisian dinar, as well as the impact of this trend on the evolution of public debt. By identifying these underlying causes, our work provides a more comprehensive and informed perspective on this complex matter.

This study stands out for its in-depth analysis of the reasons for the rise in Tunisian external public debt, with a particular focus on the depreciation of the Tunisian dinar against major currencies. It seeks to shed further light on the relationship between these factors, which is essential for formulating effective financial policies that can withstand exchange rate fluctuations. To achieve these objectives, the paper is structured as follows: after this introduction, Section 2 provides the literature review on both the exchange rate risk and the Value at Risk method. Section 3 describes the research methodology, and Section 4 presents and discusses the empirical results. Finally, Section 5 outlines policy recommendations and concludes the study.

2. Literature review

2.1. Exchange rate effect on external debt

Effective public debt management involves the art of mobilising low-cost borrowing resources while maintaining strict control over associated financial risks. Within this set of risks, we can identify credit risk, refinance vulnerability, liquidity exposure, interest rate uncertainty, and foreign exchange risk. For developing countries, the need to minimise risks can sometimes outweigh the simple reduction of debt-related costs. In this regard, the World Bank, in its 2007 report on public debt management, highlights a crucial recommendation: it is imperative to clarify the paramount importance of risk reduction compared to cost savings when formulating a debt management strategy. This recommendation is based on observations showing that some sovereign defaults have been partially precipitated by governments focusing on short-term cost savings. An illustrative example is the issuance of substantial volumes of short-term debt denominated in foreign currencies, which has significantly exposed public finances to market conditions (World Bank, 2007).

The current work closely aligns with the guidelines set forth by the International Monetary Fund (IMF, 2001) regarding public debt management, whether for advanced, emerging, or developing nations. The chief aim of debt management is to diminish expenses and associated risks, directly benefiting the taxpayer. In the context of developing countries, one approach to achieving this involves the judicious selection of currencies for external borrowing.

Unlike developed economies, which benefit from vast and highly liquid financial markets and internationally convertible currencies, enabling them to issue foreign debt denominated in their domestic currency, developing countries face the constraint of borrowing primarily in foreign currencies. This situation largely arises from the frequently observed illiquid nature of their financial markets (Miller, 1997, as cited in Fisera et al, 2021, p.4).

In the literature, the Marshall-Lerner condition must be met for the depreciation of the exchange rate to benefit the country by stimulating export growth. However, this same exchange rate depreciation could have negative implications for the accumulation of the public debt stock, especially in the presence of a heavily indebted country. Thus, the repayment of loans in foreign currency becomes more costly in the presence of a depreciating currency. At that point, heavily indebted countries in foreign currencies must benefit from exchange rate appreciation episodes to repay the growing burden of their external debts.

In this context, a study conducted by Blessy (2019) sought to empirically examine the impact of exchange rate depreciation on external debt in a group of developing countries. Using quarterly data spanning from 2004 to 2017, the findings demonstrated that exchange rate depreciation tends to increase external indebtedness in the majority of the countries analysed. Additionally, Bouabidi (2023) argues that the exchange rate emerges as one of the primary factors contributing to the phenomenal rise of external debt in Tunisia. More specifically, the author notes that 40% of the observed increase in Tunisia's external debt between 2009 and 2020 can be attributed to the exchange rate effect. In this perspective, the relationship between the exchange rate and external debt in emerging economies holds particular significance, given the adverse consequences that substantial exchange rate depreciation could entail. In this regard, Asonuma (2016) examined 18 instances of sovereign debt defaults and restructurings from 1998 to 2013. The author successfully established a positive link between real exchange rate depreciation and the emergence of debt-related crises. This relationship was explained by the fact that real depreciation increases the burden of external debt service, consequently raising the likelihood of a default situation.

2.2 Value at Risk

Several methods are available for studying the exchange rate risk faced by the external public debt portfolio. Among these approaches, the Value at Risk (VaR) method stands out. In reality, VaR assesses the most unfavourable anticipated loss for a portfolio over a given period, at a specified confidence level, and under market conditions considered to be normal (Jorion, 2006). In other words, VaR quantifies the maximum extent of losses to which a portfolio can be exposed during a specific period. Dowd (1998) defined VaR as the maximum amount one is at risk of losing on a given sum of money during a specific time frame, with a certain level of confidence. The duration of this holding period is typically one day, but can vary from a week to a month, a quarter, or even a year. However, the choice of this holding period significantly impacts the final VaR calculation: the longer the holding period, the more meaningful the VaR outcomes. Similarly, the choice of the confidence level, which acts as the threshold for defining the left tail of the portfolio's value distribution, directly influences the VaR outcome. As the confidence level increases, the value of VaR also increases. In this context, Dowd (1998) suggests that the choice of the confidence level depends on the purpose of calculating VaR. In reality, different confidence levels (such as 95%, 99%, or 99.5%) are used for various purposes. A lower confidence level is favoured for validation, while a higher confidence level is employed for risk management or determining capital requirements.

Therefore, there is no universally required holding period or confidence level when calculating VaR.

Blejer and Schumacher (1998) developed a comprehensive overview of VaR methodology for assessing the solvency of central banks and their exposure to risks. They highlighted that this approach, taking into account the balance sheet of monetary authorities, not only allows for the analysis of the origins of risks faced by central banks but can also help in anticipating financial crises. Nocetti (2006) adopted the same methodology as Blejer and Schumacher (1998) to examine early warning signals of the financial crisis that occurred in Argentina in 2001. Using VaR through Monte Carlo simulation, with a confidence level of 99.9% and 3 months, the author assessed that vulnerability indicators (calculated using VaR) provided a fairly accurate description of the crisis in Argentina.

Cakir and Raie (2007) applied VaR using both the delta-normal approach and Monte Carlo simulation to assess the impact of Sukuk, which are Islamic principles-based bonds, on the cost and risk structure of investment portfolios. Despite using a confidence level of 99% and a 5-business-day holding period, the results obtained from delta-normal VaR proved to be comparable to those derived from Monte Carlo simulation VaR. According to the analysis of these authors, the portfolio’s VaR can be constructed by combining the risks associated with the underlying securities. In other words, it represents the envelope formed by the correlation and volatility between different risk variables over the study period.

In Tunisia, Ajili (2008) employed the VaR method using the delta-normal approach to assess the foreign exchange risk linked to the external public debt portfolio. She employed exchange rate data on a daily basis for the Tunisian Dinar against the three principal constituent currencies of the long-term public debt portfolio (Euro, US Dollar, and the Swiss Franc) for the period from January 1, 1999, to June 30, 2006. The results demonstrated that Tunisia preferred the Euro as the currency to manage exchange rate risk related to its external debt. However, breaking down the VaR analysis by component demonstrated that the Japanese Yen served as the primary origin of exchange rate risk for Tunisia.

Akbar and Chauveau (2009) confirm that the use of VaR and Cost at Risk (CaR) techniques in managing the public debt portfolios of developed countries is not a new practice. In fact, Ireland and Italy use VaR techniques to manage risks related to their debt portfolios, while New Zealand employs both VaR and stop-loss limits approaches to manage exposure to exchange rate risks. These analyses are typically conducted with a confidence level of 95%.

The study conducted by Akbar and Chauveau (2009) aimed to evaluate and analyse the exchange rate risk associated with three currencies: the Euro, the US Dollar, and the Japanese Yen, on the portfolio of Pakistan's public debt using the VaR methodology over a daily holding period from 2001 to 2006. The conclusions of this study highlighted several significant findings:

- Annual exchange rate return series showed a better fit to a normal distribution compared to returns over the overall period (2001-2006);
- The results obtained from the Monte Carlo method and historical simulation were consistent with those from the Delta-Normal method;
- VaR calculated using the three methods showed a significant decrease in the potential maximum loss over the years, indicating improvements in exchange rate risk management;
- Beta analysis revealed that the US Dollar was the least risky currency as it had the only beta below one for all six years. In contrast, the Japanese Yen was the riskiest currency, with the highest beta throughout the period in the public debt portfolio;
- Despite being the individually least risky currency, the US Dollar contributed to presenting the highest risk as a component of VaR in some years, primarily due to its positive beta, which decreased significantly over the years, as well as its substantial weight in the portfolio.

In the same context of assessing exchange rate risk associated with the portfolio of public debt, Omrane (2012) also employed the VaR method to analyse the situation in Tunisia. Using daily exchange rate data for the Tunisian Dinar (TND) against the Euro (EUR), the US Dollar (USD), and the Japanese Yen (JPY), covering the period from 2 January 2004 to 31 December 2008, the results also confirmed that the Japanese Yen represents the riskiest currency, followed by the US Dollar. In contrast, the Euro appears to be the least risky currency compared to the other component currencies of the Tunisian external debt portfolio, corroborating the conclusions previously established by Ajili (2007) for the Tunisian context. Indeed, such results can be explained by the natural hedge provided by the Euro against exchange rate risk through export revenues denominated in this currency.

Virtually all of Tunisia's export revenues come from exports denominated in Euros.

In the continuation of our analysis, we will apply the VaR method to evaluate the associated risk with the exchange rates of the major foreign currencies that make up the portfolio of Tunisia's external public debt.

3. Research methodology

The purpose of this study is to evaluate the performance of managing Tunisia's external public debt in terms of exposure to exchange rate risk by identifying the risky currencies within the External Public Debt Portfolio in Tunisia (PDPET). To achieve this, the VaR approach is employed to assist the relevant authorities in pinpointing the currencies that pose the most risk compared to others in the portfolio (PDPET). Furthermore, this method will help determine the currencies that contribute the most to reducing the overall exposure to exchange rate risk in the PDPET.

The methodology adopted in this study is similar to that used by Ajili (2008) and Omrane (2012), but it extends over a longer period, from 02/01/2004 to 31/12/2019. This extension of the database highlights the significance of analysing fluctuations in exchange rate yield over the structure of Tunisia's external debt. It places particular emphasis on assessing the potential losses that this volatility could entail during the study period.

The first step in VaR calculation involves computing the returns for each exchange rate series for each year using geometric returns. We will then define the following three variables:

1/ $R_{EUR} = \ln \frac{\frac{EUR}{TND(t)}}{\frac{EUR}{TND(t-1)}} = \ln \frac{EUR}{TND_t} - \ln \frac{EUR}{TND_{t-1}}$

2/ $R_{USD} = \ln \frac{\frac{USD}{TND(t)}}{\frac{USD}{TND(t-1)}} = \ln \frac{USD}{TND_t} - \ln \frac{USD}{TND_{t-1}}$

3/ $R_{JPY} = \ln \frac{\frac{JPY}{TND(t)}}{\frac{JPY}{TND(t-1)}} = \ln \frac{JPY}{TND_t} - \ln \frac{JPY}{TND_{t-1}}$

Next, we proceed to calculate the portfolio's VaR of Tunisia's external public debt linked to exchange rate risk using the delta-normal version. We have chosen a confidence level of 95% and a one-day time horizon for this assessment. It is important to note that the application of this delta-normal approach, also referred to as the variance-covariance method, is grounded on the assumption that the price fluctuations of the assets comprising the portfolio follow a normal distribution. In other words, the returns of the three exchange rates must follow a normal distribution for this method to be applicable.

The VaR of a portfolio with (n) assets can be computed using the VaR of each asset as follows:

$$VaR_n = -\beta\sigma_n Z = [VaR * M * VaR^T]^{1/2} \quad (1)$$

Where:

$\beta = 1.65$ quantile of the normal distribution at the 95% confidence level (1.65) (since the chosen confidence level in this study is 95%)

σ – the matrix of standard deviations (dimension: n x n)

Z – a vector (dimension: 1 x n)

M – the correlation matrix (dimension: n x n)

VaR^T – the transpose of the VaR vector

$VaR = [VaR_1, VaR_2, \dots, VaR_n]$

Thus, equation (1), which quantifies the maximum potential loss for a portfolio comprising (n) assets, is exposed, can be applied for our study (with a confidence level of 95%, the number of assets, n=3, and under the assumption of normality) as follows:

$$VaR_3 = 1.65Z_1\sigma_1\ 1.65Z_2\sigma_2\ 1.65Z_3\sigma_3 = [VaR * M * VaR^T]^{1/2}$$

$$VaR_3 = \left([1.65Z_1\sigma_1\ 1.65Z_2\sigma_2\ 1.65Z_3\sigma_3] \begin{bmatrix} 1 & M_{12} & M_{13} \\ M_{21} & 1 & M_{22} \\ M_{31} & M_{32} & 1 \end{bmatrix} \begin{bmatrix} 1.65 & z_1 & \sigma_1 \\ 1.65 & z_2 & \sigma_2 \\ 1,65 & z_3 & \sigma_3 \end{bmatrix} \right)^{1/2}$$

Where M_{ij} represents the correlation between the price movements of assets *i* and *j*.

In order to thoroughly study the VaR associated with the Tunisian external public debt portfolio, by applying the equation (1), we will begin by analysing the normality of the overall portfolio for the entire study period.

Here, the term “overall portfolio” refers to all the daily data concerning the three currencies (EUR, USD, JPY), specifically the exchange rate returns, covering the period from January 2, 2004, to December 31, 2019 (see Figure 1, in the Appendix).

According to the data presented in Table 1 (in the Appendix), which outlines the statistical properties of the returns of the three exchange rates, it is evident that these returns do not follow a normal distribution. The results of the Jarque-Bera normality tests show zero probabilities for all return series, confirming the rejection of the null hypothesis of normality (at a 5% significance level), implying that the return series do not follow a normal distribution.

Next, we calculated the correlation matrix (see Table 1a, in the Appendix) as well as the variance-covariance matrix (see Table 1b, in the Appendix) to analyse the correlation between the returns of the three exchange rates.

Faced with the issue of non-normality observed in the overall portfolio, we choose to address this situation by decomposing the initial portfolio into 14 distinct annual portfolios. Specifically, we opted for an annual decomposition of the overall portfolio to move closer to normality in the data (as demonstrated by the tests we applied to our data). The descriptive statistics affirm a more robust convergence of the annual portfolios towards a normal distribution as compared to the overall distribution.

Therefore, to proceed with the calculation of parametric VaR, it is necessary to verify the normality condition of the returns of the three exchange rates. Once this condition is met, the calculation of VaR involves several steps as follows:

1) Calculating the risk vector, the correlation matrix, and spotting the structure of the foreign public debt portfolio

a. The risk vector is calculated as follows:

$$V = \beta\ \sigma_i$$

$\beta = 1.65$ (for a 95% confidence level)

σ_i - the standard deviation of position *i*; σ - the vector of individual volatilities of the returns of the three exchange rates.

The risk vector can be rewritten:

$$V = \begin{pmatrix} 1.65\ \sigma_{EUR} \\ 1.65\ \sigma_{JPY} \\ 1.65\ \sigma_{USD} \end{pmatrix}$$

Analysing the different values (σ_i) associated with the annual returns of the trio of currency exchange rates throughout the observation duration may furnish valuable perspectives regarding the ranking of these exchange rates in terms of their volatility.

b. Calculating the correlation matrix

It is useful in determining the relationships between the three exchange rate returns of the three currencies. The correlation matrix (referred to below as M) can be rewritten as follows:

$$M = \begin{pmatrix} 1 & RJPY/EUR & RUSD/EUR \\ REUR/JPY & 1 & RUSD/EUR \\ REUR/USD & RJPY/USD & 1 \end{pmatrix}$$

c. Spotting the structure of the foreign public debt portfolio

The structure of the external public debt portfolio by currency under study can be represented by a vector A as follows:

$$A = \begin{pmatrix} A_i \\ A_j \\ A_z \end{pmatrix}$$

Where A_i , A_j and A_z - the flows of Tunisian external debt in the currencies *i*, *j*, *z*, respectively.

Thus:

$$A = \begin{pmatrix} A_{EUR} \\ A_{JPY} \\ A_{USD} \end{pmatrix}$$

According to the data published by the Central Bank of Tunisia[1], during the selected study period (from January 2004 to December 2019), the predominance of the Euro as the primary currency for Tunisia's external debt is significant. Indeed, the Euro represents an average of 58% of the total external public debt. The US Dollar follows with a share of 19%, and the Japanese Yen accounts for approximately 14%. In contrast, other currencies, such as the Kuwaiti Dinar, have a negligible share in the overall composition of Tunisia's external public debt. For example, the share of the Kuwaiti Dinar does not exceed an average of 4.6% during the analysis period. Therefore, the primary exchange rate risk associated with Tunisia's external public debt comes from the three major borrowing currencies: the Euro, the US Dollar, and the Japanese Yen. As a result, the exchange rate risk related to other currencies is considered insignificant.

We have opted to establish a portfolio consisting of external debt cash flows totalling 100 million TNDs. Consequently, from this 100 million TNDs of external debt, 91 million (58 million EUR, 19 million USD, and 14 million JPY) are subject to exchange rate risk, while the remaining 9 million do not carry any risk. Therefore, the vector A, which represents the flow of Tunisian external public debt, can be presented as follows:

$$A = \begin{pmatrix} 58 \\ 14 \\ 19 \end{pmatrix}$$

[1] *Data available at the website of the Central Bank of Tunisia, www.bct.gov.tn, accessed on 01/08/2023.*

The rationale behind selecting a constant vector of cash flows for the external public debt lies in the long-term stability of the structure of Tunisian public debt by borrowing currency.

2) Determining the risk matrix

This matrix reflects the level of risk associated with each borrowing currency and is formulated as follows:

$$(\beta\ V)'\ M\ (\beta\ V)$$

Where: M : the correlation matrix between the exchange rates;

V : the matrix of risks associated with each exchange rate;

Such that:

$$V = \begin{pmatrix} 1.65\ 6\ REUR & 0 & 0 \\ 0 & 1.65\ 6\ RJPY & 0 \\ 0 & 0 & 1.65\ 6\ RUSD \end{pmatrix}$$

3) Multiplying the risk matrix by the vector A

Vector A signifies the average allocation of each currency within the external public debt portfolio, based on the following equation:

$$VaR = \lfloor A'\ (\beta V)'\ M\ (\beta V) A \rfloor^{1/2}$$

Where: A - the average allocation of each currency within the external public debt portfolio;

A' : transpose of A.

(βV)' : the transposed vector of volatilities multiplied by β.

For example, for the year 2004, the VaR associated with the annual portfolio is calculated as 0.2373293 million TNDs (see Table 3, in the Appendix). Interpreting this outcome, under a 95% confidence level, the Tunisian government's potential daily loss from a 100 million TND external public debt portfolio is limited to 0.2373293 million TND. This loss solely results from the exchange rate risk tied to the volatility of the three principal currencies included in Tunisia's external public debt portfolio.

4) Decomposition of VaR by currency

In order to mitigate the exchange rate risk linked to Tunisia's external public debt to the greatest extent possible, we conduct a currency-based decomposition of the VaR for the entire portfolio. The main objective of this decomposition is to determine the contribution of each asset to the total portfolio risk.

Therefore, the decomposed VaR can be calculated as follows:

$$VaR_i = \theta_i * A * VaR$$

Note that the assessment of the θi coefficient (as mentioned in Table 4 in the Appendix) reflects the impact of each risk factor relative to the total VaR of the portfolio.

5) Level (or degree) of VaR diversification

It entails comparing the total of individual VaR with the aggregate of decomposed VaR.

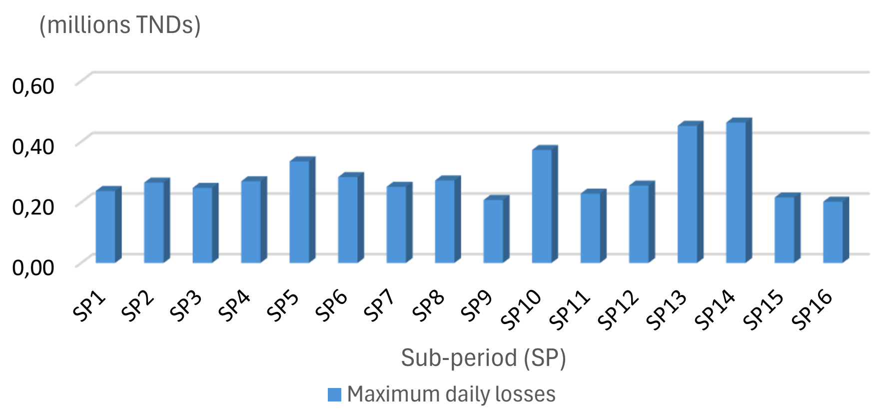
Finally, it should be noted that the five steps presented above will be repeated for each of the sixteen (16) annual portfolios.

4. Results and discussion

In our research, we chose to work with an annual length of the data series because we found that annual returns are closer to a normal distribution compared to the returns of the overall portfolio (see Table 2, in the Appendix). This implies that the parametric approach of VaR is more appropriate in this context, for a small developing country like Tunisia, given that it assumes that returns follow a normal distribution.

Graph 1

The calculation of VaR (in millions TNDs)



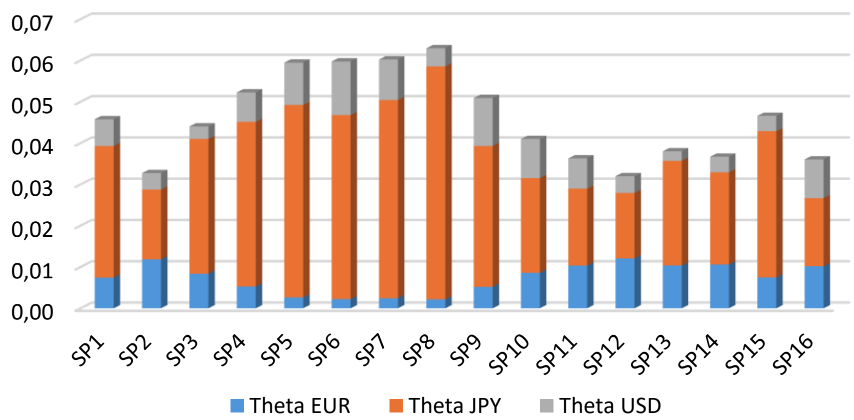
Source: Author's calculation based on matrix computation results.

The analysis of the parametric VaR has led to the results illustrated in the figure (Graph 1) above. It presents the calculated VaR for different annual portfolios with a 95% confidence level. The values on the y-axis depict the highest daily financial setbacks (in millions TND) related to a 100 million TND public debt portfolio during the research period spanning from 2004 to 2019. Thus, over this period, a representative portfolio of 100 million TND could experience daily losses ranging from 0.2 to 0.46 million TND with a 95% confidence level. This result indicates reasonable control and management of the risk linked to the Tunisian external public debt portfolio. However, despite some relative stability in annual VaR over time, there are still recorded peaks, especially in 2013 (0.37264), 2016 (0.4523), and 2017 (0.463106899). These fluctuations are mainly due to the appreciation of one or all of the borrowing currencies relative to the TND.

Afterwards, a comprehensive analysis was conducted, delving into the currency-specific distribution of exchange rate risk about Tunisia's external public debt portfolio. The thetas, which reflect the level of risk associated with each currency in this portfolio, have been summarised in Table 3 (see the Appendix) and graphically represented below.

Graph 2

The calculation of Thetas by currency



Source: Author's calculation based on matrix computation results.

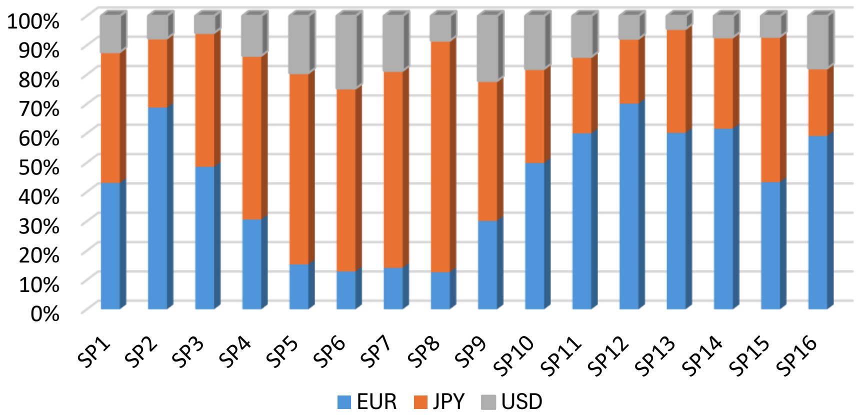
The observation of annual portfolios consistently (Graph 2 above) shows that the Japanese Yen has consistently presented the highest theta among the different currencies. This finding aligns with the previous conclusions of (Ajili, 2008) and (Omrane, 2012), who had already identified the Japanese Yen as the currency with the highest level of exposure within Tunisia's external public debt.

During the period from 2004 to 2006, the US Dollar stood out as the currency with the lowest risk level, as evidenced by the minimum theta indicated in Table 4 (in the appendix). However, there was a change in the trend from 2007 to 2013, with the Euro surpassing the US Dollar in terms of stability. During this timeframe, the Euro emerged as the currency with the lowest risk in the portfolio.

During a third period, from 2014 until the end of the study in 2019, the US Dollar regained its position as the least exposed currency for Tunisia, followed by the Euro.

Graph 3

The decomposition of VaR by currency



Source: Author's calculation based on matrix computation results.

Once again, the detailed analysis of the VaR decomposition (as presented in Table 5 in the Appendix and illustrated in Graph 3 above) confirms the previous conclusions. It is established that the Japanese Yen contributes on average to around 44.45% "of the total VaR for Tunisia's external public debt portfolio. Meanwhile, the Euro shows an average contribution of about 42.51%, a proportion very close to that of the Japanese Yen (the currency deemed the riskiest within the portfolio). In contrast, the average contribution of the US Dollar is limited to 13%, marking the lowest share in this portfolio.

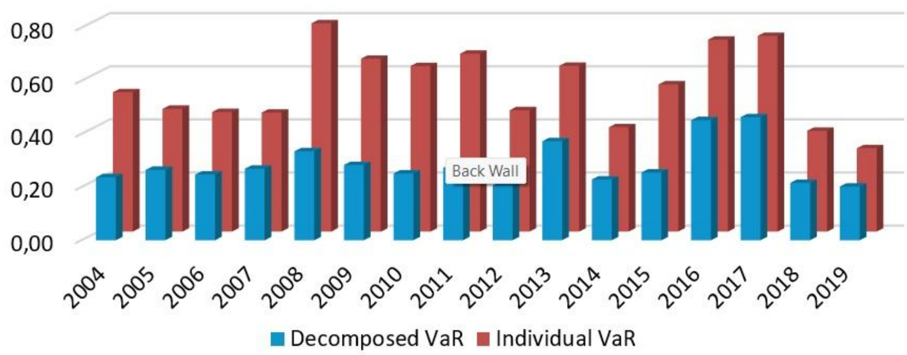
Consequently, the US Dollar can be utilised as a safeguard against currency exchange rate fluctuations in Tunisia's foreign public debt portfolio. Indeed, increasing its portion within the portfolio could lead to a reduction in the associated risk. Conversely, increasing the relative portion of the Euro or the Japanese Yen could amplify the comprehensive risk associated with this portfolio. However, it is essential to note that the negative impact of the Japanese Yen is more pronounced than that of the Euro.

The in-depth examination of the thetas related to different currencies, along with the detailed analysis of the decomposed VaR, converges to the recommendation of favouring an increase in the portion of Tunisian external public debt denominated in the US Dollar, at the expense of debts in Euro and especially Japanese Yen. This approach aims to optimise the management of the currency exchange risk inherent in the public debt portfolio.

However, it should be noted that this recommendation is made solely based on the financial analysis resulting from the VaR method. Therefore, it is crucial to consider, in subsequent studies, the relative shares of trade between Tunisia and the regions of Europe, Japan, and the United States (see Table 6 in the Appendix). These economic factors will play a key role in the optimal adjustment of currency allocations within the public debt portfolio.

Graph 4

The degree of VaR diversification



Source: Author's calculation based on matrix computation results.

The individual (non-diversified) VaR (as presented in Graph 4, above) which is the total of individual VaRs, comprises an average of 55% of the VaR for Tunisia's external public debt portfolio. Table 7 (in the Appendix) provides an overview of the split between non-diversified

VaR (the sum of individual VaRs) and diversified VaR (representing the risk associated with the interplay between the EUR, USD, and JPY). The above figure illustrates the level of VaR diversification (both individual and diversified) compared to the total VaR.

It is important to note that over the total period, individual VaR contributes on average 55% to the overall VaR, while diversified VaR represents only an average of 28.48% of the total VaR. This observation reflects effective exchange rate policy management by the Central Bank of Tunisia, as well as prudent management of Tunisia's external public debt.

5. Conclusion and policy recommendations

Managing external public debt is a major concern for many countries, especially those in the developing world. Exposure to foreign exchange risk is one of the most significant challenges these nations face, as it can have an impact on their public finances.

In this study, the VaR methodology was employed to evaluate the currency exchange risk linked to Tunisia's external public debt portfolio.

We observed that VaR, although widely used in the financial sector, has significant limitations when applied to external public debt. Specifically, the normality of exchange rate returns, a fundamental assumption of the VaR method, is not supported in our analysis of Tunisian data.

Therefore, in response to the issue of non-normality observed in the overall portfolio, we chose to decompose the global portfolio annually to move closer to normalising the data.

The analysis of annual portfolios reveals a consistent trend where the Japanese Yen consistently exhibits the highest theta among the various currencies. This observation corroborates previous findings from studies conducted by Ajili (2008) and Omrane (2012), which also identified the Japanese Yen as the currency with the highest level of exposure to risk within the Tunisian external public debt.

An important observation that emerges from our analysis is the predominance of the Euro in Tunisia's external public debt portfolio. This predominance is interesting because, from 2014 to the end of the study period (2019), the Euro exhibits a higher associated Value at Risk than the US Dollar. This finding might seem counterintuitive, but it can be explained by the natural hedge that the Euro provides to

Tunisia in terms of export earnings. Tunisia conducts a significant portion (almost 100%) of its exports with Eurozone countries. Therefore, a substantial portion of its export earnings is denominated in Euros. This means that when the Tunisian Dinar depreciates against the Euro, Euro-denominated export earnings increase in terms of Tunisian Dinars, partially offsetting the negative impact of depreciation on the external debt service denominated in Euros. Thus, this natural hedge reduces the exchange rate risk associated with the Euro in Tunisia's public debt portfolio.

However, it is becoming increasingly advantageous for Tunisia to opt for more borrowing in USD rather than EUR, especially when its trade transactions in USD increase. Several factors motivate such a decision:

1. Lower exchange rate risk: Tunisia faces a lower VaR in USD compared to EUR, indicating a currency less exposed to exchange rate risks.
2. Increased USD export earnings: An increase in export revenues denominated in USD compared to EUR would encourage Tunisian authorities to reconsider the structure and composition of their external public debt. This could be made possible by, among other factors, potential integration of Tunisia into the BRICS group (Brazil, Russia, India, China, South Africa), which could encourage Tunisia's foreign trade with new economic partners to the detriment of its traditional European trade partners.
3. Diversification of target markets: Tunisia should actively seek markets outside the Eurozone, particularly with countries in Asia, South America, or North America, which have strong trade ties with the United States. This reconfiguration of the external public debt portfolio toward the US Dollar can be considered a prudent strategy to manage exchange rate risks and leverage emerging trade opportunities.
4. Financial cooperation with other countries: Tunisia has an interest in expanding its financial cooperation with specific countries, including Algeria (100% of its debt to Tunisia is denominated in USD), Libya (100% of debt to Tunisia in USD), Saudi Arabia (with recent loan signed in USD 450 million in 2023), and others.

These strategies can help Tunisia better manage its exchange rate risks and capitalise on new commercial opportunities while maintaining prudent financial stability.

In conclusion, Value at Risk, despite its limitations, can provide valuable insights. However, it should be complemented by other measures and a thorough analysis of the specific national context. Therefore, Tunisian authorities and debt managers should continue to develop debt management strategies that consider these specificities and aim to minimise vulnerabilities to exchange rate fluctuations to ensure financial stability and long-term sustainability of the Tunisian economy.

References

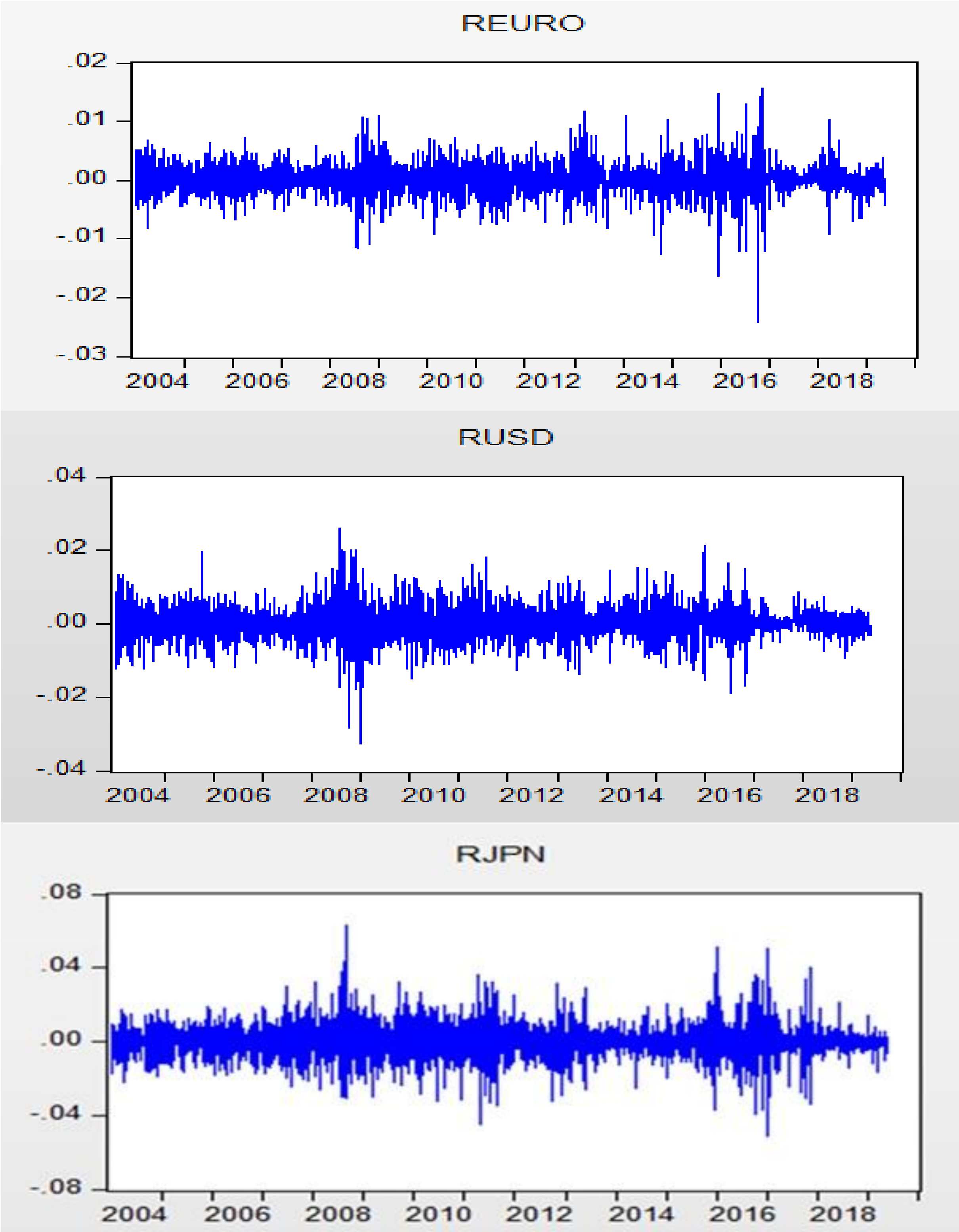
1. Akbar, F., & Chauveau, T. (2009). Exchange Rate Risk Exposure Related to Public Debt Portfolio of Pakistan: Application of Value-at-Risk Approaches. *SBP Research Bulletin*, 5(2), pp. 16-33.
2. Asonuma, T. (2016). Sovereign Defaults, External Debt and Real Exchange Rate Dynamics. *IMF Working Papers,* WP/16/37.
3. Jorion, P. (2006). Value at Risk. McGraw-Hill.
4. Cakir, S., & Raei, F. (2007). Sukuk vs. Eurobonds: Is there a Difference in Value-at-Risk? *IMF Working Papers*, WP/2007/237.
5. Omrane, S. (2012). Une analyse de l'exposition au risque de change du portefeuille de la dette publique de la Tunisie: Application de l'approche VaR. *Panoeconomicus*, 59-87. https://doi.org/10.2298/PAN12010590.
6. Ajili, W. (2008). A Value-at-Risk approach to assess exchange risk associated with a public debt portfolio: The case of a small developing economy. *World Scientific Studies in International Economics (Risk Management and Value)*, 11-60. https://doi.org/10.1142/9789812770745_0002.
7. Blejer, M. I., & Schumacher, L. (1998). Central Bank Vulnerability and the Credibility of its Commitments: A Value-at-Risk Approach. *IMF Working Papers*, WP/98/65.
8. Blessy, A. (2019). Impact of exchange rate depreciation on external indebtedness: Evidence from a sample of emerging economies. *IISES International Academic Conference*, Vienna. https://doi.org/10.20472/IAC.2019.051.004.
9. Bouabidi, M. (2023). The surge in Tunisia foreign debt: Causes and possible ways out. *Springer Nature Business & Economics*. https://doi.org/10.1007/s43546-023-00443-2.

10. Dowd, K. (1998). Beyond Value at Risk: The New Science of Risk Management. *John Wiley and Sons*.
11. IMF (2001). Guidelines for Public Debt Management. Prepared by the staffs of the International Monetary Fund and the World Bank, 21 March. https://www.imf.org/external/np/mae/pdebt/2000/eng/index.htm
12. Fisera, B., Tiruneh, M., & Hojdan, D. (2021). Currency Depreciations in Emerging Economies: A Blessing or a Curse for External Debt Management? *Institute of Economic Studies, IES Working Paper*, 6.
13. Miller, V. (1997). Why a Government might want to consider Foreign-Currency Denominated Debt? *Economics Letters*, 55(2), pp. 247-250.
14. Nocetti, D. (2006). Central Bank's Value at Risk and Financial Crises: An Application to the 2001 Argentine Crisis. *Journal of Applied Economics*, 9(2), pp. 381-402. https://doi.org/10.1080/15140326.2006.12040653.
15. *World Bank*. (2007). Managing Public Debt: From Diagnostics to Reform Implementation. Washington, D.C.

APPENDIX

Figure 1

Graphical Representation of Exchange Rate Returns



Source: Output from the EViews software.

Table 1

Descriptive Statistics of the Three Exchange Rates (02/01//2004-31/12/2019)

	EUR	JPY	USD
Mean	2.137888	16.57311	1.721938
Median	1.978670	16.30515	1.503875
Maximum	3.471050	28.12980	3.073120
Minimum	1.513900	10.31800	1.147400
Std. Dev.	0.504940	4.647974	0.529586
Skewness	1.103063	0.618112	1.076687
Kurtosis	3.288956	2.589787	2.935087
Jarque-Bera	827.1444	283.4611	775.4723
Probability	0.000000	0.000000	0.000000
Sum	8572.931	66458.19	6904.972
Sum Sq. Dev.	1022.152	86609.10	1124.369
Observations	4010	4010	4010

Source: Output from the EViews software.

Table 1a

Correlation matrix between the three exchange rates

	EUR	JPY	USD
EUR	1	0.922829	0.967294
JPY	0.922829	1	0.908068
USD	0.967294	0.908068	1

Source: Output from the EViews software.

Table 1b

Variance-covariance matrix

Covariance Analysis: Ordinary
Date: 05/31/23 Time: 11:59
Sample: 1/02/2004 5/16/2019
Included observations: 4010
Balanced sample (listwise missing value deletion)

Covariance Probability	EUR	JPY	USD
EUR	0.254901 -----		
JPY	2.165291 0.0000	21.59828 -----	
USD	0.258599 0.0000	2.234654 0.0000	0.280391 -----

Source: Output from the EViews software.

Table 2

Descriptive statistics of returns over the entire period

	REUR	RJPY	RUSD
Mean	0.000181	0.000206	0.000209
Median	0.000208	0.000104	0.000151
Maximum	0.015575	0.063230	0.026035
Minimum	-0.024284	-0.051041	-0.032776
Std. Dev.	0.002523	0.008535	0.004269
Skewness	-0.130748	0.203591	0.083125
Kurtosis	8.806952	7.493417	6.440863
Jarque-Bera	5644.182	3400.399	1982.313
Probability	0.000000	0.000000	0.000000
Sum	0.725172	0.827727	0.839031
Sum Sq. Dev.	0.025514	0.291944	0.073055
Observations	4009	4009	4009

Source: Output from the EViews software.

Table 3
Daily VaR (in millions TND)

Sub-period		Daily VaR
SP1	2004	0.2373293
SP2	2005	0.265051
SP3	2006	0.24758756
SP4	2007	0.269397
SP5	2008	0.3349582
SP6	2009	0.283242
SP7	2010	0.2512198
SP8	2011	0.2719759
SP9	2012	0.20758
SP10	2013	0.37264
SP11	2014	0.228727567
SP12	2015	0.2551319
SP13	2016	0.4523
SP14	2017	0.463106899
SP15	2018	0.21588469
SP16	2019	0.202095

Source: Author's calculation based on matrix computation results.

Table 4
Calculation of Theta (Θ) for each sub-portfolio

	REUR	RJPY	RUSD
2004	0.00743	0.03189	0.00646
2005	0.01186	0.01689	0.004
2006	0.00837	0.03265	0.00303
2007	0.00528	0.03988	0.00713
2008	0.00264	0.04662	0.01024
2009	0.00222	0.04458	0.01299
2010	0.00244	0.04801	0.00982
2011	0.00218	0.05641	0.00441
2012	0.00519	0.03411	0.01164
2013	0.0086	0.02293	0.00949
2014	0.01034	0.01865	0.00733
2015	0.01209	0.01585	0.00406
2016	0.01037	0.02536	0.0023
2017	0.01061	0.02231	0.0038
2018	0.00747	0.03543	0.00371
2019	0.01019	0.01649	0.00938

Source: Author's calculation based on matrix computation results.

Table 5
VaR Breakdown by Currency

	REUR	RJPY	RUSD	Total
2004	43.07%	44.65%	12.28%	100%
2005	68.77%	23.64%	7.59%	100%
2006	48.55%	45.71%	5.74%	100%
2007	30.62%	55.83%	13.55%	100%
2008	15.29%	65.26%	19.45%	100%
2009	12.90%	62.42%	24.68%	100%
2010	14.13%	67.21%	18.66%	100%
2011	12.65%	78.98%	8.37%	100%
2012	30.13%	47.76%	22.11%	100%
2013	49.87%	32.10%	18.03%	100%
2014	59.97%	26.11%	13.92%	100%
2015	70.10%	22.19%	7.71%	100%
2016	60.12%	35.51%	4.37%	100%
2017	61.56%	31.23%	7.21%	100%
2018	43.35%	49.60%	7.05%	100%
2019	59.08%	23.09%	17.83%	100%

Source: Author's calculation based on matrix computation results.

Table 6
Geographical Distribution of Tunisia's External Trade (Exports) in %

Sub-period	Japan	USA	EU
SP1	0.28%	1.45%	98.27%
SP2	0.27%	0.80%	98.93%
SP3	0.30%	1.73%	97.97%
SP4	0.33%	1.44%	98.23%
SP5	0.55%	2.41%	97.04%
SP6	0.53%	1.93%	97.54%
SP7	0.51%	3.34%	96.15%
SP8	0.79%	2.05%	97.16%
SP9	0.74%	2.69%	96.57%
SP10	0.61%	3.32%	96.07%
SP11	0.36%	2.03%	97.62%
SP12	0.25%	3.39%	96.35%
SP13	0.32%	2.44%	97.24%
SP14	0.16%	2.99%	96.85%
SP15	0.11%	3.68%	96.22%
SP16	0.20%	2.5%	97.29%

Source: National Institute of Statistics

Table 7

Comparison between Decomposed VaR and Individual VaR

	Decomposed VaR	Individual VaR	Diversification degree	%
2004	0.2373293	0.524797	0.287468	28.75%
2005	0.265051	0.462507	0.197456	19.75%
2006	0.24758756	0.450391	0.20280344	20.28%
2007	0.269397	0.448043	0.178646	17.86%
2008	0.3349582	0.784321	0.4493628	44.94%
2009	0.283242	0.650557	0.367315	36.73%
2010	0.2512198	0.623238	0.3720182	37.20%
2011	0.2719759	0.669997	0.3980211	39.80%
2012	0.207	0.4571	0.2495	24.95%
2013	0.37264	0.624263	0.251623	25.16%
2014	0.228727	0.392926	0.164198	16.42%
2015	0.2551319	0.554451	0.2993191	29.93%
2016	0.4523	0.722547	0.270247	27.02%
2017	0.4631068	0.736588	0.2734811	27.34%
2018	0.21588469	0.379691	0.1638	16.38%
2019	0.202095	0.3141	0.112	11.20%

Source: Author's calculation based on matrix computation results.

AN ANALYSIS OF THE FOREIGN DEFICIT IN ROMANIA AND IN OTHER EUROPEAN COUNTRIES

Camelia MILEA, PhD*
Cătălin DRĂGOI**

Abstract

Romania has maintained an external deficit continuously since 1990, which represents a vulnerability of the economy. The subject analysed is important because Romania is trying to keep under control and limit the negative effects of this imbalance, especially in the context of the process of joining the euro area, as well as for achieving sustainable development. The purpose of this study[1] is to analyse the evolution of Romania's current account balance and financial account balance, along with their components, compared to those of other European Union countries. The methodology employed combines descriptive, comparative, and empirical analysis. The study shows that, in recent years, Romania has had one of the most significant current account deficits among the European Union countries. The research also shows that Romania has not received as much capital from abroad as other European Union countries. In addition, almost every European Union country has a specialisation that allows it to maintain a high positive balance in a sub-account, through which to counteract the negative balance of the other sub-accounts.

Keywords: external deficit, component subaccounts, comparative analysis, European Union

JEL Classification: F14, F15, F21, F32

---

* *Scientific Researcher III, "Victor Slăvescu" Centre for Financial and Monetary Research, Romanian Academy, Bucharest. Corresponding author, e-mail: camelia.milea@icfm.ro*

** *Scientific Researcher, "Victor Slăvescu", Centre for Financial and Monetary Research of the Romanian Academy, Bucharest.*

[1] *This article is based on "Romania's external deficit in the current domestic and international conditions", Milea C. (coord.), a research project of the "Victor Slăvescu" Centre for Financial and Monetary Research, elaborated in 2023.*

1. Introduction

Romania has had an external imbalance every year since 1990, which represents a vulnerability of the economy. This is due to the negative current account balance, and within it, to the deficit in the balance of goods.

In recent years, international events have had a significant impact on Romania's external equilibrium. Among them, we list the slowdown in international economic growth in 2021-2023, as a result of the increase in economic, social and political uncertainty in the context of the effects of the measures adopted in order to diminish the spread of the coronavirus, of armed military conflicts, and of rising tensions between the US and China. Romania's economy has been particularly affected by the decrease in GDP growth in the countries of the European Union in the second half of 2022, amid the increase in the inflation rate. Thus, the slowdown in economic growth in the countries of the European Union and the high inflation, as a result of the increase in energy, crude oil and natural gas prices in 2022 and of rigid monetary policies, have generated the reduction in their external demand, affecting Romania in the sense of decreasing the export demand of its main trading partner, and therefore of worsening the external equilibrium.

Given that the situation of Romania's external balance depends significantly on the economic development of EU member states, our country's main trading partners, we consider it appropriate to conduct a study that analyses the evolution of the current account balance and of the financial account balance, as well as of their components, in Romania compared to other countries of the European Union, in order to show how the trade relationships with the EU countries affect Romania's external equilibrium.

The subject analysed is important as the foreign deficit is an imbalance that Romania is facing and she has to solve, especially in the context of the process of joining the euro area, as well as for having sustainable development.

The novelty of the paper consists in the in-depth analysis of the subcomponents of the current, capital and financial accounts in Romania compared to other EU members.

The paper is structured in four parts. So, after the introduction, the data and methodology used are presented. Then, there is the section of results and discussions. In the first part of this section, the authors present the evolution of the current account transactions in the European Union and of the intra-EU trade in goods and services, and make a comparative analysis of the trend of the current account balance and capital account balance in some EU countries, including Romania, giving some explanations. In the second part, there is a comparative analysis of the components of the current account in some European Union countries. Then, the authors make a comparative analysis of the financial accounts and their components in some European Union countries. The last section provides the conclusions of the paper.

2. Data and methodology

In the article, we compute data for some indicators for the period 2006-2022, but the in-depth analysis is made for 2022 in order to capture the evolution of Romania's external sector after the COVID-19 pandemic, compared to other EU countries. So, the authors aim to point out the impact of COVID-19 and of the measures meant to diminish the spread of COVID-19 on the Romanian external deficit, the reaction to the stress conditions of the Romanian economy.

The statistics have been taken mainly from Eurostat and the National Bank of Romania, and there are annual data. We used data from Annual Reports, Monthly Bulletins, the Balance of Payments, and the international investment position of Romania.

The methodology used in the paper joins the descriptive, the comparative and the empirical analysis, with data interpretation, and also the identification of correlations. In the empirical analysis, we use statistical indicators such as weights to make comparisons over time of the current account deficit in some European Union countries. Also, we compute the shares of the current account and financial account deficits and their components in GDP to highlight Romania's situation compared to other EU countries in terms of external imbalance.

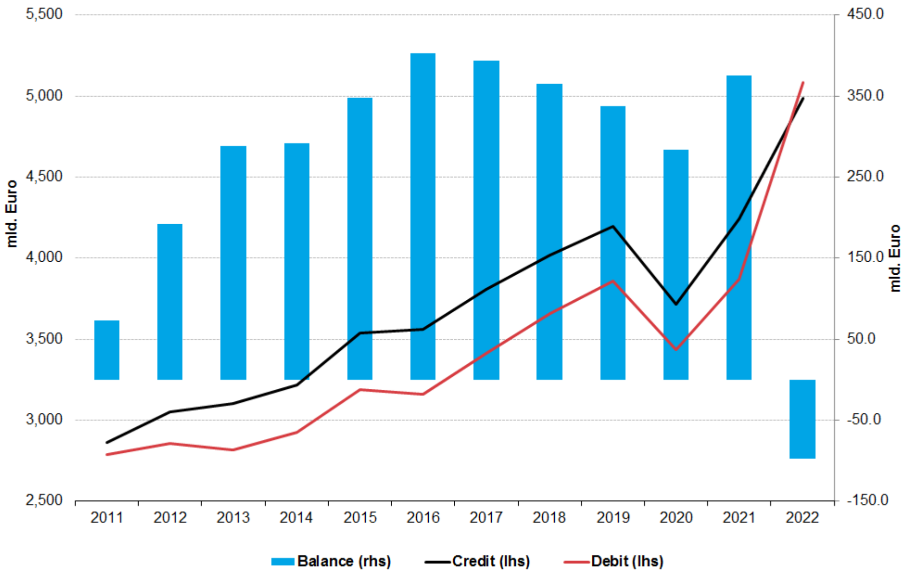
3. Results and discussions

3.1. The trend of the current account in the European Union

Current account transactions at the European Union level have been on a discontinuous upward trend (a decrease occurring in the year of the outbreak of COVID-19). The current account balance in the EU had surpluses in the period 2011-2021; only in 2022 did it have a negative value, as a result of the much faster increase in the value of imports compared to that of exports. (see Figure 1). The most important causes of this evolution are the replacement of Russian gas with much more expensive liquefied gas from the USA, with a direct effect on the final price of products, and the decrease in exports, especially to China, amid the slowdown in China's economic growth (in the context of the blockages due to the pandemic in 2022). Another explanation is that the EU is a big importer of goods and materials, whose prices (in dollars) increased in 2022, and the dollar appreciated against the euro.

Figure 1

The trend of the current account transactions in the EU, from 2011 to 2022

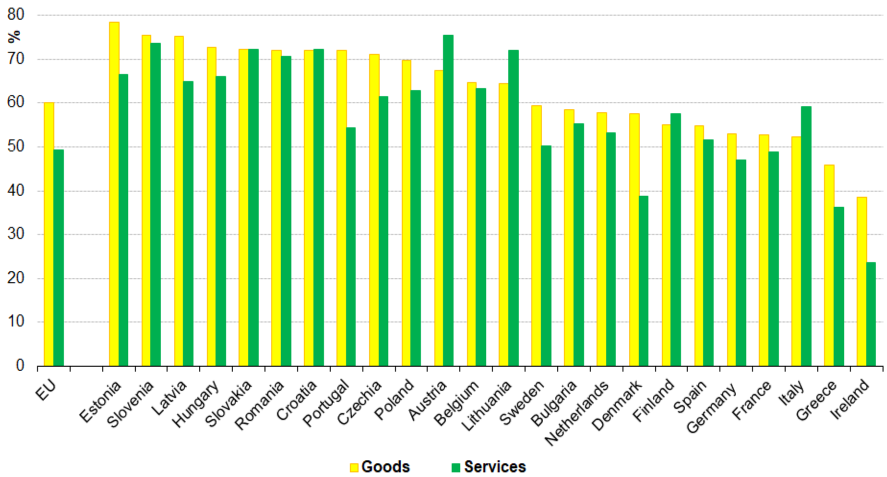


Source: Eurostat data

Based on data regarding intra-EU trade in goods and services, as shown in Figure 2, Romania has high values, ranking as the sixth country in the EU. This signifies a high dependence on the European Union in terms of trade in goods and services.

Figure 2

Intra-EU trade with goods and services in 2022 (%)



Source: Eurostat data processed by the authors

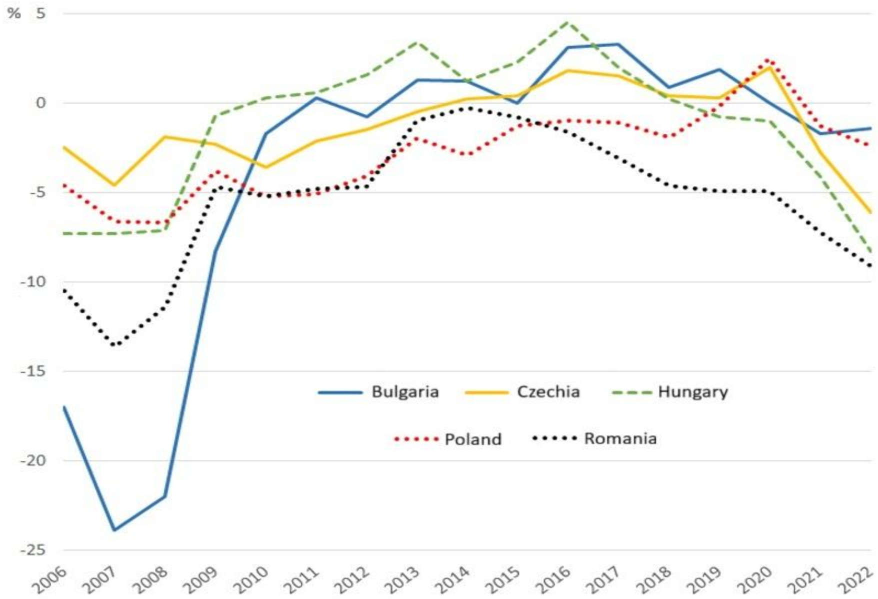
Thus, Romania has 72% trade in goods with EU countries (compared to 78%, Estonia, the country with the highest value of intra-EU trade and 38%, Ireland, the country with the lowest value of trade in goods with the EU), and 71% intra-EU trade in services (compared to 75.5% Austria, respectively, 23.7% Ireland). Therefore, Romania's economy depends significantly on the economic evolution of the European Union countries, but also on the situation of the European Union as a political entity.

In 2021, Romania's trade deficit was generated by more than 70% of intra-EU trade. The EU countries with which Romania had the largest trade deficits were Austria (EUR 2,700 million), Poland, and the Netherlands (NBR, 2022).

Given that Romania has the largest trade deficits (the main cause of the current account deficit) with EU member states (NBR, 2022), it can be said that our country's high trade dependence on the EU is not beneficial for the development of the current account balance.

Analysing the progress of the current account balance in some EU countries, depicted in Figure 3, we notice the following. Slovenia's current account balance became positive from 2012, turning negative again in 2022. Slovakia had a positive current account balance only between 2012 and 2014; for the rest of the analysed period, it was negative, with a significant deficit in 2022. Romania has had a continuously negative current account balance, with a lower value between 2013 and 2016, and a significant increase in 2021 and 2022. (see Figure 3).

Figure 3
The current account balance in some European Union countries during 2006-2022 (% GDP)



Source: Eurostat data processed by the authors

Poland has had a negative current account balance throughout the analysed period (except for 2020), but there has been a decrease in the deficit in 2013, at a value that has remained almost constant until 2022. Hungary had a positive balance between 2010 and 2018, after which the current account has had increasing deficits. Lithuania started with large deficits as a share of GDP in 2006-2008. However, the situation of the current account improved significantly, with the balance of this account being in surplus in most years of the period. The condition of the current account balance of Latvia and Estonia also improved in 2009, the following years being either in surplus or in deficit, but of much lower values than those in the period 2006-2008. In 2022, both countries recorded a significant increase in the current account deficit. After large current account deficits up to and including 2009, the current account balance has improved in Croatia, recording mostly surpluses, but in 2022, it returned to a deficit. Greece had large current account deficits between 2006 and 2011, which diminished in 2012 and 2013, remaining relatively constant, only to increase in 2020-2022. Czechia had current account deficits until 2013, then the current account balance became positive, but it returned to a deficit in 2021 and 2022. Bulgaria had large current account deficits between 2006 and 2008, which then attenuated, turning into surpluses starting in 2013. In 2021 and 2022, the current account balance returned to a deficit (see Figure 3).

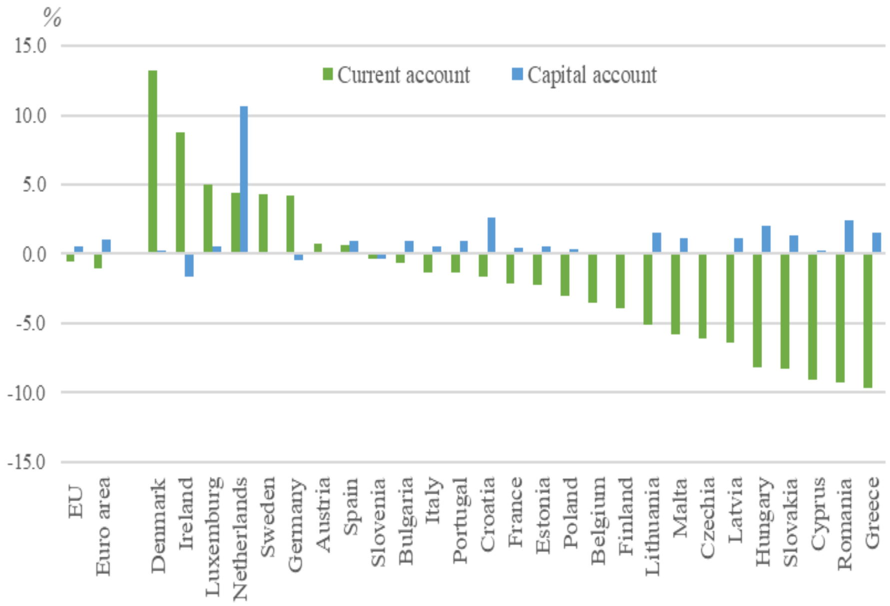
We note that in all EU member states there has been a worsening of the current account balance in 2022, in some even in 2021, as a result of the increase in the price of resources (mainly gas) due to the change of supplier (the replacement of the Russian gas with liquefied gas from the USA), and of the growth in the prices of goods, raw materials, materials imported in dollars, also in the context of the appreciation of the dollar against the euro, which has led to the worsening of the exchange rate.

A comparative presentation of the current and capital account balance, as a share of GDP, for EU countries, in 2022, is shown in Figure 4.

According to data, the deterioration of the current account balance has been higher in the new member states than in the old member states (see Figure 4). The explanation could be that developed economies benefit from fiscal space; they have resources for anti-crisis policies, for supporting the sectors affected by the crisis (e.g. they can fund energy, agriculture, etc.). Indebted economies, which have low income, budget deficits, and current account deficits, do not have the resources for additional spending (the case of many of the new EU member states).

Figure 4

The current account and the capital account balance in the European Union countries in 2022 (% GDP)



Source: Eurostat data processed by the authors

As can be seen from Figure 4, compared to many new EU member states, which have had current account surpluses in the period 2012-2020, Romania did not record an improvement. Furthermore, starting in 2017, a deterioration in the current account deficit has taken place. The balance of goods has been the main component that generated Romania's current account deficit unlike in other EU countries, in the sense that, although its share in GDP fell from 16% in 2007 to 9.6% in 2021, in the same time frame, the aggregate deficit of the balance of goods in Bulgaria, Czechia, Croatia, Hungary and Poland improved from 10.4% of GDP to 5.1% of GDP (NBR, 2022). The unfavourable situation could not be compensated by the services balance, the share of the services surplus in GDP being below the average of the five above-mentioned countries, but it has been limited by the balances of primary and secondary income, at which Romania has had more favourable positions than these countries.

In addition, in the year of crisis, 2020, Romania's current account balance deteriorated, compared to most of the new EU member states in which it improved. This development is worrying, and it raises questions about the structure of the Romanian economy, as well as of our country's exports (European Commission, 2022).

In 2022, in terms of the share of the current account deficit in GDP, Romania ranked second in the European Union (with 9.3%), with Greece in first place (Figure 4). The values of the current account balance in GDP at the level of the European Union and of the euro area have been slightly negative, with six countries recording a current account surplus, the remaining 19 states having a current account deficit. Denmark had the largest current account surplus as a share of GDP (13.2%), followed by Ireland.

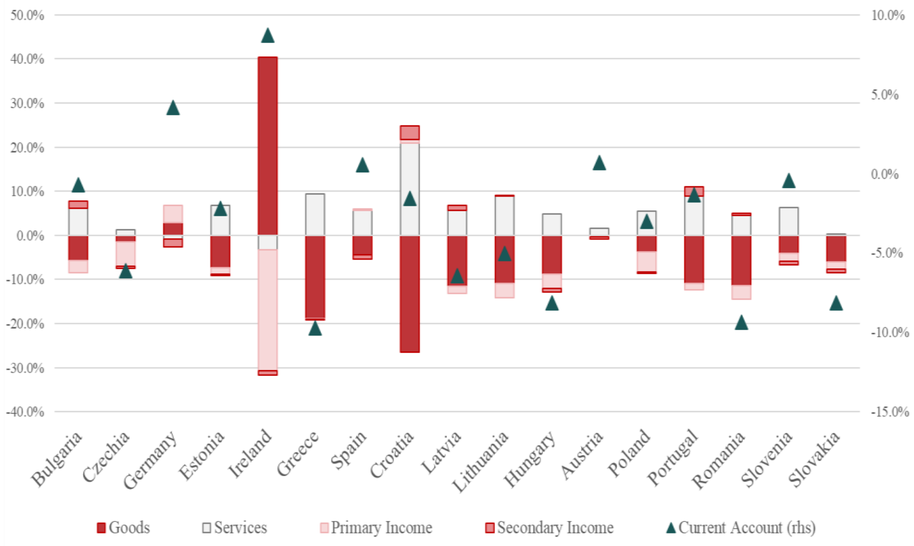
Regarding the capital account[2] as a share of GDP, in 2022, it had a positive balance in almost all EU countries (except Ireland, Germany and Slovenia), and in the euro area and the European Union as a whole, but of small values compared to the current account balance. Romania has recorded 2.4% of GDP, the third value after the Netherlands and Croatia (see Figure 4), due to the irredeemable European funds received for investments (from the European Fund for Regional Development, the Cohesion Fund, and partly the European Agricultural Fund for Rural Development)

3.2. The analysis of the components of the current account in the European Union countries

The structure of the current account balance in some European Union countries, for 2022, is depicted in Figure 5.

[2] *The capital account refers to capital transfers intended for fixed capital formation unlike current transfers which are intended for expenditures.*

Figure 5
The main components of the current account balance in 2022 (% of GDP)



Note: The current account is represented on the right axis
Source: Eurostat data processed by the authors

Analysing the data, we find that Romania ranked sixth in terms of the value of the deficit of the goods balance in GDP (with 11.3%) (after Croatia (26.7%), Greece and Latvia). Ireland recorded the highest value of the surplus of the goods balance in GDP (40.7%), much higher than that of the other five countries that had a positive value of this indicator. Therefore, Romania had imports of goods significantly higher than exports of goods, to satisfy domestic demand, both for final and intermediate consumption (see Figure 5). As can be seen in Figure 4, the euro area and the European Union had slightly negative values of the balance of goods in GDP.

From Figure 5, it can be noticed that in Romania the deficit in the balance of goods is the main cause of the current account deficit, situation that also characterizes other countries in the region (Greece, Latvia, Lithuania, Hungary and Poland).

In terms of the share of the services balance in GDP, most countries in the European Union had positive values in 2022 (except for Ireland, Finland, Sweden, Germany, Belgium, and Italy). The largest surplus has been registered by Croatia (21%), followed by Greece, Lithuania and Portugal. It is found that Croatia cover its deficit in the goods balance through a surplus of almost the same value in the balance of services. Romania had a positive, but modest value of the share of the balance of services in GDP (4.4%), compared to European countries in the same situation, namely with a large deficit of the goods balance in GDP (see Figure 5).

Large exports of services indicate a high level of economic development. At the EU and the euro area level, the indicator had slightly positive values.

In terms of the balance of primary income in GDP, in 2022, Romania had a negative, but small value. Ireland (27.6%) had the highest negative values of the indicator in the EU. The negative values show capital outflows from the country, either as employee remuneration or as investments income. Thus, an explanation for the high values of the indicator recorded by Ireland could be that it has benefited from a large workforce from abroad (for a period of less than one year), or from a large volume of foreign investments or borrowed capital, which entail the payment of dividends, interest, as well as the repatriation of profits. We also notice that this country has had large positive values of one of the other current account sub-accounts, namely services or goods, as a share of GDP, which counteracts the primary income deficit. The European Union and the euro area have values close to zero.

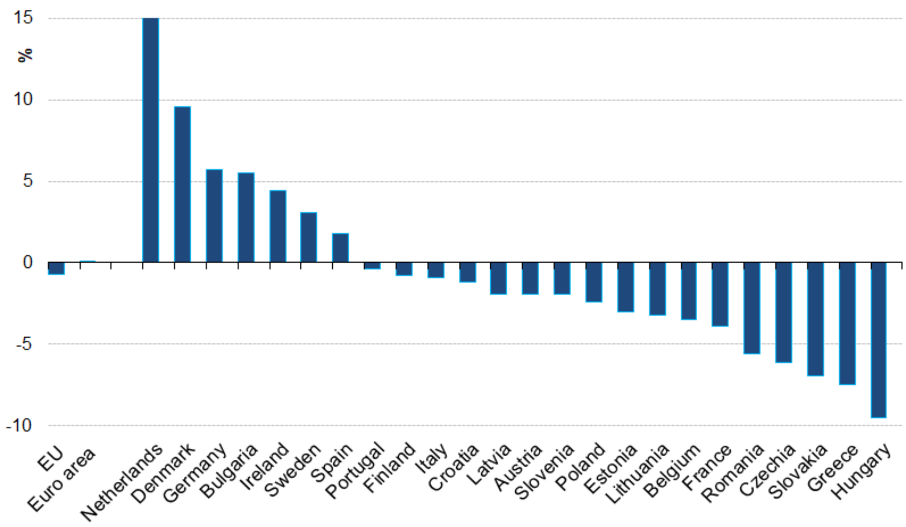
The balance of secondary income as a share of GDP recorded much lower values compared to the other sub-accounts of the current account and was generally negative. Only Romania and the other five countries (Latvia, Lithuania, Bulgaria, Croatia and Portugal) had positive values (see Figure 5). We can say that these countries benefited from inflows of current transfers that exceeded outflows, likely in the form of non-refundable European funds and workers' remittances (European Commission, 2023).

It is found that almost every country in the European Union has a specialisation that allows it to maintain a high positive balance in a sub-account of the current account, through which to counteract the negative balance of the other sub-accounts; notable exceptions include Romania and Greece.

3.3. The analysis of the financial account and its components in the European Union countries

Analysing the financial account balance as a share of GDP, we can notice that most EU countries (including Romania, with -5.6%) had a net accumulation of liabilities in 2022 (the values recorded by the indicator being negative). There are seven countries in the EU that export capital (in the form of investments and/or loans) (Netherlands, Denmark, Germany, Bulgaria, Ireland, Sweden, Spain) in 2022, the others being recipients of foreign funds (see Figure 6).

Figure 6
The financial account balance in the European Union countries, in 2022 (%GDP)



Note: The net accumulation of liabilities in the financial account balance is noted as minus, and the net acquisition of assets is noted as plus.
Source: Eurostat data processed by the authors

We consider that Romania does not receive so much capital from abroad compared to other European countries, if we take into account the value of the current account balance in GDP, respectively, the position of our country in terms of this indicator compared to other European countries.

Analysing the structure of the financial account, the indicator Foreign direct investments, assets, shows that most EU countries made direct investments abroad, but with a relatively small share of GDP. Sweden (11%), the Netherlands (8%), Denmark, Belgium, and Estonia (6%) are the countries that made the largest direct investments (as a share of GDP) abroad in 2022. Romania has been in the next-to-last place, ahead of Italy, with 0.6%. Among the countries that withdrew direct investments made abroad in 2022, Hungary recorded the highest value (as a share of GDP) (9,3%). (Table 1, in the Appendix)

In terms of direct investments of non-residents, most EU countries recorded inflows in 2022, with the highest values (as a share of GDP) being in Sweden (8,4%), Denmark (7%), Croatia (5.1%), and Poland (5%). Romania received direct investments from non-residents worth 4% of GDP, a value higher than that of 14 other EU member states (see Table 1, in the Appendix).

Most EU countries made portfolio investments abroad (assets) (as a share of GDP), with Belgium recording the highest value (6,6%) in 2022. Romania ranks among the lowest portfolio investments in the EU (0.4%). Several countries withdrew their portfolio investments from abroad in 2022, among which the highest value was recorded by the Netherlands (15%), followed by Ireland (11%).

Some EU countries received funds in the form of portfolio investments from abroad (liabilities), with the highest values going to Ireland (16%), the Netherlands (8%), Finland (7.6%), Belgium (6.5%), and Estonia (6%). Romania received capital from abroad as portfolio investments of 2.2% of GDP. There were also countries from which foreign investors withdrew their capital, with Czechia recording the highest value (4,8%).

Regarding Other investments, assets[3], in 2022, some EU member States exported capital, among which the Netherlands achieved the highest values (26%), Finland (15%), and Ireland (11%). Very few repatriated capitals were exported in previous years in these forms, Slovakia (20%), Greece (1,7%). Romania withdrew capital invested as other investments abroad in previous years, worth 0.4% of GDP.

Most EU countries recorded capital inflows from abroad in the form of Other investments, liabilities, in 2022. The largest inflows as a share of GDP occurred in Finland (13%), Belgium (10%), Italy (9%), Hungary (8.7%), and Latvia (8%). Substantial withdrawals of funds by non-residents occurred in Ireland (14.5%) and Slovakia (14%).

[3] *Granting loans, commercial credits and advances, making deposits.*

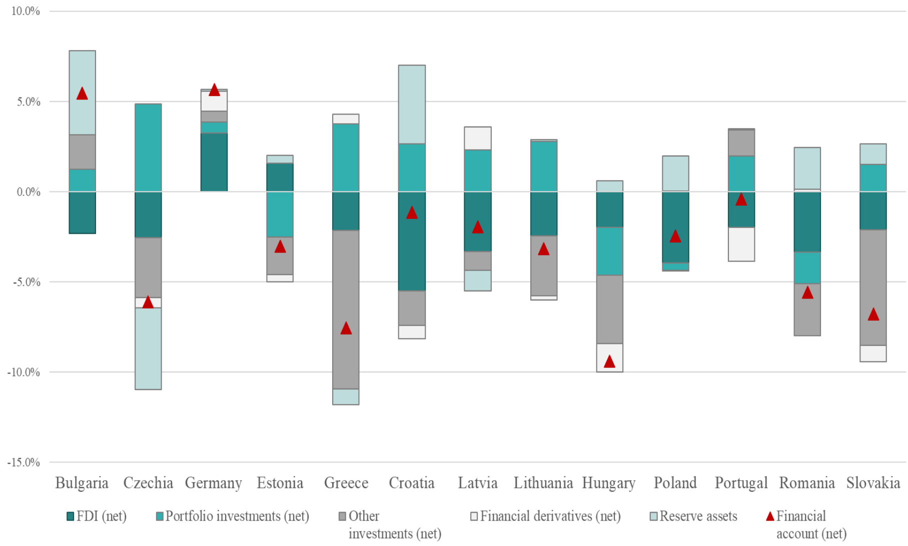
Romania benefited from inflows of Other investments from non-residents of 2.5% of GDP (see Table 1, in the Appendix).

Some countries recorded only capital outflows through all sub-accounts of the financial account (net acquisition of assets) (Estonia, Poland, Slovenia, Finland, Portugal, Spain, Bulgaria).

The net values of the components of the financial account of EU countries for 2022 are shown in Figure 7. It can be noticed that most EU countries benefited from direct investment inflows, except for Belgium, Estonia, Spain, Sweden, Ireland, Germany and the Netherlands (8.4%). Most new EU member countries[4] received FDI inflows, Croatia (5.5%) and Poland (4%) having higher values than Romania (3.4%) in 2022 (see Figure 7).

Figure 7

The main components of the financial account in EU countries, in 2022 (%GDP), net



Note: The net accumulation of liabilities in the financial account balance is noted as minus, and the net acquisition of assets is noted as plus.

Source: Eurostat data processed by the authors

[4] *We compare Romania with Bulgaria, Hungary, Croatia, Poland, Greece, Czechia, Slovakia, Lithuania, Estonia, Latvia, Poland.*

In terms of portfolio investments, net, Italy, Czechia, and Greece exported capital. On the other hand, Ireland (27%) and the Netherlands received foreign capital as portfolio investments, net.

Most of the new EU countries exported capital as portfolio investments, net, only Romania (1.7% of GDP), Hungary and Estonia imported capital as portfolio investments, net, in 2022.

Regarding Other investments, net (as a share of GDP), Ireland (26%) and the Netherlands (23%) have been large exporters of capital. Most countries in the region benefited from foreign capital in the form of other investments, net, in 2022, with Greece on the first place (8.8%), followed by Slovakia (6.4%), Hungary (3.8%), Czechia and Lithuania (3.3%) and Romania (2.9%) (except for Poland and Slovenia which had a 0 balance).

The balance of transactions with financial derivatives registered low values (as a share of GDP) in most EU countries (around 1%) in 2022, with a few exceptions (the Netherlands, 6%). Romania registered 0.1% of GDP.

Most countries had capital inflows in the form of Reserve assets.[5] In 2022, except for Czechia (4.5%), Greece (0.9%), and Latvia (1.1%). The highest value was recorded by Bulgaria (4.7%), followed by Croatia (4.3%). Romania had 2.3%.

We note that Romania is in an average position in terms of capital inflows compared to the other new EU members. As a negative point, we appreciate the imports of capital in the form of portfolio investments, which bear interest and risks, leading to increases in the current account deficit.

4. Conclusions

In the context of economic, social and political uncertainty amid the measures adopted to reduce the spread of the coronavirus and of the armed military conflicts, Romania has experienced negative effects in the sense of decrease in exports and increase in imports in terms of value (given the dependence of the Romanian economy on imports), with consequences in the direction of augmenting the current account deficit.

---

[5] *Foreign assets that are available immediately for the monetary authority and controlled by it, used for covering the needs of financing of the balance of payments, and for actions on the foreign exchange market in order to manage the exchange rate.*

In addition, the slowdown in economic growth and the high inflation in the European Union have generated the decrease in the demand for Romania's exports of our main trading partner and therefore the worsening of the external equilibrium.

Due to the high degree of Romania's intra-EU trade in goods and services, it can be concluded that our country's economy depends significantly on the economic evolution of the European Union countries, but also on the situation of the European Union as a political entity.

In Romania, the deficit in the balance of goods is the main cause of the current account deficit, a situation that also characterises other countries in the region.

Considering that Romania records the largest deficits in the balance of goods with EU member states, we can say that our country's high trade dependence on the EU is not beneficial for the evolution of the current account balance.

As a result of the comparative analysis of the current account balance of Romania with some EU member states, it is found that almost every country in the European Union has a specialization that allows it to have a high positive balance of a sub-account through which to counteract the negative balances of the other sub-accounts, the exceptions being Romania and Greece.

Standing in second-to-last place in the EU in terms of the current account deficit as a share of GDP, Romania is doing better in terms of the capital account as a share of GDP as a result of the non-reimbursable European funds received for investments.

Compared to many new EU member states, which had current account surpluses in the period 2012-2020, Romania recorded only a small and temporary improvement. In addition, in the year of crisis 2020, Romania's current account balance deteriorated, compared to most of the new EU member states, in which it improved. This development is worrying, and it raises questions about the structure of the Romanian economy and of our country's exports.

In all EU member States, a worsening of the current account balance was noticed in 2022, in some even in 2021, as a result of the increase in the price of resources (especially gas) due to the change in supplier and to the increase in the prices of goods, raw materials, materials imported in dollars, and in the context of the appreciation of the dollar against the euro. The deterioration of the current account balance was deeper in the new member States than in the old member

States, mainly as a result of the better budgetary situation of the latter, which allowed them to allocate resources to support the sectors affected by the crisis.

Following the analysis of the capital and financial account balance, we consider that Romania does not receive so much capital from abroad compared to other European countries if we take into account the value of the current account balance in GDP, respectively the position of our country in terms of this indicator compared to other European countries.

We note that Romania is in an average position in terms of capital inflows compared to the other new EU members. As a negative point, we appreciate the imports of capital in the form of portfolio investments, bearing interest, having effects in the direction of increasing the current account deficit.

In conclusion, Romania's trade relations with the countries of the European Union (in terms of structure and volume) do not support the improvement of our country's external equilibrium. In this context, we consider that it would be good for Romania to diversify its trade relations, taking its bearings also towards other external markets, including countries with which there have been traditional relations, from Asia (China and India), from the Arab world or from Latin America.

References

1. European Commission, (2022), 2022 Country Report – Romania, Brussels, 8.6.2022 SWD(2022) 624 final/2.
2. European Commission, (2023), 2023 Country Report – Romania, Brussels, 24.5.2023 SWD(2023) 623 final, https://eur-lex.europa.eu/legal-content/RO/
3. National Bank of Romania (2023), Annual Report 2022, Bucharest

Data sources:

- National Bank of Romania (2007-2024), *Annual Reports*, 2006-2023, Bucharest
- National Bank of Romania (2007-2024), *Monthly Bulletins*: *December* 2006, *December* 2007, *December* 2008, *December* 2009, *December* 2010, *January* 2012, *January* 2013, *January* 2014, *January* 2015, *December* 2015, *December* 2016, *December* 2017, *January* 2019, *January* 2020, *December* 2021, *December* 2022, *December* 2023, *December* 2024, Bucharest.

- National Bank of Romania (2007-2023), *Balance of payments and the international investments position of Romania, Annual Reports* 2006-2022, Bucharest.
- *** https://ec.europa.eu/eurostat/
- ***https://www.hnb.hr/en/web/guest/statistics/statistical-data/rest-of-the-world/balance-of-payments

APPENDIX

Table 1

The main components of the financial account in EU countries, in 2022 (%GDP) (in-depth)

	Financial account	**FDI**		**Portfolio investments**		**Other investments**	
	Net	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities
EU	*-0.7*	*-0.9*	*-1.9*	*-2.2*	*0.4*	*-0.2*	*-0.5*
Euro area	*0.1*	*-1.4*	*-2.3*	*-1.7*	*0.3*	*0.3*	*-0.3*
Malta	-11.3	-33.6	26.6	51.7	3.0	4.7	3.9
Hungary	-9.4	-9.3	-7.3	1.2	3.9	4.9	8.7
Greece	-7.5	0.9	3.1	4.4	0.7	-1.7	7.0
Slovakia	-6.8	1.4	3.5	1.6	0.1	-20.5	-14.1
Czechia	-6.1	1.1	3.6	0.1	-4.8	2.1	5.4
Cyprus	-5.8	10.5	39.8	5.4	-1.2	-5.6	-22.5
Romania	-5.6	0.6	4.0	0.4	2.2	-0.4	2.5
Lithuania	-3.2	-1.6	0.9	2.5	-0.3	2.4	5.7
Estonia	-3.0	5.8	4.2	3.5	6.0	3.8	5.9
Poland	-2.4	1.0	5.0	0.5	0.9	2.7	2.7
Latvia	-1.9	-0.3	3.0	4.4	2.1	7.1	8.2
Slovenia	-1.9	0.7	2.9	2.5	2.5	5.8	5.9
Croatia	-1.2	-0.4	5.1	1.0	-1.7	3.0	4.9
Portugal	-0.4	1.4	3.4	2.7	0.7	3.0	1.5
Spain	1.8	3.1	2.7	4.0	0.9	5.2	7.5
Ireland	4.4	4.1	3.4	-11.1	16.0	11.6	-14.5
Bulgaria	5.5	1.2	3.5	2.5	1.3	4.5	2.6
Germany	5.7	4.4	1.1	0.4	-0.2	2.3	1.7

The net accumulation of liabilities in the financial account balance is noted as minus, and the net acquisition of assets is noted as plus.

Source: Eurostat data

THE SHADOW DEFAULT-FREE REAL RATE OF RETURN

Elli KRAIZBERG, PhD*

Abstract

This paper attempts to resolve several intriguing observations. First, there is an unusually high correlation between the inflation-protected and nominal interest rates when the changes in the nominal interest rates are predominantly driven by inflationary pressure. This observation appears to contradict the Fisherian paradigm and the neo-Keynesian reasoning regarding the neutrality of monetary policy and real interest rates. Stiglitz (1983) argued that in the absence of intergenerational distribution effects, public financial policy has neither real nor financial effects on the optimal mixture of nominal and inflation-protected instruments. Second, a modest increase in the Break-Even Rate (BER) relative to a recent rise in expected inflation implies a lower Inflation Risk Premium (IRP) in a period with higher uncertainty about inflation. Third, the non-monotonic pattern of the volatilities of the default-free interest rates, where the volatility declines over maturity for the long-duration bonds. These observations may cast doubt on whether the default-free inflation-protected bond yields represent the real rates. This paper proposes to define a new concept of the shadow default-free real rate of return, derived directly from the market's equity and debt yields. The paper tests and confirms the hypothesis that this shadow rate of return is uncorrelated with the default-free nominal interest rates, highly correlated with changes in real GDP, and exhibits a monotonic volatility structure over maturity.

Keywords: inflation risk premium, forward premium, inflation-protected rate of interest

JEL Classification: G12, E43

* *Professor, School of Business Administration, Bar Ilan University, Ramat Gan, Israel. Corresponding author, e-mail: ekraizbe@biu.ac.il*

1. Introduction

A recent sharp rise in the nominal interest rates in most Western economies[1] has predominantly stemmed from inflationary pressures, which naturally have driven the market consensus of expected inflation upward[2]. During the same period, the Break-Even Interest rate (BEI) between the nominal and real interest rates has changed only moderately[3]. This observation explains why the correlation between these rates has increased significantly[4] i.e., the real rate consistently follows the nominal rate. In other words, a relatively constant BEI over this period, implying a high correlation between the nominal and inflation-protected rates, leads to the conclusion that the rise in expected inflation should have been fully offset by an equivalent decline in Inflation Risk Premium (IRP). However, this conclusion about the IRP cannot be verified empirically, as most likely both inflation expectations and the IRP have risen lately.

The above intriguing observation, clearly demonstrated in Section 2, requires a different explanation, inconsistent with mainstream paradigms such as Fisher's (1930). The Fisherian paradigm attributes the movements of the nominal rate, relative to the movements of the real rate, to changes in expected inflation. Under Fisher's paradigm, changes in the nominal rate that stem from inflationary pressures and are followed by similar changes in the real rate seem counterintuitive. Naturally, real economic factors can affect both rates, however, it is unlikely that throughout the entire recent period, the sole set of relevant factors was a real set of factors, especially in the past few years when monetary factors underlay the changes in the nominal rate. Furthermore, one can argue that inflationary pressures have an indirect, distorting real effect, but it is unlikely that these real effects are equally relevant for the nominal and

[1] From a worldwide average of 1.9% in 2020 to 7.9% in 2023 (source: World Bank data).

[2] As shown consistently by the survey of inflation expectations by the University of Michigan.

[3] From mid-2022 to the end of 2024, the default-free BEI for 20-year maturity had almost the same value of around 2.6%.

[4] The correlation between the US default-free 10-year nominal and inflation-protected bond rates increased from 0.73 in 2020 to 0.88 in 2023. See Figures 1 and 2.

real rates, as is implied by the observed high correlation between the inflation-protected and nominal rates.

Moreover, monetary policy may explain the high correlation between the very short-term rates. However, it is hardly an acceptable explanation for the 10-, 20-, and 30-year rates, which also exhibit a high correlation.

Kraizberg (2025) establishes, theoretically and empirically, a relationship between the correlation of inflation-protected and nominal interest rates and the biases in the corresponding forward markets. As in Fama (1984), these biases measure the consistent difference between the forward and the ex-post realized prices. In this case, the causality is unclear, as one cannot assert that the forward biases affect the correlation or vice versa.

In contrast to the recently observed high correlation between the real and the nominal interest rates, many scholars such as Rogoff, Rossi, and Schmelzing (2022), Obstfeld (2023), and Blanchard (2022) have concluded, based on data before the 2022-4 sharp rise in inflation-protected government bond yields, that real interest rates have declined since the 1980s. Rogoff et al. (2022) argue that the downturn trend started as early as the 16th century, thereby concluding that "the sharp drop in the real interest rate in the 21st century, particularly in the years after the global financial crisis, has been arguably the most important macroeconomic development in modern times". They conclude that there is no compelling evidence of a break in the long-run trend in global real interest rates. The common arguments are that the main underlying factors pushing the rate down are demographic shifts, lower productivity growth, corporate market power, and safe asset demand relative to supply. Potential additional factors that can explain a downturn in interest rates in the past 400 years are technological improvements in information accessibility and improved efficient enforcement of recovery mechanisms that have led to increasing trust in commercial dealings. A similar view is expressed in Miller et al. (2024), who argue that the default risk premium has decreased. Obstfeld predicts that the economic factors "do not appear poised to reverse strongly enough to drive a big and durable rise in global real interest rates over the coming years". We probably need to distinguish between the long-term trend, which is strongly affected by better accessibility to information and more efficient enforcement, and the short-term trend, which seems to follow the nominal rate closely.

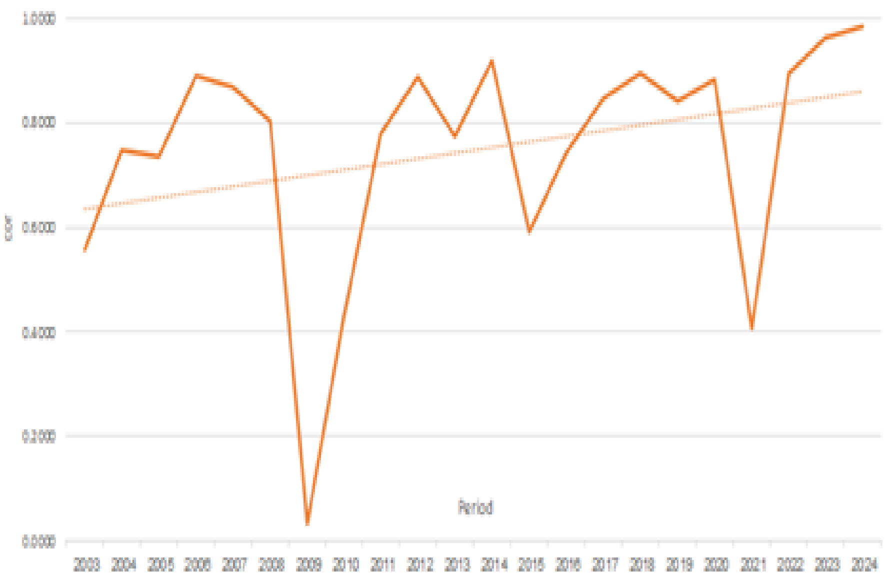
Blanchard (2023) advocates for Summers' (2014) concept of secular stagnation, noting that the important factor, r-g, (real rate of interest less economic growth rate), has been and still is negative. However, the rate of interest is one side of the equation, and perhaps we should compare the real rate of growth with the shadow real rate of return, which will be established and advocated below.

Given the declining trend in real interest rates worldwide, monetary policy decision-makers, perhaps following Wicksell's (1898) and Woodford's (2003) framework, have adopted the belief that real interest rates may not be high enough to curb the recent global upsurge in inflation. Underlying this policy decision is Wicksell's belief that the causality goes from interest rates to inflation, while Fisher's (1930) framework implies that the causality goes from inflation to interest rates. In other words, in Fisher's framework, inflation tends to affect the nominal interest rate, leaving the real rate unchanged, while in Wicksell's framework, a change in interest rates negatively affects the change in the inflation rate. Economists, using the term "long-term neutrality", argue that if Fisher's and Wicksell's effects have the same strength, the long-run real interest rate will be unaffected (for a discussion, see Anari and Kolary, 2016).

The observed high correlation between the default-free real and nominal interest rates is therefore intriguing, but no less surprising is the high correlation between the default-free inflation-protected interest rates and inflation. To the extent that the volatility in the nominal interest rates predominantly stems from shocks in expected inflation, the real interest rates should hardly follow the nominal interest rate. Moreover, a simultaneous rise in inflation and the nominal interest rate reduces the demand for real money balances, which in turn increases savings via a wealth effect, so that the real interest rate must fall in order to restore the equilibrium in the goods market. Thus, under both frameworks, Fisher's and Wicksell's, a very low or even negative correlation between the real and nominal interest rates is expected. In the short run, however, as suggested by Mundell (1963) and Tobin (1965), inflation shocks should affect the real interest rate, triggering some positive correlation between the real and nominal rates. Mishkin (1990), while arguing that Fisher's effect lacks robustness, finds that the correlation of estimated real rates and nominal interest rates is low in the 1931–1952 sample period and is even negative in the postwar period, corresponding to a negative correlation between the real rate and expected inflation. Plakandaras et al. (2023), using a 700-year data set, demonstrate the existence of a one-to-one Fisherian relationship between inflation and nominal interest rate co-movements and find that there is no impact on long-term real interest rates. The recent 2022–23 upsurge of inflation that led to a sharp increase in the nominal rates may lend itself to the hypothesis that the nominal and real interest rates should exhibit a more orthogonal relationship, but the data suggest otherwise. Figure 1 presents the behaviour of the correlation between the yields of the real and nominal interest rates. Figure 2 presents the behaviour of the correlation between the daily holding of real and nominal returns. Holding returns include daily accrued interest, accrued inflation, and capital gain/loss (see Appendix for the methodology). Both graphs demonstrate that in the recent period, there was a sharp increase in correlation between the real and nominal interest rates, reaching a level of about 70% for holding returns (Figure 2) or 95% for the yields (Figure 1).

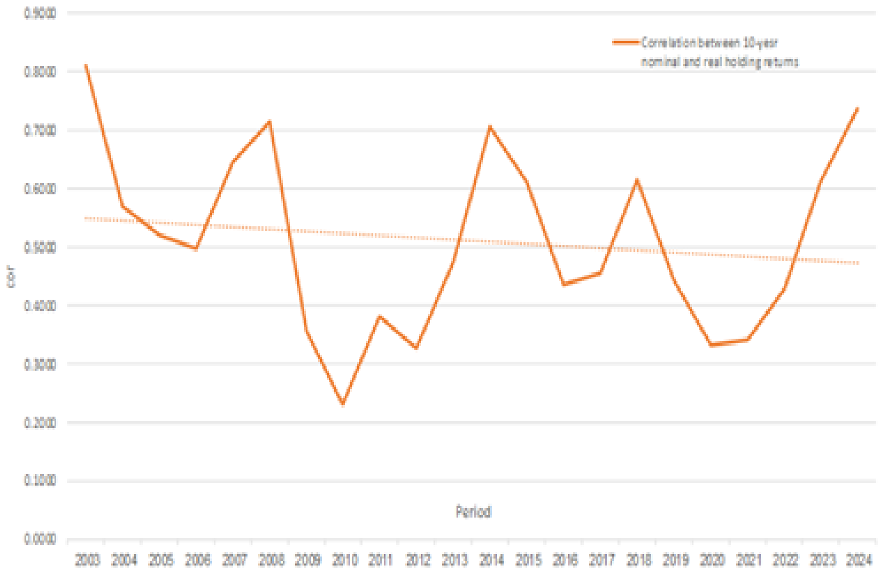
Figure 1

The correlation between nominal and real interest rates (U.S. Treasuries, 2003-2024)



Source: Based on daily yields extracted from FRED St. Louis, https://fred.stlouisfed.org/categories/22

Figure 2
The correlation between nominal and real holding returns (U.S. Treasuries, 2003-2024)



Source: Based on daily returns, extracted from FRED https://fred.stlouisfed.org/categories/22)

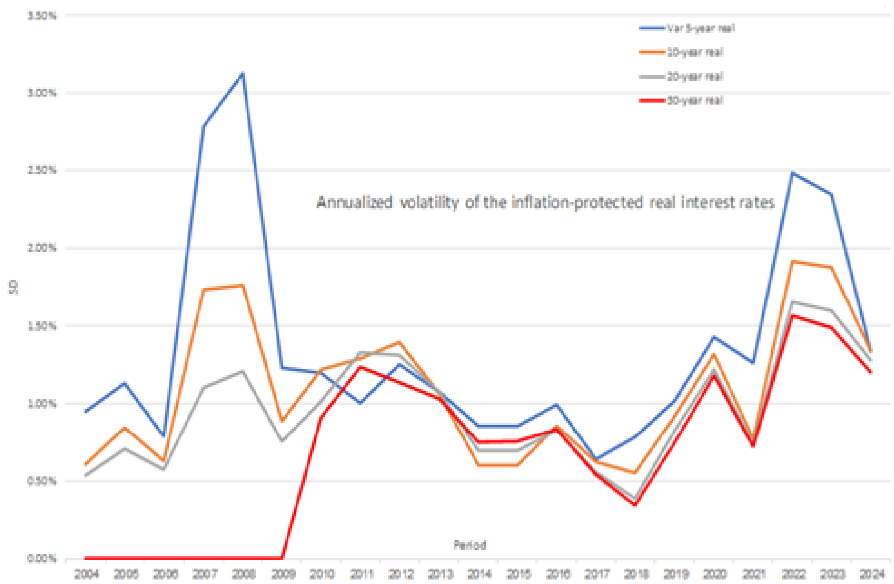
The second intriguing observation is the behaviour of the annualised[5] volatilities of the daily changes in interest rates. While the variability in the nominal rates is "normal" in the Keynesian sense of increasing with time to maturity and being fairly monotonic, the variability in the inflation-protected rates decreases with time to maturity and is non-monotonic during some periods.

Figure 3 depicts the variability in the inflation-protected interest rates.

[5] *Based on the assumption of random walk.*

Figure 3

Volatility of inflation-protected interest rates (U.S. Treasuries, 2004-2024)



Source: Calculated on the changes of daily yield in FRED, St. Louis

On the other hand, a monotonic pattern over time to maturity is obtained when calculating the difference (Phi) between the standard deviation of the changes in the nominal interest rate and the combined standard deviation of the changes in the real interest rate and the inflation rate. Presumably, this difference is highly correlated with the so-called IRP (inflation risk premium), which is monotonically increasing over maturity.

Table 1 shows the average Phi, and Figure 4 presents the behaviour of Phi for the past 20 years.

Table 1

Phi - A measure of a biased standard deviation

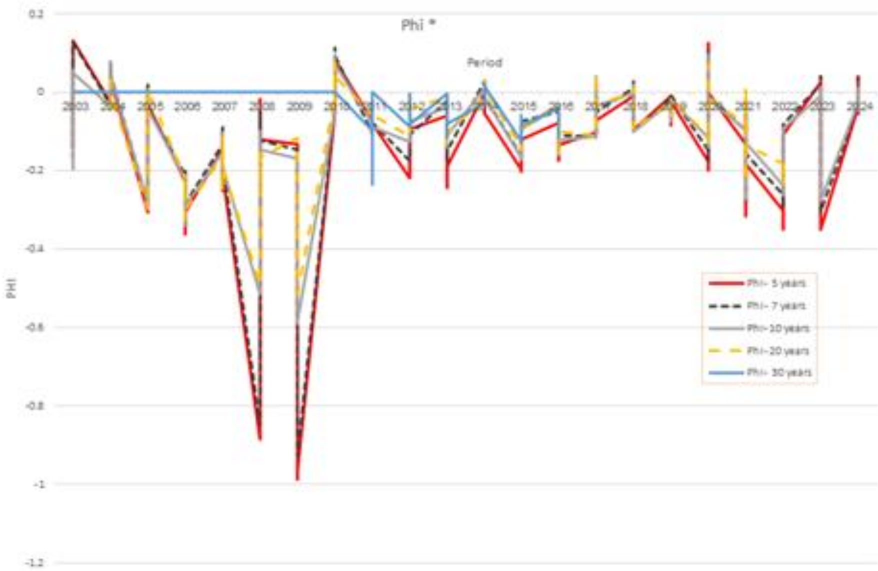
Maturity (years)	Phi
5	-1.64880
7	-1.03572
10	-0.55644
20	-0.13354
30	-0.11219

Note: Phi, the difference between the standard deviation of the nominal interest rate and the combined standard deviation of the real interest rate and inflation (percents). $Phi = SD[(i_{t+1} - i_t)] - SD[(r_{t+1} - r_t) + (\pi_{t+1} - \pi_t) + (r_{t+1}\pi_{t+1} - r_t\pi_t)]$, *where* i_t, r_t *are the nominal and real interest rates, respectively, at time t and* π_t *is the CPI/u level, seasonally unadjusted.*

Source: Based on data extracted from FRED.

Figure 4

The difference between the standard deviation of the nominal interest rate and the combined standard deviation of the real interest rate and inflation (U.S. Treasuries, 2003-2024)



Sources: Based on data extracted from FRED.

Standard models in the literature, such as affine term-structure models, that attempt to decompose the nominal yields into real, expected inflation, and a risk premium, would conclude that it is not trivial to identify parameters that may substantiate inconsistent variability trends that are observed in nominal and inflation-protected bond data.

The above intriguing observations may prompt the question of whether there is a common denominator that may explain or link them together. We believe that there is an explanation rooted in the definitions of the default-free real rate of return. We wish to construct an alternative measure of the real rate of return, labelled here as the shadow default-free real rate of return. This real rate of return is a specific linear combination of the real rate of interest and the expected real equity rate of return. If the real interest rate has historically declined, as argued in the literature mentioned above, and given a relatively stable expected equity rate of return, then the shadow real rate of return must have decreased as well; however, this conclusion may not be substantiated empirically, at least not in the past twenty years.

Some of the intriguing observations may be explained by utilising the shadow real rate of return, as will be demonstrated in this paper's empirical results. The shadow default-free real rate of return should not be confused with any commonly used definition. In the past century, various definitions of the 'real rate' have been proposed or identified as follows:

1. The Fisherian hypothesis implies that the real interest rate is the difference between the nominal rate of interest and expected inflation. Marshal (1890) suggested that the real rate is the above difference, less an additional term, which is the arithmetic product of the nominal and real rates. Subsequently, the definition was modified to include an inflation risk premium (IRP), being the covariance of the marginal rate of substitution of consumption over time and inflation (See earlier studies in Cox, Ingersoll, and Ross (1985), Benninga and Protopapadakis (1991), and more recent work. Mishkin (1990) investigates the behavior of the real rate and inflation and finds that "the real rate, whether adjusted or unadjusted for taxes, is negatively correlated with inflation".

2. Economists cite Wicksell's (1890) natural/neutral rate as the equilibrium real interest rate, consistent with the eventual full capacity of the utilisation of available resources in the context of low and stable

inflation. Wicksell (1998) wrote: "There is a certain rate of interest on loans which is neutral in respect to commodity prices and tends neither to raise nor to lower them". It is an unobservable interest rate on loans that is neutral concerning commodity prices and tends neither to raise nor to lower them. Woodford (2003), Andrés, López-Salido, and Nelson (2008), Barsky, Justiniano, and Melosi (2014), Cúrdia, Ferrero, and Ng, G.C., Tambalotti (2015), and Holston, Laubach, and Williams (2017) incorporate the natural interest rate concept into new Keynesian models. Laubach and Williams (2003, 2016) operationalise this notion by defining the natural rate as the real short-term interest rate consistent with the economy operating at its full potential once transitory shocks to aggregate supply or demand have abated. Lopez-Salido et al. (2020) incorporate information from long-run survey forecasts of inflation, as opposed to market data, and demonstrate a sharper decline in the estimated natural interest rate since the early 2000s. Carr (2009, 2018) combines novel finance models, starting with Vasicek (1977) and the notion of the natural interest rate, by introducing factors other than time, demonstrating that bond market expectations of riskless rates converge to the natural rate of interest. Obstfeld (2023) distinguishes between the Natural and Neutral rates: "By natural rate, I will mean the real rate of interest prevailing in an equilibrium where price rigidities are absent. By neutral rate, I will mean the real policy rate of interest that eliminates inflationary or deflationary pressures".

3. The yield to maturity on default-free, inflation-protected government bonds (TIPS), observable as market data since 1997. The extent to which these rates represent the real rate of interest is questionable, considering several empirical and theoretical observations:

- Liquidity risk. The TIPS market, in which inflation-protected bonds are traded, is relatively new and has attracted less attention than the traditional nominal treasuries. Liquidity risk may arise from multiple market frictions, such as limited investor participation, transaction costs, the composition of market participants, funding constraints, and net supply imbalances between the two types of securities

- Deflation-protected provision of the US and Japanese TIPS. The overall inflation component accrued to the value of the TIPS may not be negative, as stated by the terms of the bonds, thereby creating an option for the bondholders. (see Grishchenko, Vanden, and Zhang, 2011; Kitsul and Wright, 2012; and Hiraki and Hirata, 2020, who study the Japanese inflation-linked bonds, in which a principal protection feature prevailed after 2013).

- Adapting the Fisherian causality[6]. If the default-free nominal interest rate fluctuates in response to changes in expected inflation, the default-free, inflation-protected interest rate should not follow suit. Yet, the default-free nominal and inflation-protected rates of interest are highly correlated, at least in the past 20 years (see Kraizberg, 2025, who argues that the high correlation can be partially explained by corresponding forward premiums). Mishkin (1990), before the first issuance of the TIPS while using the difference between the nominal interest rate and expected inflation as a proxy for the real interest rate, finds that the correlation between the real rate and nominal interest rates is low in the 1931-52 sample period and is even negative in the postwar period.

The shadow[7] default-free real rate of return, established here, unlike the natural real interest rate, may be extrapolated from the financial markets data. Specifically, it is a measure extrapolated from the private defaultable sector, adjusted for the default-free rate of return, while avoiding the need to estimate the so-called "government equity share"[8] in the economy. The inflation-protected interest rates constitute just one component of the equation when deriving the shadow real rate of return, where the latter is a linear combination of the inflation-protected interest rates and an extrapolated default-free real rate of return of equity. Scaling market participants along their risk preferences, the government is considered the most risk-tolerant, less than fully diversified, relative to the less risk-tolerant, fully diversified private sector. In a perfect economy, one could argue that the government should hold equity financed by debt, while the less risk-tolerant private sector would be a net lender. Under this framework, if the government had been a risk-tolerant agent with a major equity position, its borrowing rate, i.e., the inflation-protected rates, would reflect the true real interest rate (see a different relevant view in Hall

[6] *Alternatively, under a particular case in which Fisher and Wicksell's effects are of the same strength, (iii) holds as well.*

[7] *A somewhat unrelated strand of literature refers to shadow rates as the potential negative nominal rates of interest in a Zero Lower Bound economy. See a survey in Lee (2020).*

[8] *The so-called government equity position is not a marketable security and can only be estimated through government spending as a portion of GDP.*

(2017). However, this is hardly the case in Western economies, and therefore, using the inflation-protected rates as a benchmark for the real rate may be misleading. The extrapolated shadow real rates of return, if estimated correctly, may provide a better picture as is demonstrated in the empirical part of this paper.

This paper wishes to empirically confirm the concept of a shadow default-free real rate of return, implied from the financial markets, which is neither the default-free inflation-protected rate of interest nor the natural real rate of interest. We hypothesise and test several implications:

i. We expect to find a much lower correlation between the shadow default-free real rate of return and the default-free nominal rate of interest when the changes in the nominal rates predominantly stem from inflationary pressures. If this assertion is confirmed, it contrasts the high observed correlation between the default-free inflation-protected and nominal interest rates. This finding, if confirmed, would be supporting evidence for the Fisherian hypothesis.

ii. Similarly, we expect to find a very low correlation between the shadow real rate of return and inflation, unlike the puzzling high correlation between the inflation-protected interest rate and inflation.

iii. We may contrast the common belief that the real interest rate exhibits a long-term declining trend, demonstrating, at least in the past 20 years, a non-decreasing trend in the shadow real rates of return.

iv. Finally, we expect to find a monotonic increase in variability of the shadow real rates of return over maturity, as opposed to the non-monotonic pattern exhibited by the inflation-protected interest rates.

We will conduct further tests to determine whether the shadow real rate of return more accurately reflects changes in real output. Laubach and Williams (2003, 2015) argue that the recent decline in real interest rates, along with a decrease in the natural interest rate, is associated with a decline in potential GDP (see Figure 6 in LW). Likewise, we hypothesise that the shadow real rate of return is directly linked to the realised or expected rate of change in real output. If the shadow real rate of return derived from financial markets serves as a proxy for the overall, economy-wide real rate of return, we expect to observe a strong correlation between these two variables. Conversely, if we do not find a significant correlation, we may attribute this to misspecification or measurement errors in the empirical estimation of the shadow real rates. In that case, we will calibrate our findings by adjusting technical parameters. Rogoff, Rossi, and Schmelzing (2022,

Table 7) emphasise, through their literature survey using data from 1311 to 2021, a significant negative correlation between the real interest rate and the Baxter-King-filtered[9] long-run components of both aggregate population growth and aggregate real output growth. We will adopt these variables to test our hypotheses regarding the shadow real rate of return.

2. The setting

By definition,

$$\Delta\left(i_{t,t+1} - r_{t,t+1}\right) \equiv \Delta\left(BEI_{t,t+1}\right) \equiv \Delta\left(E_t\pi_{t,t+1} + IRP_{t,t+1}\right) \qquad \text{(D-1)}$$

where $i_{t,t+1}$ is the one-period, default-free nominal interest rate, and $r_{t,t+1}$ is the one-period default-free, inflation-protected interest rate, BEI is the break-even interest rate, and $E_t\pi_{t,t+1}$ is the expected one-period inflation rate given the information set known at time *t*. IRP, the Inflation Risk Premium, captures the difference between the BEI and expected inflation. As per our discussion in the introduction, if the BEI is stable, as it was in the past three years, then it must be true that,

$$\Delta\left(i_{t,t+1} - r_{t,t+1}\right) \equiv \Delta\left(BEI_{t,t+1}\right) \equiv \Delta\left(E_t\pi_{t,t+1} + IRP_{t,t+1}\right) = 0 \qquad \text{(D-2)}$$

(D-2) implies that an increase in expected inflation, as surely occurred since interest rates started to rise, then the IRP must have declined to offset the increasing expected inflation. However, as the risk of higher inflation rose, so did the IRP. While a constant BEI lends itself to a high correlation between the nominal and real interest rates, the invalidation of the identity (D-2) raises a question about the proper explanation for the high correlation between these rates.

We shall start with a basic argument. If the changes in the nominal interest rate are predominantly affected by changes in expected inflation, then it should be captured by the coefficient $\beta_{t,t+1}$ in the following equation:[10]

$$\Delta i_{t,t+1} = \alpha_{t,t+1} + \beta_{t,t+1}\,\Delta E_t\pi_{t,t+1} + \epsilon_{t,t+1} \qquad (1)$$

---

[9] *Baxter and King (1999 remove short and medium-run fluctuations from all variables.*

[10] *In Fama (1975) and Mishkin (1990) the implied causality is reversed* $\pi_{t,t+2} - \pi_{t,t+1} = \alpha_{t+1,t+2} + \beta_{t+1,t+2}(i_{t,t+2} - i_{t,t+1}) + \epsilon_{t+1,t+2}$.

$$\Delta i_{t,t+1} = i_{t+1,t+2} - i_{t,t+1} \tag{1a}$$

$$\Delta E_t \pi_{t,t+1} = E_t \pi_{t+1,t+2} - E_t \pi_{t,t+1} \tag{1b}$$

where $\pi_{t,t+1}$ is the realized one-period inflation rate from time *t* to *t+1*.

The relationship between $E_t \pi_{t,t+1}$, the expected one-period inflation rate at time *t*, and the realized inflation is,

$$\pi_{t,t+1} = E_t \pi_{t,t+1/\varphi_t} + \epsilon^{\pi}_{t,t+1} \tag{2}$$

where $\epsilon^{\pi}_{t,t+1}$ is the forecast error**.** If rational expectations hold, then, $E\epsilon^{\pi}_{t,t+1} = 0$. If $\epsilon^{\pi}_{t,t+1}$ consistently differs from zero it provides an ex-post estimate for the IRP, denoted here as $E\epsilon^{\pi*}_{t,t+1}$.

Then (1) can be written as:

$$\Delta i_{t,t+1} = \alpha_{t,t+1} + \beta_{t,t+1}\ \Delta\pi_{t,t+1} \quad + \Delta E\epsilon^{\pi*}_{t,t+1} \tag{3}$$

$\beta_{t,t+1} = 1$ implies the Fisherian view. If the concurrent $\beta_{t,t+1}$ differs from one, it may also indicate a delayed effect of inflation on the nominal interest rate. In contrast with the Fisherian view, the changes in inflation may be related to the corresponding real interest rate $r_{t+1,t+2}$ as long as $\beta_{t,t+1} \neq 1$.

By definition, the default-free inflation-protected interest rate, $r_{t,t+1}$, is

$$\begin{aligned} r_{t,t+1} &\equiv i_{t,t+1} - E_t \pi_{t,t+1} + E\epsilon^{\pi*}_{t,t+1} \\ &\equiv i_{t,t+1} - E_t \pi_{t,t+1} + IRP_{t,t+1} \end{aligned} \tag{4}$$

Then, from (1-3) it follows that

$$\Delta r_{t,t+1} = \alpha^{*}_{t+1,t+2} + \beta^{*}_{t,t+1}\ \Delta\pi_{t,t+1} + \Delta E\epsilon^{\pi*}_{t,t+1} \tag{5}$$

where $\alpha^{*}_{t,t+1} = -\alpha_{t,t+1}$ and $\beta^{*}_{t,t+1} = 1 - \beta_{t,t+1}$.[11]
$\beta_{t,t+1} = 1$ implies $\beta^{*}_{t,t+1} = 0$, i.e., the inflation-protected rate is orthogonal to the expected inflation, thereby orthogonal to the nominal rate.

Following Fama (1984) and Hardouvelis (1984), if rational expectations hold, then,

11 Inserting -Δt,t+1 on both sides of (1) and substituting for (2) and using the definition (3) and finally multiplying by -1.

$$\beta^*_{t,t+1} = \frac{\sigma^2(\Delta r_{t,t+1}) + \rho_{\Delta r_{t,t+1},\Delta\pi_{t,t+1}}\sigma(\Delta r_{t,t+1})\sigma(\Delta\pi_{t,t+1})}{\sigma^2(\Delta r_{t,t+1}) + \sigma^2(\Delta\pi_{t,t+1}) + 2\rho_{\Delta r_{t,t+1},\Delta\pi_{t,t+1}}\sigma(\Delta r_{t,t+1})\sigma(\Delta\pi_{t,t+1})} = \frac{\sigma^{*2} + \rho_{\Delta r_{t,t+1},\Delta\pi_{t,t+1}}\sigma^*}{1 + \sigma^{*2} + 2\rho_{\Delta r_{t,t+1},\Delta\pi_{t,t+1}}\sigma^*} \quad (6)$$

where σ^* is the ratio of the standard deviation of changes in the inflation-protected interest rate to the standard deviation of the changes in inflation. ρ is the correlation coefficient between the changes in inflation-protected interest rate and the changes in inflation. Interestingly, even if the real interest rate was orthogonal to the rate of inflation, $\beta^*_{t,t+1}$ could still be positive while the effect of the slope is offset by a negative constant.

In practice, $\beta_{t,t+1} \neq 1$. Both $\beta_{t,t+1}$ and $\beta^*_{t,t+1}$ are positive and smaller than one, which may explain the high correlation between the nominal and the inflation-protected interest rates. However, the observed values of these coefficients are the consequence of this correlation, rather than the cause.

We propose a measure of the *shadow real rate of return*, hypothesising that it will exhibit a low correlation with the nominal interest rate. The shadow real rate of return is a specific weighted average of the expected equity rate of return and the rate of marketable obligations. The methodology of estimation of the shadow real rate will be explained in detail below, but first, we wish to provide one possible explanation for the hypothesised low correlation between the shadow real rate and the nominal interest rate.

We hypothesise that the expected shadow real rate of return, $E_t r^s_{t,t+1}$ (as opposed to the inflation-protected interest rate $r_{t,t+1}$) is a linear combination of the expected overall market equity rate of return, $E_t x_{t,t+1} = ln\,(\frac{E_t X_{t+1}}{X_t})$ and the nominal interest rate on the obligation, $i^l_{t,t+1}$, with weights of ω and (1-ω), i.e.

$$E_t r^s_{t,t+1} = \omega E_t x_{t,t+1} + (1-\omega) i^l_{t,t+1} \quad (7)$$

If $i^l_{t,t+1}$ increases due to some inflationary pressure while the shadow real rate remains constant, the explanation may be related to the change in equity rate of return, or changes in the weights of ω and 1-ω, i.e.

$$d(E_t r^s_{t,t+1}) = d(\omega E_t x_{t,t+1}) + d((1-\omega) i^l_{t,t+1} = 0 \qquad (8)$$

Then, if $d(i^l_{t,t+1})$ $is\ positive\ but$ $d(E_t r^s_{t,t+1}) = 0$, it must be true that

$$d(i^l_{t,t+1}) = \frac{d\omega}{1-\omega[E_t x_{t,t+1} - i^l_{t,t+1}]} + \frac{\omega}{(1-\omega) d(E_t x_{t,t+1})} \qquad (9)$$

3. Methodology

We will apply the above setting to derive the *default-free shadow real rate of return*. We proceed with a two-stage estimation procedure. The first stage of the procedure is comprised of the following sub-steps:

- Estimation of the market defaultable nominal rate of interest.
- Estimation of the market leverage ratio of defaultable instruments.
- Estimation of the market expected nominal rate of return on equity.
- Estimation of the market's overall expected nominal rate of return.
- Estimation of the default-free shadow real rate of return.

3.1. Data specifications

The following data sets were implemented in the empirical estimations:

- S&P index, daily, 4 pm prices. Source: FRED, St. Louis Fed 1998-2024.
- S&P Futures, daily 4 pm prices of the nearby contract, excluding the price at the contract expiration day, and instead the new nearby contract price is utilized. Source: Chicago Mercantile Exchange, CME, 1999-2024.
- Nominal treasury interest rates (YTM), daily at 3 pm, 1-30-year treasury bonds.
- Inflation-protected interest rates, daily 3 pm (YTM), for 5-30-year inflation-protected government bonds. Source: US Department of the Treasury 2003-2024, and FRED 2000-2003.
- The above U.S. Treasury bond yields represent the default-free interest yields. The daily yields are for the latest-issued existing treasury notes or bonds. Given the frequency of issuances of these instruments, the deviation from the actual maturity date is less than two weeks for maturity of up to 5 years, less than a month and a half for 10-year maturity, and less than 6 months for 20 and 30-year maturities. Similar deviations apply to the inflation-protected yields.

- S&P dividend rates. Ex-post quarterly declared, weighted average, dividend rates of the S&P firms.
- Nominal interest rates for S&P firms 2000-2024. Daily rates of Aaa and Baa-rated bonds for firms, which comprise the S&P index. Source: Moody's, 2000-2024, also in FRED.
- S&P firms' financial reports. Source NYSE**.**

3.2. Estimation of the market defaultable nominal rate of interest

The nominal rate of interest of the S&P firms is established, using the weighted average rating of the S&P firms, based on Moody's average ratings between Aaa and Baa (or S&P and Fitch equivalent ratings). The way it was calculated is as follows: We ordinally ranked Moody's ratings between Aaa (=1) and Baa3 and below (=11). Then, we sum the relative debt size over all firms, multiplied by rating. The outcome is a number between 1 and 11 multiplied by Moody's average interest rate for that category, which represents the average interest rate.[12]

The average maturity dates fluctuated between 8.9 and 10.2.[13]

3.3 Estimation of the defaultable market leverage ratio (quarterly)

Utilising the book values of the liabilities of all S&P firms may misrepresent the leverage ratio. Thus, we incorporate daily market data, quarterly book figures, and Merton's (1974) model, dividend-adjusted, to estimate the quarterly leverage weights in market terms. Specifically, the iterative process[14] includes the following variables:

- ✓ Daily equity value, as the total market capitalisation of the S&P index.
- ✓ Average duration of all rated S&P firms
- ✓ Nominal interest rates on government bonds with a maturity date close to the average duration of S&P debts. End of quarter.

---

[12] *Aaa[(wi*RATINGi)/11]+iBaa3[(1-wi)*RATINGi)/11], where wi is the debt size of an S&P firm relative to all S&P firms' debt in face value (quarterly) and. iAaa and iBaa3 are daily rates. Over the past 25 years [(wi*RATINGi)/11], it fluctuated moderately between 0.71 and 0.74 (about A3/A-). Firms that were Bloomberg, Goldman Sachs not rated by either Moody's, S&P, or Fitch are omitted.*

[13] *Source: S&P, Bloomberg. We did not use duration as a measure of the horizon. The difference is negligible for the short-term instruments.*

[14] *The overall asset value is iteratively implied from the market capitalisation plus the iteratively derived value of the liabilities, utilising Merton (1974), thereby setting the leverage in market terms.*

- ✓ Actual and declared dividend rate at the end of a quarter.
- ✓ The annualised variance of the assets' rates of return was implied from the variance of daily changes in the S&P index price.
- ✓ Total face values of the liabilities of all S&P firms at the end of each quarter, applied to the following quarter.

The two series, book or market leverages, produce very different results. The book leverage tends to elevate the real rate of return, but both series are highly correlated as the level of the rates of interest affects the value of the liabilities and equity in the same direction.

3.4. Estimation of the expected market equity nominal rate of return

Estimating the expected equity rate of return is central to scholarly research in finance. We wish to estimate the expected market equity nominal rate of return for the horizons of 7,10,20, and 30 years. We could rely on theoretical General or Partial Equilibrium frameworks such as the myopic CAPM, or the continuous time framework under Risk Neutral Valuation, but these estimates are as robust as the estimates of the underlying parameters. This approach will be implemented by the estimation of the implied market expectations embedded into future prices. Additionally, we use statistical prediction models that implicitly assume that the market forms expectations based on a current set of information, which is strongly affected by past observations. We realise that models may be robust in the short run in the sense that the predictions conform to the realised values, but given the central focus of this paper, we only wish to derive the market expectations rather than the prediction of the actual outcomes.

We adopted two commonly used approaches: time series forecasts (Box-Jenkins ARIMA) and implied projection from data comprised of futures prices. See Mishkin (1990) for a discussion of additional Econometric issues.

3.4.1 The use of Futures data to infer the expected equity rate of return

Fama (1984) raises doubts about the predictive power of the forward market prices concerning future spot prices. Forward prices reflect a concurrent no-arbitrage condition (CIP) and are consistently biased relative to realised future prices. Fama and Bliss (1987) and Campbell and

Shiller (1991) showed that the forward rates consistently deviate from the spot rates at a one-year horizon. However, they showed that forward-spot spreads do seem to predict changes in interest rates at longer horizons. Stambaugh (1988) and Cochrane and Piazzesi (2005) extend the finding of time-varying expected bond returns by forecasting returns with all available yields, not just single yields with specific maturities, finding substantially more return predictability.

If the CIP holds, the concurrent market rates of the forward and spot rates have little informative value, but the biased forward rate relative to the ex-post spot rate might. Following the discussion in the literature regarding the empirically demonstrated finding that the forward prices are biased estimators of the expected prices, we will extract the expected equity rate of return utilising the observed consistent biases.

In principle, if the absence of arbitrage opportunities is assumed, the futures prices of equity should follow:

$$F_{t,t+1} = X_t e^{(i_{t,t+1} - d_{t,t+1})\tau} \quad (10)$$

where $F_{t,t+1}$ is the current futures price for delivery at time *t+1*, t=*(t+1)*-*t*. X_t is the current equity price, $i_{t,t+1}$ is the nominal default-free interest rate for bonds mature at time *t+1*, and $d_{t,t+1}$ is the dividend rate on equity. $F_{t,t+1}$ reflects the default-free rate of interest and the dividend rate, but, in practice, it contains two valuable pieces of information.

First, if expectations are rational, and we observe a consistent, statistically significant difference between the futures prices and the ex-post equity price, i.e.

$$\frac{E_t X_{t+1}}{X_t} = -\alpha_t + (1-\beta_t)F_{t,t+1}/X_t + \varepsilon_t = \frac{X_{t+1}}{X_t} \;/(E\varepsilon_t = 0) \quad (11)$$

where $E_t X_{t+1}$ is the expected equity value under rational expectations if $E\varepsilon_t = 0$. X_{t+1} is the realised price of equity at time *t+1*. α_t is a constant term and β_t, If different from one, it reflects the biased forward price given the realised price at time *t+1*. Thus, β_t , assuming that $E\varepsilon_t = 0$, may contain valuable information, trivially extracted, about expected equity yield.

Second, β_t reflects the information at time t, but *b* may change over time. Thus, the outcome $\beta_t - \beta_{t-1}$ is a valuable piece of information,

$$\frac{d\frac{E_t X_{t+1}}{X_t}}{dt} = d\alpha + (1-\beta_t)\frac{dF_{t,t+1}/X_t}{dt} - F_{t,t+1}/X_t\frac{d\beta}{dt},\ \text{given } E\varepsilon_t = 0,\ \text{and}\ dt \to 0 \quad (12)$$

For example, a change in *b*, ceteris paribus, implies a similar change in expected equity yield. See Söderlind and Svensson (1997) for a similar approach.

3.4.2 Time series forecasting

We will compare the random walk, Box-Jenkins' ARIMA (*0,1,0*) formulation with various *ARIMA* (*p,d,q*) models[15], while inserting, (i) the order of differencing *(d)* that needs to stationarize the behaviour of overall market equity price, or the order that minimises the standard deviation of the error term[16], (ii) setting the Box-Cox's lambda to zero, (iii) all statistically significant *MA* factor (*q*), (iv) including the mean, (v) the AR factor (*p*), and (vi), the Akaike (1985) Information Criteria (AIC) is minimised:

$$AIC = MIN\left[\sigma_e^2 + \frac{2(P+q)}{n}\right] \quad (13)$$

We apply the Augmented Dickey-Fuller test for non-stationarity with a cutoff significance level less than 0.05 for nonstationarity, thereby setting the order of differencing, d, as follows:

$$(X_t - X_{t-1})/Q_{t-1} = \alpha + \beta t + \theta_1(X_{t-1} - X_{t-2})/X_{t-2} \ldots .\theta_s(X_{t-s} - X_{t-s-1})/X_{t-s-1} + \cdots. \quad (14)$$

With d=2 and 5 lags, we reject the null hypothesis of nonstationarity as p>.05, as shown below:

ANOVA

Model		Sum of Squares	df	Mean Square	F	p
M_1	Regression	$5.900\times10^{+6}$	8	737446.332	0.596	0.782
	Residual	$9.637\times10^{+9}$	7790	$1.237\times10^{+6}$		
	Total	$9.643\times10^{+9}$	7798			

[15] *p, d, and q are non-negative integers, p is the order (number of time lags) of the autoregressive model, d is the degree of differencing (the number of times the data have had past values subtracted), and q is the order of the moving-average model.*
[16] *Most likely higher than one as we expect a time-varying trend.*

We also apply Ljung-Box's Q^* statistic to estimate the total number of lags and reject the hypothesis of randomness at 0.05:

$$Q^* = n(n+2)\sum_{l=1}^{h} \hat{\rho}_l^2/(n-l) \qquad (15)$$

Where *n* is the sample size *(n*=7807 is our sample size, starting from 1/1/2003, including 1939 observations of the market equity prices, prior to 1/1/2003), ρ_l is the autocorrelation at lag *l*. The hypothesis is that, in the presence of ARCH components, at least one of the estimated $\alpha_i \alpha$coefficients in (10) must be significant,

$$e_t^2 = \delta_0 + \sum_{i=1}^{q} \delta_i e_{t-i}^2 \qquad (16)$$

We experimented with Box-Cox's lambda: -1.5, 1, 1.5, and the differences in the various outcomes were negligible.
The version ARIMA (*1,2,1*) with a constant μ_t, and θ, δ, seems acceptable for our purpose. The final model is:

$$(EX^*{}_{t+1})^m = (1 + \mu_t + \theta_1(X^*{}_t - X^*{}_{t-1}) + e_t^2 + \delta_1 e_{t-1}^2)^m \qquad (17)$$

Where: $X_{t-n}{}^* = (X_{t-n} - X_{t-n-1})/X_{t-n-1}$, $EX^*{}_{t+1}$ is the out-of-sample short-term forecast, and *m* is the annualising factor. The crucial assumption is that $(EX^*{}_{t+1})^m$ is time-invariant. That is, the market's expected long-term return at any point in time is constant over the horizon, and yet it may change over time. This is a reasonable assumption, as in practice, the market forms expectations for up to one year or so, and it is unlikely that at the same point in time, the expectations for, say, five years ahead, are very different.

3.5. Estimation of the market overall expected nominal weighted rate of return.

Given the weighted average interest rate on S&P firms' obligations (3.2), and the corresponding expected equity rate (3.4), both for the same average maturity of the obligations, [17] the overall expected nominal rate of return is established as a linear combination of the above rates, given the weights as in 3.3. Thus, the market's overall expected nominal rate of return, $i_{t,t+1}^*$ is given by,

---

[17] *Based on the average maturity of S&P obligations at each point in time.*

$$E_t i^*_{t,t+1} = E_t x_{t,t+1}\left(\frac{X_t}{X_t + L_t}\right) + i^l_{t,t+1}\left(\frac{L_t}{X_t + L_t}\right) \quad (18)$$

where, $E_t x_{t,t+1} = ln\,(E_t X_{t+1}/X_t)$ is the expected equity rate of return of the market portfolio in natural log terms. $i^l_{t,t+1}$ is the average rate of interest on S&P liabilities, calculated in section 3.2. $\frac{X_t}{X_t+L_t} nd \frac{L_t}{X_t+L_t}$ are the weights calculated in section 3.3 for the overall market's values of the equity X_t, and the liabilities $, L_t$.

3.6. Estimation of the default-free shadow real rate of return.

We wish to derive the expected shadow real rate of return, $E_t r^s_{t,t+1}$ utilizing a modified Fisherian paradigm, given that the default-free interest yields are represented by the U.S. Treasury yields:

$$E_t r^s_{t,t+1} = E_t i^*_{t,t+1} - (E_t \pi_{t,t+1} + IRP_{t+1}) - g_t\,, \quad (19)$$

$E_t \pi_{t,t+1}$ is the expected inflation at time *t*, and IRP_{t+1} is the *Inflation Risk Premium*, and $E_t i^*_{t,t+1}$ is the expected nominal rate of return at time *t*, derived in section 3.4, equation (19), implied from the market portfolio of the private sector. g_t is the business risk spread between the interest rate on default-free bonds and the value-weighted risk of bonds in the market portfolio, adjusted linearly by the relative weights in (18). There is no reason to assume that the weights are reflected differently in the spread of nominal bonds vs. the spread of inflation-protected bonds.

We assume that a positive correlation, if any, between business risk and inflation is already reflected in the IRP. Then, $E_t r^s_{t,t+1}$ is the expected default-free real rate of return at time *t*, labelled here as the *expected shadow default-free real rate of return.*

If we apply Mishkin's (1990) then the ex-post default-free real rate of return at time *t* is,

$$r^s_{t-1,t} = i_{t-1,t} - (\pi_{t-1,t} + IRP_t) - g_t \quad (20)$$

Decomposing the current yield into the expected rate and risk premia, or decomposing the BEI into expected inflation and IRP, as demonstrated in the affine term structure model,[18] or calibrating a

[18] *Finance theory introduced affine term structure models to derive the interest rate yield curve (Vasicek, 1977; Cox, Ingersoll, and Ross, 1985; Duffie & Kan, 1996).*

Stochastic Discount Factor (SDF), does not serve our purpose. We wish to derive the shadow default-free real rate of return, utilising relatively weak assumptions rather than calibrating a model to fit the data. Furthermore, for such decomposition, one must develop a model, somewhat unrelated to the focus of this paper, for the potential causes of inflation[19]. The literature still debates this issue. Some scholars attribute the post-pandemic rise in inflation to government expenditures following the pandemic and a spiral relation with wages. Stiglitz (2023), however, disagrees with the above interpretations, showing that the demand side is not the cause but rather supply-side technical factors. If we are not aiming for the decomposition of the yield into expected inflation and IRP we may utilise the following definition,

$$BEI_{t,t+1} \equiv (E_t\pi_{t,t+1} + IRP_{t+1}(E_t\pi_{t,t+1} + IRP_{t+1} \qquad \text{(D3)}$$

First, we generate daily expected inflation estimates through the changes in the annualised Break-Even Interest rate, $\Delta BEI_{t,t-12}$, i.e.,

$$\pi_{t,t-12} + \Delta BEI_{t,t-12}{}^{20} \qquad (21)$$

where $\pi_{t,t-12}$ is the 12 months' actual inflation. Then, without loss of generality, we utilize the definition (D1) and replace $(E_t\pi_{t,t+1} + IRP_{t+1})$ in (18) with $BEI_{t,t+1}$,

$$E_t r^s_{t,t+1} = i^*_{t,t+1} - BEI_{t,t+1} - g_t\,. \qquad (22)$$

Seemingly, the shadow real rate of return is myopic, but given that the expected equity rate of return is based on the average maturity of S&P obligations. The end results based on the two methodologies are given in Figure 5.

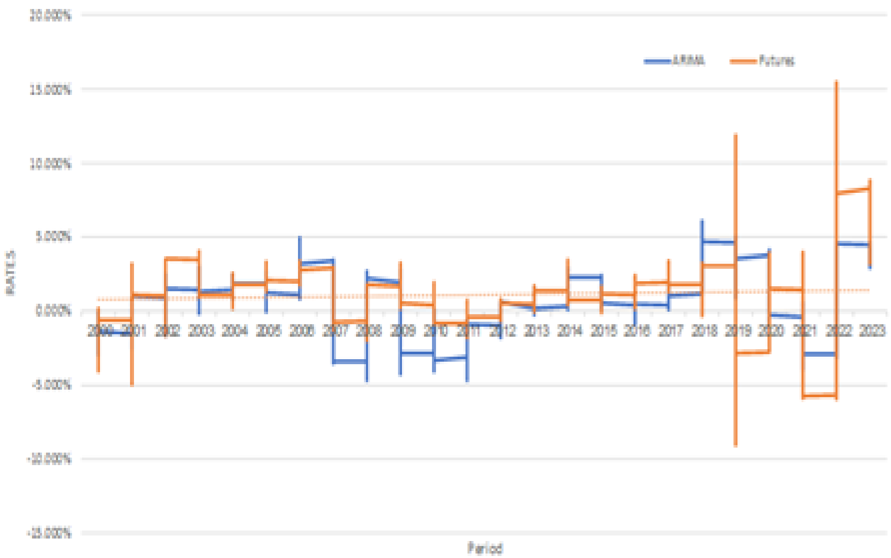
Kim and Wright (2005), Cochrane and Piazzesi (2005), and Adrian, Crump, and Moench (2013) added an expectation component, thereby enhancing affine models' forecasting. Carr (2018), following Vasicek and using duration as a risk measure, calculates the expected interest rate along the risk dimension only.

[19] *Atkeson and Ohanian (2001), Stock and Watson (2009), and Kocherlakota (2016), argue that real variables like unemployment and output imbalances have little forecasting power for future inflation. See also Homer and Sylla (2005), Eichengreen (2015), and Hamilton et al. (2016).*

[20] *This alternative seems to be highly correlated with the inflation expectations survey conducted by the University of Michigan.*

Figure 5

The shadow default-free real rate of return (U.S. Treasuries)



Note: The shadow default-free real rate of return - measured in percentage term; orange line - based on the Futures data, and blue line - based on the ARIMA model.
Source: Raw data was extracted from FRED, St. Louis, and calculated as specified in the methodology

3.7. Stage B

The characteristics of the expected shadow default-free real rate of return will be verified by testing the following hypotheses.

- While the nominal and inflation-protected interest rates have exhibited a high and increasing correlation, the one between the *default-free real rate of return* and the nominal interest rate is low. If this hypothesis is confirmed, it lends itself to a different interpretation of the Fisherian paradigm.
- While the changes in the real GDP are not correlated with the inflation-protected real rate of interest, the changes in real GDP and the *expected shadow default-free real rate of return* are.
- While the variability pattern over the maturity of the inflation-protected real interest rate is not monotonic, the variability of the *expected shadow default-free real rate of return* over maturity is.

- While the *expected shadow default-free real rate of return* has exhibited no significant trend in the past twenty years, the inflation-protected interest rate, as demonstrated in the literature, has exhibited a declining trend.

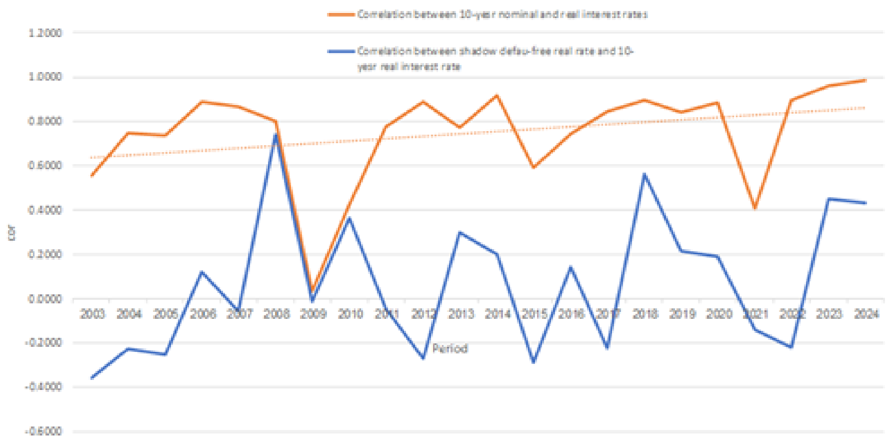
4. Results

4.1. The correlation between the default-free nominal rate of interest and the shadow default-free rate of return

Figure 6 presents the correlation between the default-free inflation-protected rates and the nominal interest rates. This correlation has increased significantly in the past few years. The graph also presents the correlation between the default-free nominal interest rate and the shadow default-free real rate of return. While the correlation between the 10-year maturity nominal and the real interest rates has risen significantly (from 0.73 to 0.88), the corresponding correlation between the nominal interest rate and the shadow real rate hovers around zero.

Figure 6

Correlation between real and nominal interest rates as opposed to the correlation between the shadow real and nominal rate (U.S. Treasuries 2003-2024)



Note: orange line - correlation between real and nominal interest rates; blue line - correlation between the shadow real and nominal rate.

Source: Data shown in Figure 5 and FRED, St. Louis

The Fisherian paradigm attributes the relative movements of the nominal rate, given the movements of the real rate, to the changes in expected inflation. Under this paradigm, changes in the nominal rates that stem from inflationary pressures but are followed by similar changes in the real rate seem counterintuitive. One may argue that real economic factors can affect both rates, but it is unlikely that during the entire period, the sole set of factors that affected both rates was the real ones, particularly in the past few years, when monetary factors clearly underlined the changes in the nominal rate. Additionally, one can argue that inflationary pressures have indirectly distorted real effects; however, it is unlikely that these effects would be of the same magnitude on both the nominal and real rates. Figure 6, besides conforming to the new version of the Fisherian paradigm, may support the view that the shadow real rate better represents the real rate rather than the inflation-protected rate.

4.2. Real GDP and the default-free shadow real rate of return

Following the results of the previous section, we suspect that the shadow default-free real rate of return will better reflect economic activity in real terms, represented by the behaviour of the real GDP. As widely stated in the literature, the inflation-protected interest rate does not reflect the behaviour of the real GDP. We confirm this result in Table 2a, which shows that the correlation between the real GDP and the inflation-protected interest rate, concurrently or with lags, is not significantly different from zero.

Table 2a

The correlation between real GDP and inflation-protected interest rates (2003-2024)

	5-year horizon	10-year horizon	20-year horizon
lag n=3	-0.035	-0.02895	-0.086784
lag n=2	-0.0506	-0.05985	-0.124975
lag n=1	-0.1099	-0.09358	-0.138323
Concurrent	-0.0929	-0.07938	-0.10972
lag n=-1	-0.0626	-0.05069	-0.086121
lag n=-2	-0.0475	-0.024	-0.053446
lag n=-3	-0.0097	-0.04649	-0.08135

Note: inflation-protected interest rates at time t, and real GDP with quarterly lags of 0 to 3 quarters.

Source of data: FRED, St. Louis

Alternatively, when we tested the correlation between the real GDP and the shadow default-free real rate, the correlation was significantly positive, particularly for the annualised, no-time-dimension shadow real rate. Table 2b presents the results.

Table 2b
The correlation between real GDP and the shadow rates of return (2003-2024)

	1	2	3	4	5	6
lag n=3	0.0218	-0.08978	-0.060434	0.120748	0.061766	0.134038
lag n=2	0.1113	0.012119	0.062615	0.119929	0.130862	0.141934
lag n=1	0.1895	0.133836	0.193069	0.222665	0.175331	0.134167
Concurrent	0.4403	0.336462	0.465163	0.309445	0.238143	0.123036
lag n=-1	0.3995	0.389534	0.483081	0.325674	0.233648	0.115161
lag n=-2	0.0838	0.363254	0.311460	0.275292	0.233820	0.111493
lag n=-3	-0.0838	0.295113	0.180900	0.247966	0.206063	0.047330

Notes: (1) - no time dimension, the shadow rate of return is based on Futures data; (2) - no time dimension, the shadow rate of return is based on the ARIMA model; (3) - no time dimension, the shadow rate of return is the average of (1) and (2); (4) - 5-year horizon; (5) - 10-year horizon; (6) - 20-year horizon. Quarterly lags of 0 to 3 quarters.

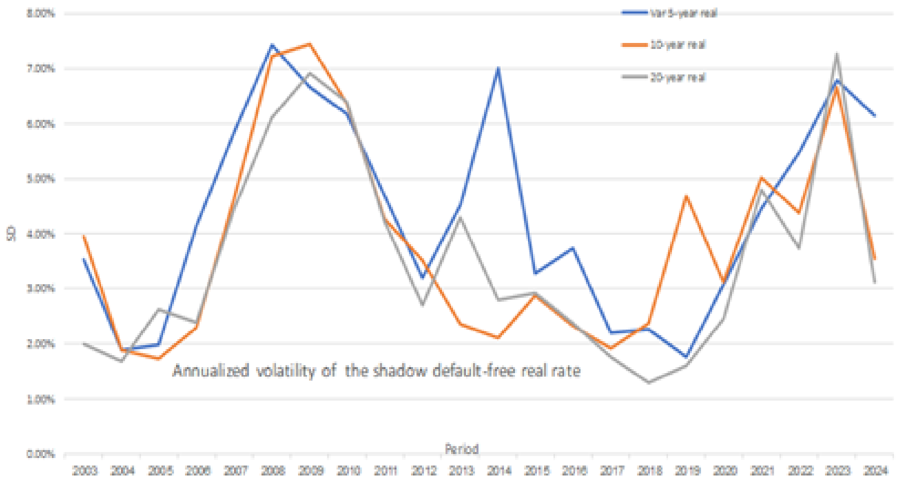
Source: Data presented in Figure 5 and FRED, St. Louis.

The results provide additional confirmation that the shadow default-free real rate of return better represents the real economy and conforms to a variant of the Fisherian paradigm.

4.3. The volatility pattern of the shadow default-free real rate of return

While Figure 3 presented a non-monotonic pattern of rate volatility over maturity for the inflation-protected interest rates, Figure 6 presented a monotonic pattern for the shadow default-free real rate of return over horizons of 5,10, and 20 years. However, as in the case of the inflation-protected rates in which the short-maturity rate has the highest volatility, we observe similar results for the shadow real rate; the shorter the horizon, the higher the volatility of the rate.

Figure 7
The pattern of volatility of the shadow default-free rate of return over various horizons (U.S. Treasuries, 2003-2024)



Note: The volatility is measured as the standard deviation of the default-free shadow rate of return. The standard deviation is calculated on the annualised daily shadow rates of return.

Source: rates presented in Figure 5.

A possible explanation for the non-monotonic behaviour of the volatilities of the inflation-protected interest rates may lie in the trading volume, as the market for the 20-year maturity bonds experiences lower volume. However, this may not be the proper explanation for the theoretical notion of the shadow real rates of return. Under the Keynesian paradigm, one would expect the volatility to be positively correlated with the maturities, but given that we observe an inverse yield curve (abnormal in Keynes' terms) during a significant portion of the sample period, the pattern shown in Figure 6 is consistent with the shape of an inverse yield curve.

4.4. Trend in the shadow expected default-free real rate of return

Recent views in the literature, as cited in the introduction, tend to conclude that the real interest rate exhibits a long-term declining trend. We argue that better enforcement and increased accessibility to information explain this trend over the past 100-300 years; however, we doubt that the decline in rates from the late 1980s until 2022 constitutes a long-term trend. Thus, we look at the behaviour of the shadow real rate of return.

Figure 5 clearly indicates that no consistent trend can be detected in the shadow default-free real rates of return for the past 20 years.

5. Conclusion

Two intriguing observations may be explained by substituting the default-free inflation-protected interest rates with the shadow default-free rate of return. The first intriguing observation is the high correlation between the inflation-protected and nominal interest rates. The second one is the observed low correlation between inflation-protected interest rates and real GDP growth rate. The shadow default-free rate of return is not directly observable. This paper suggested one estimation method of this rate, but we realise that the choice of estimation procedure is critical.

References

1. Adrian, T., Crump, R.K., & Moench, E. (2013). Pricing the term structure with linear regressions. *Journal of Financial Economics,* 110, 110138.
2. Anari, A., and Kolary, J. (2016). Dynamics of interest and inflation rates. *Journal of Empirical Finance*, 39, pp. 129-144.
3. Andrés, J., López-Salido, J. D., & Nelson, E. (2009). Money and the natural rate of interest: Structural estimates for the United States and the euro area. *Journal of Economic Dynamics and Control*, 33(3), pp. 758–776.
4. Atkeson, A., & Ohanian, L. (2001). Are Phillips Curves Useful for Forecasting Inflation?. *Federal Reserve Bank of Minneapolis Quarterly Review*, 25(1), pp. 2-11. DOI: https://doi.org/10.21034/qr.2511
5. Barsky, R., Justiniano, A., & Melosi, L. (2014). The Natural Rate of Interest and Its Usefulness for Monetary Policy. *The American Economic Review*, 104(5), pp. 37-43.
6. Benninga, S., & Protopapadakis, V. (1991). The Stock Market Premium, Production, and Relative Risk Aversion. *The American Economic Review*, 81(3), pp. 591-599.

7. Blanchard, O. (2022). Fiscal Policy under Low Interest Rates. The MIT Press.
8. Carr, D. (2009). Determinants of the Yield Curve. A Model for the Relationship between Risk and Yield. *Journal of Financial Transformation*, 26, pp.79-84.
9. Carr, D. (2018). The yield's curve search for the natural rate of interest. Available at: http://dx.doi.org/10.2139/ssrn.3224598
10. Cochrane, J., & Piazzesi, M. (2005). Bond Risk Premia. *American Economic Review*, 95(1), pp. 138–160.
11. Cox, J., Ingersoll, J., & Ross, S. (1985). A theory of the term structure of interest rates. *Econometrica*, 53, pp. 385-408.
12. Cúrdia, V., Ferrero, A., Ng, G.C., & Tambalotti, A. (2015). Has U.S. Monetary Policy Tracked the Efficient Interest Rate?. *Journal of Monetary Economics*, 70, pp. 72-83.
13. Duffie, D., & Kan, R. (1996). A yield-factor model of interest rates. *Mathematical Finance*, 6, pp. 379-406.
14. Eichengreen, B. (2015). Secular stagnation, the long view. A*merican Economic Review: Papers and Proceedings*, 105(5), pp. 66–70.
15. Fama, E.F. (1975). Short-Term Interest Rates as Predictors of Inflation. *American Economic Review*, 65(3), pp. 269-282.
16. Fama, E.F. (1984). Forward and Spot Exchange Rates. *Journal of Monetary Economics*, 14(3), pp. 319-338.
17. Fama, E.F., & Bliss, R.R. (1987). The information in long-maturity forward rates. *American Economic Review*, 77(4), pp. 680-692.
18. Fisher, I. (1930). The Theory of Interest, as Determined by Impatience to Spend Income and Opportunity to Invest It. New York: Macmillan Company.
19. Grishchenko, O.V., Vanden, J.M., & Zhang, J. (2011). The Information Content of the Embedded Deflation Option in TIPS. *FRSB, Finance and Economics Discussion Series*, 2011-58.
20. Hall, R.E. (2017). The role of the growth of risk-averse wealth in the decline of safe real interest rate. *NBER Working Paper Series*, 22196. Available at: http://www.nber.org/papers/w22196
21. Hamilton, J.D., Harris, E.S., Hatzius, J., & West, K.D. (2015). The Equilibrium Real Funds Rate: Past, Present, and Future. *NBER Working Paper Series*, 21476. DOI 10.3386/w21476
22. Hardouvelis, G. (1984). Market Perceptions of Federal Reserve Policy: A View from the Weekly Money Announcements. *Journal of Monetary Economics*, 14(2), pp. 225-240.

23. Hiraki, K., & Hirata, W. (2020). Market-based Long-term Inflation Expectations in Japan: A Refinement on Breakeven Inflation Rates. *Bank of Japan Working Paper Series*, 20-E-5.
24. Holston, K., Laubach, T., & Williams, J.C. (2017). Measuring the Natural Rate of Interest: International Trends and Determinants. *Journal of International Economics*, 108(S1), pp. 559–575.
25. Homer, S., & Sylla R. (2005). A History of Interest Rates. Wiley Finance, Rutgers University Press.
26. Kim, D.H., & Wright, J.H. (2005). An Arbitrage-Free Three-Factor Term Structure Model and the Recent Behavior of Long-Term Yields and Distant-Horizon Forward Rates. *FRSB Finance and Economics Discussion Series*. 2005-33.
27. Kitsul, Y., & Wright, J.H. (2012). The Economics of options-implied inflation probability density functions. *NBER Working Paper Series*, 18195.
28. Kocherlakota, N.R. (2016). Sluggish inflation expectations: a Markov chain analysis. *NBER Working Paper Series*, 22009.
29. Kraizberg, E. (2025). Why do they follow each other? The highly correlated nominal and inflation-protected interest rates. *The Journal of Fixed Income*, 35(1), pp. 18-39. DOI: 10.3905/jfi.2025.1.205
30. Laubach, T. & Williams, J.C. (2016). Measuring the Natural Rate of Interest Redux. *Business Economics*, 51, pp. 57–67.
31. Laubach, T., & Williams, J.C. (2003). Measuring the natural rate of interest. *The Review of Economics and Statistics*, 85(4), pp. 1063-1070.
32. Lee, S.S. (2020). Information value of the interest rate and the zero lower bound. *Macroeconomic Dynamics*, 24, pp. 1758–1784.
33. Lopez-Salido, D., Sanz-Maldonado, G., Schippits, C. & Wei, M. (2020). Measuring the Natural Rate of Interest: The Role of Inflation Expectations. *Board of Governors of the Federal Reserve System, FEDS Notes*, 19 June.
34. Merton R.C. (1974). On the pricing of corporate debt: the risk structure of interest rates. *Journal of Finance*, May.
35. Miller, M., Paron, J.D., & Wachter, J.A. (2025). Sovereign default and the decline in interest rates. *NBER Working Paper Series*, 34021.
36. Mishkin, F.S. (1990). Is the Fisher effect for real? A re-examination of the relationship between inflation and interest rates. *Journal of Monetary Economics*, 30, pp. 195-215.
37. Mundell, R.A., (1963). Inflation and real interest. *Journal of Political Economy*, 71, pp. 280—283.

38. Obstfeld, M. (2023). Natural and Neutral real Interest rate. *NBER Working Paper Series*, 31949.
39. Plakandaras, V., Gupta, R., Karmakar, S. & Wohar, M.E. (2023). Are real interest rates a monetary phenomenon? Evidence from 700 years of data. *Research in International Business and Finance*, 66, 102010.
40. Rogoff, S.K., Rossi, B., & Schmelzing, P. (2022). Long-run trends in long-maturity real rates, *NBER Working Paper Series*, 30475.
41. Söderlind, P., & Svensson, L. (1997). New techniques to extract market expectations from financial instruments. *Journal of Monetary Economics*, 40, pp. 383-429.
42. Stock, J.H., & Watson, M.W. (2007). Why has US Inflation Become Harder to Forecast*?. Journal of Money, Credit and Banking*, 39(s1), pp. 3-33.
43. Summers, L.H. (2014). U.S. Economic Prospects: Secular Stagnation, Hysteresis, and the Zero Lower Bound. *Business Economics*, 49(2), pp. 65-73.
44. Tobin, J. (1965). Money and Economic Growth. *Econometrica*, 33, pp. 671-684.
45. Vasicek, O. (1977). An equilibrium characterisation of the term structure. *Journal of Financial Economics*, 5, pp. 177-188.
46. Wicksell, K. (1898). *Interest and Prices: A Study of the Causes of Value of Money*. In: Kahn, R.F. (Ed.), MacMillan, London, UK,1936.
47. Woodford, M. (2003). Interest and Prices: Foundations of a Theory of Monetary Policy. Princeton University Press, NJ.

APPENDIX

Calculating the ex-post daily holding rates of return

- **Data**

Inflation-protected and nominal yields 2003-2024 for 5 and 10 years to maturity and 7/2004-2024 for 20 years to maturity. Monthly non-seasonally adjusted CPI/u on the day of release.

- **Methodology**

Yields recorded daily at 3 pm were converted into zero-coupon prices (disregarding the tax effects). This way, both the daily accrued interest and the daily capital gain/loss were captured.

The accrued inflation component for the inflation-protected bonds:

The treasury department publishes monthly the daily adjustments for inflation, which are officially used for the settlement of holders' accounts. At the beginning of each month, the adjustment is set based on the known changes in inflation, that is, the first daily inflation adjustment factor $\pi^*_{1,t}$ in a month *t,* is:

$\pi^*_{1,t} = e^{\pi^*_{1,t-1}} \sqrt[n]{\frac{CPIh_{t-2}}{CPIh_{t-3}}}$, where *n* is the number of days in the month.

And so on for the rest of the month *t.*

In other words, the current adjustment is based on the actual inflation 2 and 3 months before. Instead, we use a different, more concurrent measure where both the treasury's and ours eventually converge:

$$\pi^*_{1,t} = \Delta BEI \sqrt[n]{\frac{CPIh_{t-1}}{CPIh_{t-2}}}$$

Where ΔBEI is the daily change in the breakeven real and nominal interest differential, i.e.,

$$\Delta BEI_{n,t} = (i_{n,t} - r_{n,t})/(i_{n-1,t} - r_{n-1,t})$$

Where *n* is the day in the month *t*.

We believe that this formulation better represents the concurrent daily return. For example, on a certain day in which an unexpected surge in inflation was announced, the treasury inflation adjustment factor is preset, while the BEI reflects the new information and the actual rate of return.

FINANCIAL DEVELOPMENT AND INCOME INEQUALITY NEXUS IN SOUTH AFRICA: AN EMPIRICAL INVESTIGATION

Mercy T. MUSAKWA, PhD*
Nicholas M. ODHIAMBO, PhD**

Abstract

The South African government has faced a persistent struggle in reducing income inequality over the years, despite notable advancements in certain sectors, including the financial sector. This study examined the asymmetric impact of financial development on income inequality in South Africa using data from 1980 to 2017. The results show that positive shocks to financial development are associated with higher income inequality in both the short and long term. However, negative shocks to financial development exhibit an inverse relationship with income inequality in the long run, while in the short run, the two move in the same direction. This study differs from previous research by analysing the impact of financial development on income inequality using nonlinear autoregressive distributive lag (NARDL) and the financial development index, a composite measure that integrates bank-based and market-based indicators of financial development.

Keywords: sustainable development, income levels, developing country, autoregressive distributed lag

JEL Classification: G21, D63, D31

1. Introduction

Globalisation has brought numerous benefits to most economies that have opened their economies. The accrued benefits have resulted in most countries, including developing countries, fast-tracking liberalisation of all sectors in the economy. However, there are growing studies that have also examined the empirical evidence of the benefits obtained from globalisation. It is emerging that

---

* *Department of Economics, University of South Africa, Pretoria, South Africa. Corresponding author, e-mail: tsile.musa@gmail.com*
** *Professor, Department of Economics, University of South Africa, Pretoria, South Africa.*

globalisation has worsened income inequality in some countries participating in globalisation. This makes income inequality not only a challenge for South Africa alone, but a global challenge. Global inequality has found an expression in the Sustainable Development Goals – Goal 10 – reduce inequality and Goal 5 - achieve gender equality and empower all women and girls. South Africa has a legacy of high inequality that was inherited from the apartheid era. In South Africa, globalisation and internal policies pursued from 1994 failed to redress past inequality and provide a tangible solution to current inequality trends, making South Africa a highly unequal country with a GINI coefficient of 0.63 (World Bank, 2025a). Slow economic growth has contributed to slow job creation, resulting in high unemployment.

National Development Plan (NDP) 2030- a national blueprint for South Africa, captures poverty, inequality and unemployment as the triple challenge, with most policies rolled out aimed at reducing the triple challenge. The deepening inequality in South Africa has developed in parallel with financial development. South Africa has a relatively advanced financial sector in Africa, and the question this study would like to answer: Can South Africa use financial development to reduce income inequality?

Several studies have attempted to empirically test the impact of financial development on income inequality. The studies found mixed results. Some found a positive relationship between financial development and income inequality (see Karis and Cil, 2024; Alshubiri, 2021; Bittencourt et al., 2019; de Haan & Sturm, 2017); while some studies found a negative impact of financial development on income inequality (for example, Umit & Eyuboglu, 2024; Chisadza & Biyase, 2022; Bolarinwa & Akinlo, 2021), yet others found no relationship between the two (Ahmed & Masih, 2017). In addition, most studies assumed a linear relationship between financial development and income inequality despite growing evidence that positive and negative shocks to the independent variable may not have the same impact on the dependent variable. This study, therefore, provides a new insight into the nature of the relationship between financial development and income inequality, incorporating the asymmetric impact. The results from the study provide guidance on income inequality policies.

This study departs from previous empirical studies by examining the asymmetric impact of financial development on income inequality in South Africa, using the Financial Development Index (FD) developed by the International Monetary Fund (IMF). Income inequality is captured by the pre-tax GINI coefficient. South Africa was selected for the study because it is among the highly unequal countries in the world, yet also among the countries in Africa with the most advanced financial system. The country also acknowledges in the NDP 2030 the inequality challenges. Further, South Africa is a signatory to the SDGs, showing commitment to achieving the SDGs. The results from this study provide guidance to policymakers in South Africa on what could work to alleviate income inequality and put the country on the path to achieve SDG10 and part of the NDP2030 objectives.

The study is structured as follows: Section 2 is subdivided into two parts; the first subsection covers financial development and income inequality dynamics in South Africa, and the second subsection provides an empirical literature review. Section 3 highlights the estimation techniques, and Section 4 covers data analysis and discussion of results. The last section, Section 5, concludes the study.

2. Literature review

2.1. Income Inequality and Financial Development Dynamics

South Africa has an advanced financial system in comparison to some developing countries in Africa (Bank of International Settlements 'BIS', 2012). Prior to independence, the financial sector in South Africa was exclusive to some categories of the population. After 1994, the financial liberalisation gradually opened the financial sector to all South Africans. Liberalisation of various sectors started in the 1990s, setting a tone for a gradual transition from isolation to integration into the international global economy. Liberalisation in the financial sector included the removal of restrictions on capital inflows and outflows (SARB, 2025). The Financial Services Charter was a bold move towards an inclusive and liberalised financial sector. The South African Reserve Bank (SARB) plays a crucial role in regulating the financial sector. The SARB was operational in 1921, created through the Currency and Banking Act No. 31 of 1920. After the South African Reserve Bank Act of 1989 was signed into law, the mission of the SARB was defined as the protection of the internal and external value of the rand (SARB, 2025). Over the years, the financial sector has grown in breadth and depth of its offerings. The liberalisation of the financial sector was backed by a legal overhaul and financial regulations that ensure all market players work towards the advancement of a financial sector that incorporates quality, diverse products and accessibility to South Africans. The Financial Sector Regulation Act of 2017, which has been implemented in incremental steps since 2018, aim to establish a Twin Peaks model of financial regulation – financial sector soundness and consumer protection. The Twin Peaks model aims to maintain and uphold financial stability (van Heerden, 2018). This has led to the creation of the Prudential Authority tasked to regulate system-wide safety and financial sector soundness, and the Financial Sector Conduct Authority that oversees efficiency, customer protection and financial sector integrity (van Heerden, 2018). Despite having made progress in financial development, South Africa still struggles with market concentration in the banking sector, where there are a few dominant banks.

Following an overhaul of the financial sector and embracing liberalisation, the South African financial sector has experienced an increase in the number of banks operating in the financial sector and customers accessing the financial sector (World Bank, 2025b). The trends in financial sector development captured by the Financial Development Index are reported in Figure 1.

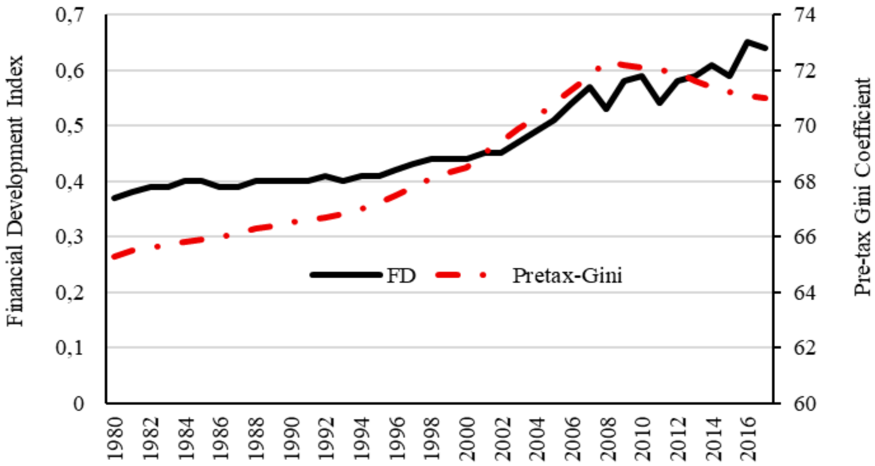
On the income inequality dynamics, South Africa is ranked among one of the most unequal countries (World Bank, 2025b; Statistics South Africa 'StatsSA', 2020) - the inequality in South Africa between racial groups and intra-racial differences. The persistent inequality can be traced back to the apartheid era, and social and economic factors post the apartheid period. According to the World Bank (2015b) and the International Monetary Fund (IMF, 2020), inequality in South Africa is not only evident in income distribution but also manifests in unequal access to opportunities in education, housing, jobs, health, and among provinces.

After independence in 1994, the government rolled out policies aimed at redressing the inequalities of the apartheid era. It is evident that these measures were insufficient to eliminate inequality in South Africa, given the country's current high level of inequality. The Reconstruction and Development Programme (RDP) aimed to address past injustices in healthcare, housing, land reform, and sanitation. A notable improvement in access to social services was recorded; however, over the years, government interventions have failed to eliminate the growing inequality among racial and intra-racial inequality (World Bank, 2015b). The government rolled out several programmes to alleviate inequality and integrate all social classes. South Africa has one of the largest social safety nets in Africa that caters for different categories in society. The transfers include Old Age Grant, Child Support Grant, Disability Grant, Foster Care Grant, War Veterans Grant, Care Dependency Grant and Social Relief of Distressed Grants. The grants availed by the government provide relief to different categories in society (World Bank, 2025b); however, the transfers are not sufficient to transform the recipients into creating independence from government support.

Apart from social grants, the government has transformed social services like education and health to make them accessible to less privileged families. There are schools and clinics that provide free education and free primary health care, respectively. The government also provides funding for tertiary education. Several government interventions to reduce inequality have placed a constraint on the fiscal budget; coupled with depressed economic growth, government fiscal space to roll out programmes has been limited. Slow economic growth has failed to absorb a growing labour force, resulting in high unemployment in general and youth unemployment in particular (World Bank, 2015c). Thus, it reduces the chances of emancipation from the vicious cycle of inequality and dependence on government support.

South Africa recorded a GINI coefficient of 0,67 in 2006, and it dropped to 0.65 in 2015 before decreasing again in 2024 to 0.63 (World Bank, 2025b). Although there was a decline in the GINI coefficient, income inequality levels remain high and far from achieving equality. When inequality is measured by other metrics, such as the Palma ratio, 10% of the population spent 8.6 times more than the bottom 40% in 2006. Although a decline was recorded to 7.9 in 2015, the difference remains significant (StatsSA, 2020). Inequality varies across provinces in South Africa, with some provinces like Eastern Cape, Western Cape and Mpumalanga registering relatively high inequality levels compared to Gauteng (StatsSA, 2020). The dynamics in financial development and income inequality are reported in Figure 1.

Figure 1
Trends in Financial Development and Income Inequality



Source: SWIID (2023) and IMF (2025)

Figure 1 reports the trends in financial development captured by the Financial Development Index and the pre-tax Gini coefficient from 1980 to 2017 (SWIID, 2023; IMF, 2025). The two series trend together show a steady increase through the study period. The upward trend in both series suggests a positive association between financial development and income inequality. This may be one of the reasons why income inequality has remained stubbornly high, as this trend has been associated with advancement in financial development, which has earned South Africa credit as one of the countries with an advanced financial sector**.**

2.2 Empirical literature review

The theoretical link between financial development and income inequality is fostered in several channels. Firstly, financial development creates jobs that provide income to the workers. Secondly, financial development plays a crucial role in intermediation, allowing deficit units to borrow for consumption and investment. Thus, providing a channel through which households and firms can get credit during times of credit crunch and investment funds, respectively. Access to investment funds allows firms to expand their operations and create more jobs. Given that income inequality in South Africa is closely linked to wage earnings, this provides an alleviation of income inequality. On the other hand, the ability of families to access financing from the bank allows households to consume more social services like health and education, housing, and smooth consumption. Lastly, the drive for financial inclusion allows access to financial institutions for previously unbanked individuals. Thus, expanding the possibility of household consumption and investment. In this study, empirical literature on financial development and income inequality is reviewed, consisting of studies that found a positive impact, those that found mixed results, studies that found a negative impact and some studies that found an insignificant impact.

Karis and Cil (2024) examined the impact of financial development on income inequality for 13 OECD member countries using data from 1993 to 2017. Using the GINI coefficient as a measure of income inequality and banks' domestic credit to the private sector, the study found financial development to have a positive impact on income inequality. Alshubiri (2021) examined the effects of financial deepening on income inequality for 32 Organisation for Economic Co-operation and Development (OECD) and ASIAN countries using data from 2002 to 2018. Using GMM estimation and pooled OLS, the study found financial depth proxies for informal and formal financial sectors to have a positive impact on income inequality. Excessive expansion of the formal financial sector compared to other sectors was found to result in an unequal impact on income inequality. In the same spirit, Bittencourt et al. (2019) in a study on 50 United States using data from 1976 to 2011, found the impact of financial development on income inequality to be non-linear. They separated their sample into above-average and below-average inequality groups. An increase in financial development was found to increase above-average income inequality in states, and an inverted U-shaped relationship was found for average income inequality in states. de Haan and Sturm (2017) found the same results as Karis and Cil (2024) in a separate study on 121 countries using panel data from 1975 to 2005. Adams and Klobodu (2016), in a study on 21 Sub-Saharan African countries (SSA) using data from 1985 to 2011, found that financial development increases income inequality.

Apart from studies that have found a positive impact of financial development on income inequality, there are also studies that have found mixed results. For example, Bolarinwa and Akinlo (2021) examined a non-linear relationship between financial development and inequality in Africa using a sample of 40 countries: 7 high-income countries, 20 low-income countries and 13 low-middle income countries. The study found that aggressive financial development worsens inequality in high-income countries and reduces inequality in low- and middle-income countries. Nguyen et al. (2019), in a separate study on 21 emerging countries, using data from 1961-2017, found an inverted U-shaped relationship between financial development and income inequality, meaning inequality responds differently depending on the stages of financial development. Early stages were found to be characterised by an increase in income inequality, and after a certain stage, income inequality decreases with an increase in financial development.

Altunbaş and Thornton (2019), in a study on a panel of 121 countries using quantile regression, found financial development to promote equality across inequality quantiles in upper-middle-income countries, while for low and high-income countries, financial development was found to promote inequality. Chiu and Lee (2019) explored the non-linear effects of financial development and country risks on income inequality for 59 countries using data from 1985 to 2015. Using panel smooth transition regression, the study found that financial development improves income inequality in high-income countries and worsens income inequality in low-income countries.

There are also some studies that found financial development to reduce income inequality or to have an insignificant impact. Among the studies that found a financial development to reduce income inequality, Umit and Eyuboglu (2024) investigated the impact of financial development on income inequality for China, Turkey, Brazil, India, Argentina, Russia, Indonesia and Mexico. Using data from 1989 to 2021, the study found financial development to reduce income inequality in Russia, India and Argentina. Chisadza and Biyase (2022), in a study on financial development and income inequality for 148 countries using data from 1980 to 2019, found financial development to reduce inequality across emerging and least developed countries, but it was found to be insignificant for advanced countries. The study also found banking sector development to have income inequality-reducing effects for emerging and least developed countries. Bolarinwa and Akinlo (2021) in a study on 40 African countries from high-income, middle- and low-income countries found the existence of a threshold levels of financial development that reduce inequality. Aggressive financial development was found to promote inequality in high-income countries and reduce inequality in low- and middle-income countries. Thornton and Di Tommaso (2020) found the same results as Umit and Eyuboglu (2024) and Chisadza and Biyase (2022) in a study on 119 advanced and developing countries.

Ahmed and Masih (2017) examined the impact of financial development on income inequality for Malaysia using data from 1970 to 2007 and employing autoregressive distributed lag (ARDL). The study found financial development to be insignificant in influencing income inequality.

The results from the studies that have been reviewed show inconclusive results, with some studies pointing to the financial development worsening income inequality (see, Karis and Cil ,2024; Alshubiri, 2021; Bittencourt et al., 2019) and some studies findings mixed results (Bolarinwa & Akinlo, 2021; Nguyen et al., 2019) and yet another strand of literature found financial development to have an insignificant impact on income inequality (Ahmed & Masih, 2017). The commitment to reduce inequality was made by most developed and developing countries by being signatories to the SDGs, and South Africa is not an exception. Given the inconclusive results from the literature, coupled with the persistently high income inequality in South Africa, another study on financial development and income inequality offers policymakers more insight.

3. Research Methodology

The asymmetric impact of financial development on income inequality is examined using the non-linear autoregressive distributed lag (NARDL) developed by Shin et al (2014). The approach was selected because of numerous advantages. For instance, the NARDL approach departs from the traditional ARDL by decomposing the impact of the independent variable into negative and positive partial sums. In addition, the results obtained are in the short and long run, providing guidance to policies that attach timeframes. Thus, it allows policymakers to design policies that focus on short-run interventions and those that focus on long-term impact on income inequality.

Variables

The primary variables in this study are income inequality (INEQ), proxied by the pre-tax GINI coefficient, and financial development, measured by the Financial Development Index (FD) developed by the IMF. To fully specify the model and minimise model specification error, other control variables that were included in the model are total export and imports divided by GDP (TRADE), Gross Fixed capital Formation (GFCF), GDP per capita (YPC) and population growth (POPGR). Table 1 reports variable definition and data sources.

Table 1

Variable definition

Variable Name	Variable Definition	Data Source
FD	Financial Development Index	IMF
GINI	Pre-tax GINI coefficient	SWIID
TRADE	[Exports plus imports]/GDP	WDI
GFCF	Gross Fixed Capital Formation (% of GDP)	WDI
YPC	Economic Growth (GDP per capita growth)	WDI
POPGR	Population growth	WDI

WDI = World Bank Development Indicators online database, IMF = International Monetary Fund, SWIID = Standardised World Income Inequality Database

Model specification and data

Equation (1) provides the general model specification.

$$\mathrm{INEQ} = \mathrm{f(FD, TRADE, GFCF, YPC, POPGR)} \quad (1)$$

Where: INEQ = Inequality measured by the pre-tax GINI coefficient; FD = Financial Development Index; TRADE = [Export + Imports]/GDP; GFCF = Gross Fixed Capita Formation (% of GDP); YPC = per capita GDP; POPGR = population growth

The positive and negative partial sums of the Financial Development Index (FD) are given in equation (2) and further decomposed in equations (3) and (4).

$$\mathrm{FD_t} = \rho_0 + \mathrm{FD^+_{nt}} + \mathrm{FD^-_{nt}} \quad (2)$$

Where:

$$\mathrm{FD^+_{nt}} = \sum_{J=1}^{t} \Delta\mathrm{FD^+_{nt}} = \sum_{j=1}^{t} \max(\Delta\mathrm{FD_{nj}}; 0) \quad (3)$$

$$\mathrm{FD^-_{nt}} = \sum_{J=1}^{t} \Delta\mathrm{FD^-_{nt}} = \sum_{j=1}^{t} \min(\Delta\mathrm{FDn}; 0) \quad (4)$$

Based on equation (2), (3) and (4), the NARDL model can be expressed as:

$$\Delta INEQ_t = \sigma_0 + \sum_{i=1}^{p} \sigma_{1i} \Delta INEQ_{t-i} + \sum_{i=0}^{q1} \sigma_{2i}^{+} \Delta FD_{nt-i}^{+} + \sum_{i=0}^{q2} \sigma_{3i}^{-} \Delta FD_{nt-i}^{-} + \sum_{i=0}^{q3} \sigma_{4i} \Delta TRADE_{t-i} + \sum_{i=0}^{q4} \sigma_{5i}\, \Delta GFCF_{t-i} + \sum_{i=0}^{q5} \sigma_{6i}\, \Delta YPC_{t-i} + \sum_{i=0}^{q6} \sigma_{7i}\, \Delta POPGR_{t-i} + \rho_1 INEQ_{t-1} + \rho_2^{+} FD_{nt-1}^{+} + \rho_3^{-} FD_{nt-1}^{-} + \rho_4 TRADE_{t-1} + \rho_5 GFCF_{t-1} + \rho_6 YPC_{t-1} + \rho_7 POPGR_{t-1} + \gamma_{1t} \quad (5)$$

Where: σ_0 = constant; $\sigma_1 - \sigma_7$= short-run coefficients; $\rho_1 - \rho_7$ = long-run coefficients; and γ_{1t} = error term.

The NARDL error correction representation of equation (5) is given in equation (6).

$$\Delta INEQ_t = \sigma_0 + \sum_{i=1}^{p} \sigma_{1i} \Delta INEQ_{t-i} + \sum_{i=0}^{q1} \sigma_{2i}^{+} \Delta FD_{nt-i}^{+} + \sum_{i=0}^{q2} \sigma_{3i}^{-} \Delta FD_{nt-i}^{-} + \sum_{i=0}^{q3} \sigma_{4i} \Delta TRADE_{t-i} + \sum_{i=0}^{q4} \sigma_{5i}\, \Delta GFCF_{t-i} + \sum_{i=0}^{q5} \sigma_{6i}\, \Delta YPC_{t-i} + \sum_{i=0}^{q6} \sigma_{7i}\, \Delta YPOPGR_{t-i} + \lambda ECM_{t-1} + \gamma_{2t} \quad (6)$$

Where ECM = Error correction term.

4. Results and discussion

Stationarity of the variables included in the model was tested using the Phillips-Perron and the Augmented Dickey-Fuller test, and the results are presented in Table 2. It reports stationarity of all variables included in the model in levels or in first difference. The next step is to test for a long-run relationship among the variables.

Table 2

Unit Root Test Results

	Augmented Dickey (ADF)		Phillips-Perron (PP)	
Variable	Level	Δ	Level	Δ
Gini	-1.348367	-2.704091*	-0.992893	-3.416702***
FD	-1.231077	-6.794090***	1.045329	-9.141020***
TRADE	-1.803790	-4.687731***	-0.384826	-6.227622***
GFCF	-2.166147	-4.020321***	-0.896242	-3.7386***
YPC	-3.4185**	-	-3.4222***	-
POPGR	-1.268083	-3.509178***	-1.340478	-3.509178***

*Notes: *, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively. Δ denotes first difference.*

The results reported in Table 3 confirm that the variables included in the model are cointegrated. This is confirmed by comparing the calculated F-statistics of 9.297350 to the critical values also provided in the table. The calculated F-statistic is greater than the upper bound at 1% level of significance, confirming the presence of cointegration.

Table 3

Cointegration Results

Dependent variable	F-Statistic		Cointegration Status			
FD	9.297350***		Cointegrated			
Asymptotic critical values						
	10%		5%		1%	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
	2.977	4.260	3.576	5.065	5.046	6.930

*Notes: *, ** and *** denote statistical significance at 10%, 5% and 1% levels*

Table 4 reports the asymmetric test.

Table 4

Asymmetric Test Results

FD as dependent variable			
Test	**F-statistic**	**P-value**	**Decision**
W_{LR}	42.95464***	0.000	Asymmetric
W_{SR}	7.744158**	0.0155	Asymmetric

*1) ** and *** denote statistical significance at 5% and 1% levels, respectively. 2) WLR = long-run asymmetric test. 3) WSR = short-run asymmetric test*

The asymmetric test results reported in Table 4 reveal the presence of asymmetry in the short and the long run. This indicates that the analysis can be done using the non-linear autoregressive distributed lag. The asymmetric long and short-run results are presented in Table 5.

Table 5

Asymmetric Long and short-run results

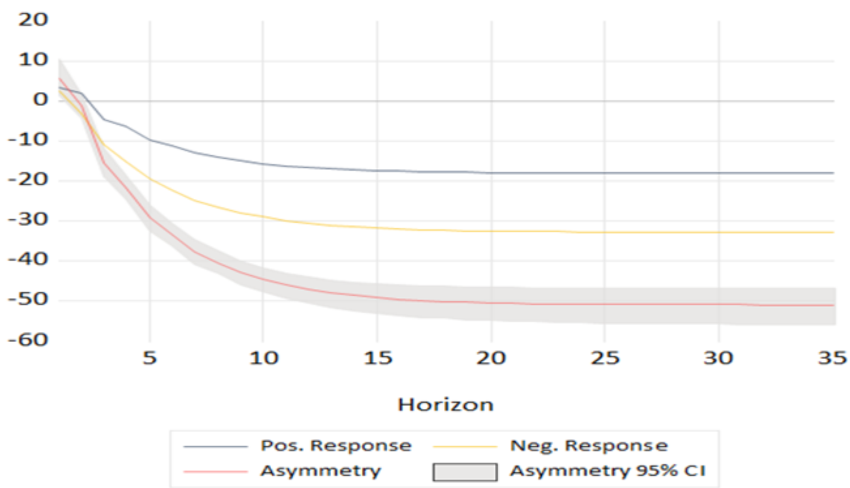
FD as a proxy of financial development		
Panel A: Long-Run Results		
Regressor	**Coefficient**	**T-ratio [p-value]**
C	19.52195***	9.814531 [0.0000]
$TREND$	0.129783***	9.4314482 [0.0000]
FD^{+}	18.11925**	-2.437483 [0.0212]
FD^{-}	32.79921***	3.718455[0.0009]
$TRADE$	0.033208	1.601867 [0.1200]
$GFCF$	-0.002506	-0.029458 [0.9767]
YPC	0.001541***	3.575413 [0.0012]
$POPGR$	-0.038141	-0.247704 [0.8061]
Panel B: Short-Run Results		
Regressor	**Coefficient**	**T-ratio [p-value]**
$\Delta INEQ(-1)$	-0.446439**	-3.357063 [0.0033]
ΔFD^{+}	3.214991**	2.695174 [0.0143]
$\Delta FDI^{+}(-1)$	7.684075***	5.298891 [0.0000]
ΔFD^{-}	-2.532358**	-2.554773[0.0194]
$\Delta FD^{-}(-1)$	-7.693451***	-4.406894[0.0003]
$\Delta TRADE$	0.005887*	2.074898 [0.0518]
$\Delta TRADE(-1)$	0.001837	0.654654 [0.5205]
$\Delta GFCF$	0.028137**	2.281568[0.0342]
$\Delta GFCF(-1)$	0.009271	0.969936[0.3443]
ΔYPC	0.000389***	3.236435 [0.0043]
$\Delta YPC(-1)$	-0.000230	-1.360339 [0.1896]
$\Delta POPGR$	-0.032257	-0.751081[0.4618]
$\Delta POPGR(-1)$	-0.067622	-1.458218 [0.1611]
$ECM(-1)$	-0.350282***	-9.752899[0.0000]
Panel C: Test statistics and diagnostics		
R- Squared	0.978738	
R-Bar-Squared	0.961952	
F-statistics [Prob]	58.30643 [0.000000]	

*Notes: *, ** and *** denote statistical significance at 10%, 5% and 1% levels, respectively. Δ denotes first difference*

The results reported in Table 5, Panels A and B, confirm a positive association between positive shocks to financial development and income inequality in both the long run and the short run. This is evidenced by the coefficients of FD^+ , ΔFD^+ and $\Delta FD^+(-1)$, all of which are statistically significant at either the 5% or 10% level. The results also indicate an inverse relationship between negative shocks to financial development and income inequality in the long run, whereas in the short run, they move in the same direction. The dynamic multiplier graph in Figure 2 also confirms that, overall, negative shocks to financial development have a more pronounced and lasting impact on income inequality over time than positive shocks. The findings from this study point to the importance of intentional policies to guide financial development and complementary policies and programmes, such as a comprehensive social safety net and employment creation.

Figure 2

Dynamic Multiplier Graph



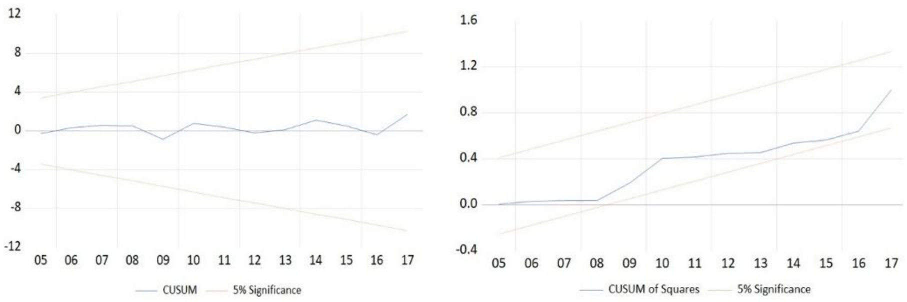
Source: Computation from E-views

Other results presented in Panels A and B confirm that trade openness (TRADE) and gross fixed capital formation (GFCF) have a positive impact on income inequality, but only in the short run. Gross Domestic Product per capita (YPC) was found to worsen income inequality in both the short and long run. Population growth (POPGR), on the other hand, had an insignificant effect on income inequality in South Africa, regardless of the time horizon considered.

The model demonstrates a good fit, with an explanatory power of 97%. The error correction term (ECM), with a coefficient of –0.350282, has the expected negative sign, confirming the model's convergence toward equilibrium whenever there is a disequilibrium in the economy. Additionally, the model passed the stability tests, as evidenced by the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) plots reported in Figure 3.

Figure 3

Stability Test



Stability test at 5% level of significance

Source: Computation from E-views

5. Conclusion

The study explored the asymmetric impact of financial development on income inequality in South Africa using data from 1980 to 2017. The study was motivated by the struggle that the South African government has faced in reducing income inequality in the country since its independence. This is despite advancements in some sectors, like the financial sector. The study investigated if South Africa could benefit from financial development in reducing income inequality in the country. The Financial Development Index (FD) was used as a proxy for financial development to examine the impact of financial development on income inequality, using the non-linear autoregressive distributed lag (NARDL) approach.

The study found positive shocks to financial development to be positively associated with income inequality in both the long run and the short run. However, the negative shocks to financial development were found to have an inverse relationship with income inequality in the long run, whereas in the short run, they move in the same direction. The dynamic multiplier graph confirms that negative shocks to financial development have a more pronounced and lasting impact on income inequality over time. The findings from the study confirmed that financial development cannot be taken as a panacea for income inequality reduction without complementary programmes and intentional policies**.** Based on the results, it is recommended that the South African government implement a multidimensional policy intervention specifically tailored to address and reduce income inequality.

As the country continues to advance financial sector development, a balanced approach is required to ensure that the South African financial sector remains competitive and responsive to domestic needs, while also contributing to the alleviation of income inequality—one of the key goals of the National Development Plan. This may entail a gradual and steady advancement in financial development, supported by policies and programmes specifically aimed at reducing income inequality—such as promoting financial inclusion and improving access to financial services, particularly for marginalised populations. Other interventions include programmes aimed at job creation and the expansion of social services such as education, housing, and healthcare, to help reduce the gap between the rich and the poor. These programmes can be complemented by a comprehensive social safety net as a short-term relief measure.

Although an effort was made to ensure the scientific rigour of the study, it is not without limitations. Firstly, the availability of data restricted the study period. Future studies can benefit from the use of extended data. Secondly, the study used the financial development index as a measure of financial development. The financial development index combines bank-based and market-based financial indices; future studies can explore the nature of the relationship between income inequality and bank-based and/or market-based measures of financial development separately. Lastly, inequality is multidimensional; future studies can benefit from investigating the impact of financial development using multidimensional measures of inequality.

Reference

1. Adams, S., & Klobodu, E.K.M. (2016). Financial development, control of corruption and income inequality, *International Review of Applied Economics*, 30(6), 790-808. DOI: 10.1080/02692171.2016.1208740.
2. Ahmed, A.R., & Masih, M. (2017). What is the link between financial development and income inequality? evidence from Malaysia, *MPRA Paper* 79416.
3. Alshubiri, F. (2021). Financial deepening indicators and income inequality of OECD and ASIAN countries. *The Journal of Economic Asymmetries*, 24(e00211). https://doi.org/10.1016/j.jeca.2021.e00211.
4. Altunbaş, Y. & Thornton, J. (2019). The impact of financial development on income inequality: A quantile regression approach. *Economics Letters*, 175, pp. 51–56.
5. Bittencourt, M., Chang, S., Gupta, R., & Miller, S.M. (2019). Does financial development affect income inequality in the US States? *Journal of Policy Modelling*, 41(6), pp. 1043–1056. http://dx.doi.org/10.1016/j.jpolmod.2019.07.008.
6. Bolarinwa, S.T., & Akinlo, A.E. (2021). Is there a nonlinear relationship between financial development and income inequality in Africa? Evidence from dynamic panel threshold. *The Journal of Economic Asymmetries*, 24(e00226). http://dx.doi.org/10.1016/j.jeca.2021.e00226.
7. Chisadza, C., & Biyase, M. (2022). Financial Development and Income Inequality: Evidence from Advanced Emerging and Developing Economies, *University of Pretoria, Department of Economics Paper Series*, Working Paper 2022-21, April.
8. Chiu, Y.B., & Lee, C.C. (2019). Financial development, income inequality, and country risk. *Journal of International Money and Finance*, 93, pp. 1–18. doi: 10.1016/j.jimonfin.2019.01.001.
9. de Haan, J., & Sturm, J. (2017). Finance and income inequality: A review and new evidence. *European Journal of Political Economy*, 50(C), pp. 171–195. DOI: 10.1016/j.ejpoleco.2017.04.007.
10. IMF (2020). South Africa: Bridging the Income Divide. Available from https://www.imf.org/en/Blogs/Articles/2020/02/07/south-africa-bridging-the-income-divide. [Accessed 3 June 2025].
11. IMF (2025). Financial Development Index Database. Available from https://legacydata.imf.org/?sk=f8032e80-b36c-43b1-ac26-493c5b1cd33b. [Accessed 28 May 2025].

12. Karış, C. & Çil, D. (2024). The Impact of Financial Development on Income Inequality: Evidence from OECD Countries. *Istanbul Business Research*, 53(1), pp. 103–118.
13. Nguyen, C.T., Ngoc Vu, T., Hong Vo, D., & Thi-Thieu Ha, D. (2019). Financial development and income inequality in emerging markets: a new approach. *Journal of Risk and Financial Management*, 12(4), 1-14. http://dx.doi.org/10.3390/jrfm12040173
14. SARB, (2025). History. Available from https://www.resbank.co.za/en/home/about-us/history. [Accessed 2 June 2025].
15. Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014), Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. Festschrift in Honor of Peter Schmidt, Springer, New York, NY, 281-314.
16. Stats SA, (2020). How Unequal is South Africa? Available from https://www.statssa.gov.za/?p=12930. [Accessed 3 June 2025].
17. SWIID, (2023). (Version 9.6) [Solt, Frederick. 2020. "Measuring Income Inequality Across Countries and Over Time: The Standardized World Income Inequality Database." Social Science Quarterly 101(3):1183-1199].
18. Thornton, J., & Di Tommaso, C. (2020). The long-run relationship between finance and income inequality: Evidence from panel data. *Finance Research Letters*, 32(101180). http://dx.doi.org/10.1016/j.frl.2019.04.036.
19. Umit, A.O., & Eyuboglu, S. (2024). Re-investigation of financial development on income inequality: An empirical analysis for G-20 emerging economies. *Scientific Annals of Economics and Business*, 71(41), DOI: https://doi.org/10.47743/saeb-2024-0027.
20. Van Heerden, C. (2018). Twin Peaks Model of Financial Regulation for South Africa Seelk to Promote and Maintain Financial Stability. University of Pretoria: Mercantile Law, 20 July. Available from https://www.up.ac.za/mercantile-law/news/post_2705235-twin-peaks-model-of-financial-regulation-for-south-africa-seeks-to-promote-and-maintain-financial-stability#:~:text=The%20essence%20of%20the%20South,Conduct%20Authority%2C%20tasked%20with%20overseeing. [Accessed 2 June 2025].
21. World Bank (2025a). Gini index- South Africa. Available from https://data.worldbank.org/indicator/SI.POV.GINI?locations=ZA. [Accessed 16 June 2025].

22. World Bank. (2025b). Country Brief- Inequality in South Africa: An assessment of the Southern African Customs Union. https://documents1.worldbank.org/curated/en/099125003072240961/pdf/P1649270b73f1f0b5093fb0e644d33bc6f1.pdf. [Accessed 3 June 2025]
23. World Bank. (2025c). World Development Indicators. Available at: https://databank.worldbank.org/source/world-development-indicators. [Accessed 16 June 2025].

Data sources:

- World Income Inequality Database (WIID). Available from https://www.wider.unu.edu/project/world-income-inequality-database-wiid. [Accessed 12 June 2025].

AN EMPIRICAL STUDY OF PROPERTY AND REAL ESTATE COMPANIES LISTED ON THE INDONESIAN STOCK EXCHANGE

Hestinuraini USAT, PhD Candidate*
Asep Rokhyadi Permana SAPUTRA, PhD**
Fety Rochyawati Qudrat MULYA, PhD***

Abstract

This study examines the impact of debt policy, firm size, and liquidity on firm value in property and real estate companies listed on the Indonesia Stock Exchange (IDX) from 2022 to 2024. Using a quantitative approach, this research employed multiple linear regression analysis supported by classical assumption tests. The results show that debt policy and firm size do not have a significant positive effect on firm value, indicating that high leverage and firm scale are not sufficient to enhance shareholder value in this sector. Conversely, liquidity demonstrates a significant positive effect, suggesting that firms with strong short-term financial capabilities are more attractive to investors and better able to sustain long-term value creation. Theoretically, these findings highlight the limited role of debt and firm size in improving firm value when financial risk and cash flow instability are high. Practically, the study suggests optimising capital structure, diversifying financing sources, improving cash flow management, and maintaining transparency to investors as strategies to strengthen firm value.

Keywords: debt policy, firm size, firm value, liquidity, property and real estate, Indonesia

JEL Classification: E52, G11, G15, G32

* *Management Program Study, Faculty of Economics, Mercu Buana University of Yogyakarta, Indonesia.*

** *Lecturer, Management Program Study, Faculty of Economics, Mercu Buana University of Yogyakarta, Indonesia. Corresponding author, e-mail: asep@mercubuana-yogya.ac.id*

*** *Lecturer, Financial Management Program Study, Yappis College of Merauke, Papua, Indonesia.*

1. Introduction

The value of a firm can be assessed through its stable stock price and long-term sustainable growth. A high share price indicates a strong firm performance, which is positively perceived by investors as a signal of success and potential future investment opportunities (Hamzah & Muslim, 2022). Companies listed on the Indonesia Stock Exchange (IDX) demonstrate varying firm values, and high-quality firms are generally more attractive to shareholders. Firms with strong quality can maintain high stock prices and secure greater investment prospects in the future. Debt policy, as a component of corporate financial policy, is sourced externally and is closely linked to capital structure. The composition of debt within the capital structure must be managed carefully to achieve an optimal balance between risk and expected returns, thereby maximising both share prices and firm quality (Nasution, 2020). However, excessive reliance on debt can negatively affect firm quality, as high debt levels tend to reduce the attractiveness of shares (Juliyando & Saputra, 2023). Firm size also plays a crucial role in determining firm value. Larger firms generally have greater access to both internal and external financing sources, which enhances financial stability and operational efficiency (Saini et al., 2024). Moreover, firm size strongly influences investor assessments, as it reflects the company's ability to generate operating profits and signals financial stability in the long run (Nurwulandari, 2021). Liquidity, on the other hand, reflects a firm's ability to meet its short-term obligations when they become due. It is typically measured by comparing current assets to current liabilities (Jihedi et al., 2021). Higher levels of liquidity indicate stronger financial performance and signal to investors that the firm can manage its debt commitments effectively.

2. Theory and hypothesis development

The research is underpinned by a fundamental theory and its formulation, complemented by three theoretical developments.

Portfolio theory is an investment concept designed to help investors maximise returns while minimising risks. A portfolio is a structured combination of various investment instruments and assets arranged to achieve the investor's specific investment objectives. This theory enables investors to manage risk exposure effectively, as lower investment risk can directly enhance firm value, both in terms of market value and intrinsic value. Firm value itself reflects investors' perception of a company, which is closely linked to its stock price (Rubach et al., 2023). A high firm value not only increases investor confidence but also indicates better future prospects for the firm (Shyju et al., 2023). One standard measure of a firm's value is the Price-to-Book Value (PBV), which is used to assess whether a firm's shares are considered expensive or undervalued. PBV is calculated as the ratio of a company's stock price to its book value, serving as a useful indicator of the market's evaluation of the firm's overall performance.

2.1. The effect of debt policy on firm value

If a firm's operational funds are insufficient, they can be fulfilled through external financing, primarily debt. Debt policy is a strategy adopted by companies to finance their operations using debt instruments, commonly referred to as financial leverage. Financial leverage illustrates the extent to which debt and preferred stock are utilised within the capital structure (Geng et al., 2022). The management of debt policy is crucial because the use of debt can provide tax shields, thereby increasing firm value. In addition, debt policy helps control free cash flow, which, if not managed properly, may be excessively utilised by management, potentially leading to wasteful investment (Anah et al, 2022). Companies with an effective debt policy demonstrate good managerial capability in optimising capital sourced from debt to finance operational and investment activities, which ultimately enhances firm quality as the company proves capable of managing its financial obligations (Arfan, 2022). Furthermore, firm value also increases when a company has a larger market capitalisation, a higher book value, and strong profitability. Investors are generally more attracted to larger-scale companies due to their stable financial conditions and lower perceived risks (Dewantari et al, 2019). Therefore, an optimal debt policy is expected to have a positive impact on firm value.

H1: Debt policy has a positive effect on firm value in property and real estate companies listed on IDX for the period 2022-2024.

2.2. The effect of firm size on firm value

Firm value can be reflected through stock market prices, where an increase in share price indicates higher firm value and greater shareholder welfare (Bandanuji & Khoiruddin, 2020). Firm size also plays a significant role in shaping a firm's value. A larger firm size suggests business development and growth potential, which is often responded to positively by investors, thereby increasing the firm's competitiveness and its ability to distribute higher dividends (Silviatun & Saputra, 2024). Firm size represents a company's ability to build and maintain public trust through its accumulated assets and operational success. Companies with larger firm sizes are generally perceived as more stable and resilient, making them more attractive to enter the capital market. This stability can entice investors to purchase company shares, which in turn drives up stock prices (Lesmana et al, 2024). Generally, firm size significantly influences investor assessments, as it reflects the firm's ability to generate sustainable operating profits and predicts long-term financial stability (Nurwulandari, 2021). Based on this reasoning, firm size is expected to have a positive effect on firm value.

H2: Firm size has a positive effect on firm value in property and real estate sector companies listed on IDX for the period 2022-2024.

2.3. The effect of liquidity on firm value

Liquidity is a financial ratio that describes a firm's ability to meet its short-term obligations (Jamiah, 2023). Liquidity provides valuable information to investors and analysts regarding how effectively a firm utilises its current assets to cover current liabilities and other short-term obligations (Jihedi et al., 2021). In essence, liquidity represents the firm's capacity to fulfil its financial responsibilities adequately. Furthermore, liquidity can influence dividend distribution, as firms with higher liquidity levels are more capable of paying dividends to shareholders (Andayani & Purbawangsa, 2019). The liquidity ratio also benefits various stakeholders, including creditors, distributors, and suppliers, as it reflects the firm's financial stability and ability to maintain external relationships. Therefore, liquidity calculations are crucial not only for internal management but also for external stakeholders. Conversely, when a firm experiences liquidity difficulties, stakeholders' trust and confidence may decline (Rahmadani et al, 2025).

H3: Liquidity has a positive effect on firm value in property and real estate sector companies listed on IDX for the period 2022-2024.

3. Research method

This section presents the variables, definitions, measurements, population and sample, as well as the analytical tools.

Table 1

Variables, operational definitions, and measurements

Variable	Operational definition	Measurement
Debt Policy	According to Lumbanbatu et al (2023), higher levels of debt can increase stock prices; however, excessive debt may reduce the overall quality of the firm, as the associated costs may outweigh the benefits derived from debt utilisation. In other words, the greater the fixed debt employed by the firm, the higher both the risks and potential benefits. Debt policy can be measured using the Debt-to-Asset Ratio (DAR), a financial ratio that compares total debt to total assets.	$DAR = \frac{Total\ Debt}{Total\ Assets}$
Firm Size	According to Harnovinsah et al. (2023), a firm will grow larger if it has easy access to both external and internal funding sources. A larger firm size indicates that the company is expanding, making it more attractive to investors and thereby increasing firm value. Furthermore, Hamzah and Muslim (2022) state that firm size can be assessed from the total assets owned by the company, and it significantly influences firm performance because the size of the firm affects investors' assessments and their investment decisions. Therefore, firm size is an important variable to consider in determining a company's value.	$Firm\ size = \ln(Total\ Assets)$
Liquidity	According to Jamiah (2023), liquidity refers to a ratio that reflects a firm's ability to pay off short-term debt using its current assets. Similarly, Monoarfa (2018) explain that liquidity represents the extent to which current liabilities can be covered by assets that are easily converted into cash within a short period. Liquidity is commonly measured using the Current Ratio, which serves as a fundamental indicator of a firm's short-term solvency and demonstrates its ability to meet its short-term financial obligations when they become due.	$Current\ Ratio = \frac{Current\ Assets}{Current\ Liabilities}$

Source: Synthesis made by authors based on information from various scholarly articles

The population used in this study were 60 firms in the property and real estate sector listed on IDX. In this study, a purposive sampling method was used. Based on this method, a sample of 30 firms was obtained, which will be used in this study.

Table 2

Sample of firms

No	Firm	Code
1	Agung Podomoro Land Tbk	APLN
2	Bekasi Asri Pemula Tbk	BAPA
3	Bekasi Fajar Industrial Estate Tbk	BEST
4	Bhuwanatala Indah Permai Tbk	BIPP
5	Binakarya Jaya Abadi Tbk	BIKA
6	Bukit Darmo Property Tbk	BKDP
7	Bumi Serpong Damai Tbk	BSDE
8	Ciputra Development Tbk	CTRA
9	Duta Anggada Realty Tbk	DART
10	Duta Pertiwi Tbk	DUTI
11	Greenwood Sejahtera Tbk	GWSA
12	Indonesian Paradise Property Tbk	INPP
13	Intiland Development Tbk	DILD
14	Lippo Cikarang Tbk	LPCK
15	Lippo Karawaci Tbk	LPKR
16	Mega Development Tbk	EMDE
17	Metro Realty Tbk	MTSM
18	Metropolitan Kentjana Tbk	MKPI
19	Metropolitan Land Tbk	MTLA
20	Modernland Realty Tbk	MDLN
21	Pakuwon Jati Tbk	PWON
22	Perdana Gapuraprima Tbk	GPRA
23	Pikko Land Development Tbk	RODA
24	Plaza Indonesia Realty Tbk	PLIN
25	PP Properti Tbk	PPRO
26	Pudjiadi Prestige Tbk	PUDP
27	Ristia Bintang Mahkotasejati Tbk	RBMS
28	Roda Vivatex Tbk	RDTX
29	Sentul City Tbk	BKSL
30	Suryamas Dutamakmur Tbk	SMDM

Source: Secondary data, Indonesia Stock Exchange (IDX).

This study employs regression and correlation analysis tools along with classical assumption tests, including the normality test, multicollinearity test, autocorrelation test, and heteroscedasticity test (Hair et al., 2013). Furthermore, multiple linear regression analysis was conducted using partial tests (t-test, $\alpha < 0.05$), simultaneous tests (F-test, $\alpha < 0.05$), and the coefficient of determination (R^2) test (Bentler & Bonett, 1980). All analyses were carried out using IBM SPSS Statistics version 24.

4. Results and discussion

4.1. Classical assumption test

Classical assumptions are intended to ensure that the regression equation produced is accurate in estimation, unbiased, and consistent. The classical assumption tests applied in this study include the normality test, autocorrelation test, multicollinearity test, and heteroscedasticity test.

4.1.1. Normality Test

A normality test is used to determine whether the confounding or residual variables in a regression model follow a normal distribution. A belief is that the t and F tests describe that the quality of the residuals follows a normal distribution.

Table 3

Normality Test Results

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		90
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	369.82051370
Most Extreme Differences	Absolute	.124
	Positive	.124
	Negative	-.090
Test Statistic		.124
Asymp. Sig. (2-tailed)		.002[c]
Exact Sig. (2-tailed)		.114
Point Probability		.000

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.

Source: Primary data were processed using SPSS.

Based on Table 3, the exact asymptotic sign (2-tailed) number 0.114 is greater than 0.05. This means that the data in this study is normally distributed, so that it is feasible to use and the assumption of normality is fulfilled.

4.1.2. Multicollinearity Test

The multicollinearity test aims to determine whether there is a correlation among independent variables. This test can be conducted using the Tolerance and Variance Inflation Factor (VIF) values. The criteria used are as follows: if the VIF value is < 10, it indicates that there is no multicollinearity problem; and if the Tolerance value is > 0.10, it also indicates that there is no multicollinearity problem.

Table 4

Multicollinearities Test Results

Coefficients[a]							
Model 1	Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Err.	Beta			Tolerance	VIF
(Constant)	183	150		1.225	.224		
DAR_X1	-.324	.258	-.154	-1.256	.212	.724	1.382
SIZE_X2	-.125	.277	-.049	-.452	.652	.916	1.092
CR_X3	.123	.050	-.301	2.472	.001	.733	1.365

a. Dependent Variable: PBV

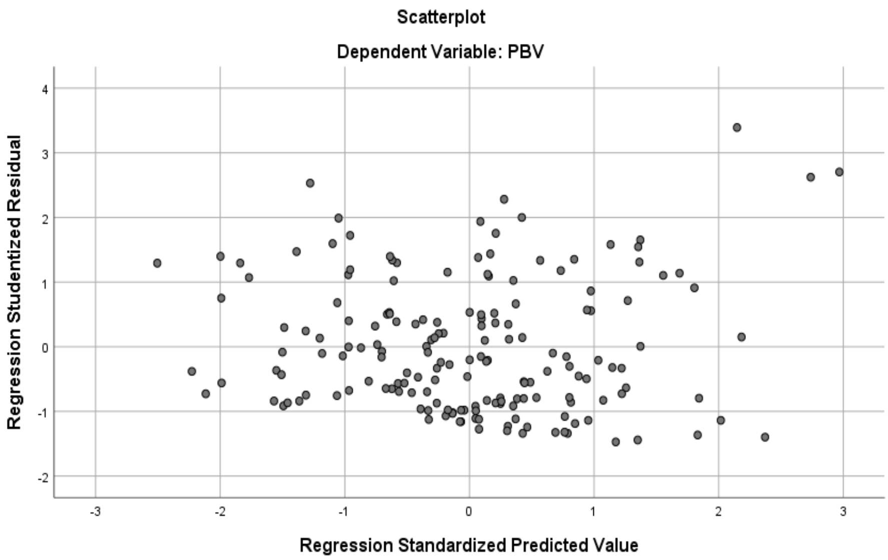
Source: Primary data were processed using SPSS.

Based on Table 4, it is shown that debt policy (DAR) has a tolerance value of 0.724 (>0.1) and a VIF value of 1.382 (<10). Firm size has a tolerance value of 0.916 (>0.1) and a VIF value of 1.092 (<10). Liquidity has a tolerance value of 0.733 (>0.1) and a VIF value of 1.365 (<10). These results indicate that there is no multicollinearity among the variables.

4.1.3. Heteroscedasticity Test

The heteroscedasticity test aims to determine whether there is an inequality in variance between the residuals of one observation and another.

Figure 1
Scatterplot residual and standard predictive of PBV



Source: Primary data were processed using SPSS.

Based on the scatterplot graph above, it can be observed that the data points in this study are spread above and below (around) the value of zero, and the distribution of the data does not form a specific pattern. Thus, it can be concluded that heteroscedasticity does not occur. Therefore, this regression model meets the assumption and is feasible to be used in determining firm value through the influencing variables, namely debt policy, firm size, and liquidity.

4.1.4. Autocorrelation Test

The autocorrelation test aims to determine whether there is a correlation between the residual error in the current period and the residual error in the previous period. If such a correlation exists, it indicates the presence of an autocorrelation problem.

Table 5

Autocorrelation Test Results

Summary[b]					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.490[a]	.241	.204	342.90139	2.086

a. Predictors: (Constant), LAG_Y, DAR_X1, SIZE_X2, CR_X3
b. Dependent Variable: PBV
Source: Primary data were processed using SPSS.

Based on Table 5, it can be observed that the DW value in this study is 2.086, which is greater than the upper bound (dU) of 1.6498 and less than (4–dU) of 1.914. This indicates that the regression analysis shows no evidence of either positive or negative autocorrelation. Therefore, it can be concluded that the model in this study is free from autocorrelation.

4.2. Multiple Linear Test

This analytical technique aims to confirm the relationship between the dependent variable and the independent variables, whether the relationship is positive or negative.

Table 6

Multiple Linear Regression Test Results

Coefficients[a]					
Model 1	Unstandardised Coefficients		Standardised Coefficients	t	Sig.
	B	Std. Err.	Beta		
(Constant)	183	150		1.225	.224
DAR_X1	-.324	.258	-.154	-1.256	.212
SIZE_X2	-.125	.277	-.049	-.452	.652
CR_X3	.123	.050	-.301	2.472	.001

a. Dependent Variable: PBV
Source: Primary data were processed using SPSS.

Based on Table 6, which presents the results of the multiple linear regression test, the regression equation can be formulated as follows:

$$\mathrm{PBV} = 183 + 324\mathrm{DAR} + 125\mathrm{UK\text{-}PER} + 123\mathrm{CR} + \mathrm{e} \qquad (1)$$

The regression equation (1) shows a constant value of 0.183. This indicates that when the independent variables (debt policy, firm size, and liquidity) are assumed to be constant, the firm value is 0.183.

The regression coefficient for the independent variable, debt policy, is -0.324. This means that if debt policy increases by one unit, the firm value will decrease by 0.324 units, assuming other variables remain constant. The regression coefficient for the independent variable, firm size, is -0.125. This implies that if firm size increases by one unit, the firm value will decrease by 0.125 units, assuming other variables remain constant. The regression coefficient of the independent variable *liquidity* is 0.123. This indicates that if liquidity increases by one unit, the firm's value will increase by 0.123 units, assuming all other variables remain constant.

4.3. Statistical test t

The t-test is conducted to examine the individual (partial) impact of each independent variable on the dependent variable. The results of the t-test are as follows:

The independent variable debt policy shows a significance value of 0.212 > 0.05 and a t-count of -1.256. Therefore, H_0 is accepted and H_a is rejected, indicating that the debt policy variable has no significant effect on firm value.

The independent variable firm size shows a significance value of 0.652 > 0.05 and a t-count of -0.452. Thus, H_0 is accepted and H_a is rejected, which means that firm size has no significant effect on firm value. Meanwhile, the independent variable liquidity shows a significance value of 0.001 < 0.05 and a t-count of 2.472. Hence, H_0 is rejected and H_a is accepted, suggesting that liquidity has a significant positive effect on firm value.

4.4. F Statistical test

The F-test is used to determine whether there is a simultaneous influence of the independent variables on the dependent variable. The F-test can be conducted using alpha values (α) of 1%, 5%, and 10%.

Table 7

F Statistical test results

ANOVA[a]					
Model 1	Sum of Squares	df	Mean Square	F	Sig.
Regression	3 128 640.973	3	782 160.243	6.652	.000[b]
Residual	9 876 834.557	86	117 581.364		
Total	13 005 475.530	89			

a. Dependent Variable: PBV
b. Predictors: (Constant), LAG_Y, DAR_X1, SIZE_X2, CR_X3
Source: Primary data were processed using SPSS.

Based on Table 7, the F-test results show that the F-count (6.652) is greater than the F-table value (2.71) and the Sig. value (0.000) < 0.05. Therefore, H_0 is rejected and H_a is accepted, indicating that debt policy (X1), firm size (X2), and liquidity (X3) simultaneously have a significant effect on firm value (Y).

4.5. Test Coefficient of Determination (R^2 Test)

The Coefficient of Determination (R^2) can be used as a guideline to determine the extent to which the independent variables explain the variation in the dependent variable.

Table 8

R^2 Test results

Summary[b]					
Model	R	R Square	Adjusted R-Squared	Std. Error of the Estimate	Durbin-Watson
1	.490[a]	.241	.204	342.90139	2.086

a. Predictors: (Constant), LAG_Y, DAR_X1, SIZE_X2, CR_X3
b. Dependent Variable: PBV
Source: Primary data were processed using SPSS.

Based on the results shown in Table 8, the Adjusted R-Square value is 0.204, or 20.4%, indicating that the variables of debt policy, firm size, and liquidity explain 20.4% of the variation in the dependent variable (firm value). The remaining 79.6% is influenced by other variables not included in the model.

5. Discussion

The discussion of this study will elaborate on three findings as stated in the hypotheses.

5.1. Debt Policy Has No Significant Effect on Firm Value

The first finding of this study is that corporate debt exceeds assets in property and real estate firms listed on IDX from 2022 to 2024. This condition implies that debt policy may compromise the firm's quality. It occurs because higher debt levels increase the firm’s risk exposure. Rising debt leads to a decline in firm quality (Manuk, Asfiyah and Febriani, 2024). The higher probability of bankruptcy compared to the benefits of tax savings at a certain debt level can lead to a deterioration in the firm’s quality. This indicates that firms cannot simply maximise the use of debt (Nasution, 2020). Firms that continuously rely on debt face risks, such as a decline in stock prices, although the expected rate of return may increase (Suryani & Melasari, 2023). Firms with high debt levels in their capital structure are considered risky; conversely, firms with very low levels of debt are viewed as unable to utilise external capital growth that could support operational expansion. Therefore, managers must exercise greater caution in determining corporate debt policies (Aras, Persada and Nabella, 2023). The findings of this study suggest that the debt policy variable does not have a significant impact on firm value. These results are consistent with the studies of Shafiq et al. (2023), which also concluded that debt policy has no significant effect on firm value.

5.2. Firm Size Has No Significant Effect on Firm Value

The second finding of this study is that firm size does not drive an increase in firm value. This is because firm size is assessed based on total assets that support the firm’s operational activities, where larger firm size requires greater budgets to finance operations (Lubis et al., 2017). A firm tends to grow larger if it has easier access to funding sources, whether external or internal. A large firm size indicates development and makes it easier to attract investors, thereby potentially increasing firm value (Bandanuji & Khoiruddin, 2020). However, a large firm size may also reduce firm value due to insufficient monitoring of operational activities and strategies implemented by the firm. Nevertheless, larger firms also seek to improve their performance to ensure that investors are not disadvantaged when paying higher prices for their shares (Azharin & Ratnawati, 2022). The size of a firm reflects its capability to bear risks that may arise from various situations faced by the firm (Bon & Hartoko, 2022). The findings of this study reveal that the firm size variable has no significant effect on firm value. These results are consistent with those of Suryani and Melasari (2023), who also concluded that firm size has no significant impact on firm value.

5.3. Liquidity Has a Positive and Significant Effect on Firm Value

The third finding of this study is that current asset activities perform well as they are supported by efficient current liabilities in enhancing firm value. When liquidity increases, firm value also rises, and investors are attracted to firms with strong liquidity levels. Liquidity reflects the firm's ability to meet its obligations and can be used to assess the firm's financial condition and wealth (Nurwulandari, 2021). Firms with high liquidity are able to pay dividends smoothly to investors and provide positive signals that encourage investors to invest in the firm (Markonah et al, 2020). An increase in liquidity indicates that the firm's current assets are also increasing, enabling it to cover short-term debt; moreover, higher current assets suggest to investors that the firm can manage its finances effectively (Sari, 2020). The findings of this study confirm that the liquidity variable has a significant positive effect on firm value. These results are consistent with the study by Anah et al. (2022), which also found that liquidity has a significant and positive influence on firm value.

6. Conclusion

Based on the research results described previously, it can be concluded that during the 2022-2024 period, debt policy has no significant positive effect on the value of firms in the property and real estate sector listed on IDX. Similarly, firm size has no significant positive effect on firm value within the same sector and period. In contrast, liquidity has a significant positive effect on firm value in property and real estate sector firms listed on IDX.

The findings of this study indicate that the large debt incentives are not always effective in increasing firm value. The increased financial risk, dependence on cash flow stability, and negative signal to investors determine this. The first reason mentioned refers to the fact that although the debt can increase returns for shareholders through leverage, the excessive use of debt can increase the risk of bankruptcy, which actually reduces the value of the firm. The second one means that if the firm does not have a stable cash flow to pay interest and principal, debt can be a burden that damages the value of the firm. Moreover, in some cases, increasing debt is considered a signal that the firm lacks internal capital (retained earnings), which can reduce market perception.

Practical implications refer to the following:

(1) Managing financial risk due to high leverage.

- Determining the optimal capital structure involves analysing to determine the most efficient combination of equity and debt (for example, through trade-off theory or pecking order theory analysis).
- Diversification of financing sources to reduce reliance on bank loans, considering alternative options such as bonds, asset-based financing, or equity financing.
- Use of derivatives or insurance to manage interest rate or exchange rate risks that affect debt burdens.
- Monitoring financial ratios, maintaining the debt to equity ratio (DER), interest coverage ratio, and current ratio at a healthy level.

(2) Reducing dependence on stable cash flow.

- Improve cash flow management, use short-term and long-term cash flow projections to ensure sufficient liquidity.
- Match debt term with cash flow, take long-term debt to fund long-term projects, and vice versa.
- Prepare a liquidity reserve fund, set aside emergency funds to pay interest or instalments when cash flow is disrupted.
- Diversify revenue sources, expand product lines or market segments to reduce dependence on one source of revenue.

(3) Avoid negative signals to investors.

- Transparency in communication to investors, openly explain the reasons and strategies for using debt in annual reports or analyst meetings.
- Show projected return on loan funds, provide IRR/ROI estimates of debt-financed projects to show that debt will provide added value.
- Maintain healthy retained earnings, avoid excessive dividend distribution so that retained earnings can cover some of the capital needs.
- Maintain credit reputation, maintain the firm’s credit rating so that investors continue to believe in the firm’s ability to pay obligations.

References

1. Anah, S., Fikra, M., & Widayati, C.C. (2022). The Effect of Profitability, Dividend Policy and Debt Policy on Company Value. *The 4th Social and Humanities Research Symposium (SoRes 2021)*, Bandung, Indonesia, pp. 25–42. https://doi.org/10.2991/assehr.k.220407.119
2. Andayani, N.K.M., & Purbawangsa, I.B.A. (2019). The Role of Profitability in Mediating the Effect of Liquidity, Capital Structure, and Sales Growth on Corporate Value in Manufacturing Companies of the Indonesian Stock Exchange. *Russian Journal of Agricultural and Socio-Economic Sciences*, 95(11), pp. 93–103. https://doi.org/10.18551/rjoas.2019-11.12.
3. Aras, M., Persada, I.N., & Nabella, S.D. (2023). The Influence of Service Quality, Trust, and Facilities on the Decision to Choose SP Hotel Batam. *International Journal of Accounting, Management, Economics and Social Sciences (IJAMESC)*, 1(4), pp. 417–431.
4. Arfan, A. (2022). Pengaruh Profitabilitas, Ukuran Perusahaan, Solvabilitas, Keputusan Investasi Dan Kebijakan Hutang Terhadap Nilai Perusahaan. *Jurakunman (Jurnal Akuntansi dan Manajemen)*, 15(1), pp. 165–178. https://doi.org/10.48042/jurakunman.v15i1.95.
5. Azharin, M.N., & Ratnawati, D. (2022). Pengaruh Kepemilikan Institusional, Kebijakan Dividen dan Kebijakan Hutang Terhadap Nilai Perusahaan. *JESYA (Jurnal Ekonomi dan Ekonomi Syariah)*, 5(2), pp. 1264–1278. https://doi.org/10.36778/jesya.v5i2.726.
6. Bandanuji, A., & Khoiruddin, M. (2020). The Effect of Business Risk and Firm Size on Firm Value with Debt Policy as Intervening Variable. *Management Analysis Journal*, 9(2), pp. 200–210. https://doi.org/10.15294/maj.v9i2.37812.
7. Bentler, P.M., & Bonett, D.G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, 88(3), pp. 588-606. https://doi.org/10.1037/0033-2909.88.3.588
8. Bon, S.F., & Hartoko, S. (2022). The Effect of Dividend Policy, Investment Decision, Leverage, Profitability, and Firm Size on Firm Value. *European Journal of Business and Management Research*, 7(3), pp. 7–13. https://doi.org/10.24018/ejbmr.2022.7.3.1405.
9. Dewantari, N.L.S., Cipta, W., & Susila, G.P.A.J. (2019). Pengaruh Ukuran Perusahaan Dan Leverage Serta Profitabilitas Terhadap Nilai Perusahaan Pada Perusahaan Food and Beverages Di BEI. *Prospek: Jurnal Manajemen dan Bisnis*, 1(2), pp. 74-83. https://doi.org/10.23887/pjmb.v1i2.23157.
10. Geng, L., Cui, X., Nazir, R., & Binh An, N. (2022). How do CSR and perceived ethics enhance corporate reputation and product

innovativeness? *Economic Research-Ekonomska Istraživanja*, 35(1), pp. 5131–5149. https://doi.org/10.1080/1331677X.2021.2023604.

11. Hair, J., Hult, T., Ringle, C., & Sarstedt, M. (2013). A Primer on Partial Least Squares Structural Equation Modelling (PLS-SEM). First Edition. SAGE Publications.
12. Hamzah, A., & Muslim, M. (2022). Several Factors Affecting Firm Value Manufacturing in Indonesia. *Jurnal Akuntansi*, 26(1), pp. 127–141. https://doi.org/10.24912/ja.v26i1.821.
13. Harnovinsah, H., Sopanah, A., Hadijah, Y., Iswari, H.R., Khoiril, M.I., & Saptaria, L. (2023). What Factors Influence a Firm Value? Optimistic Financial Performance. *JMK (Jurnal Manajemen dan Kewirausahaan)*, 8(2), p. 121. https://doi.org/10.32503/jmk.v8i2.3476.
14. Jamiah. (2023). The Effect of Profitability and Liquidity on Company Value: A Case Study of a Banking Company on IDX (2014-2018). *PubBis: Jurnal Pemikiran Dan Penelitian Administrasi Publik Dan Administrasi Bisnis*, 7(2), pp. 148–159. https://doi.org/10.35722/jurnalpubbis.v7i2.785.
15. Jihadi, M., Vilantika, E., Hashemi, S.M., Arifin, Z., Bachtiar, Y., & Sholichah, F. (2021). The Effect of Liquidity, Leverage, and Profitability on Firm Value: Empirical Evidence from Indonesia. The *Journal of Asian Finance, Economics and Business*, 8(3), pp. 423–431. https://doi.org/10.13106/JAFEB.2021.VOL8.NO3.0423.
16. Juliyando, D., & Saputra, A.R.P. (2023). The effect of green transformational leadership on service employees in Indonesia. *International Journal of Service Management and Sustainability (IJSMS)*,8(1), pp. 1–20. https://doi.org/10.24191/ijsms.v8i1.21896.
17. Lesmana, E., Saputra, A.R.P., & Verasari, M. (2024). The Impact of Organisational Citizenship Behaviour Environment: Analysis of Green Work Engagement, Green Transformational Leadership, and Green Human Resource Management on Outsourcing Employees. *JISR Management and Social Sciences & Economics*, 22(4), pp. 21–45. https://doi.org/10.31384/jisrmsse/2024.22.4.2.
18. Lubis, I.L., Sinaga, B.M., & Sasongko, H. (2017). Pengaruh Profitabilitas, Sruktur Modal, Dan Likuiditas Terhadap Nilai Perusahaan. *Jurnal Aplikasi Bisnis dan Manajemen*, 4(2), pp. 87–92. https://doi.org/10.17358/jabm.3.3.458.
19. Lumbanbatu J.M., Muda, I., & Abubakar, E. (2023). The Effect of Profitability, Debt Policy and Dividend Policy on Firm Value with Investment Decisions as a Moderating Variable (Case Study of Manufacturing Companies Listed on the Indonesia Stock Exchange). *International Journal of Research and Review*, 10(1), pp. 324–332. https://doi.org/10.52403/ijrr.20230135.

20. Manuk, N.A.E.P., Asfiyah, N., & Febriani, R. (2024). The Influence of Transformational Leadership on Employee Performance with Readiness to Change as a Mediation Variable. *Jurnal Manajemen Bisnis dan Kewirausahaan*, 4(4), pp. 360–374. https://doi.org/10.22219/jamanika.v4i4.36983.
21. Markonah, M., Salim, A., & Franciska, J. (2020). Effect of Profitability, Leverage, and Liquidity on the Firm Value. *Dinasti International Journal of Economics, Finance & Accounting*, 1(1), pp. 83–94. https://doi.org/10.38035/dijefa.v1i1.225.
22. Monoarfa, R. (2018). The Role of Profitability in Mediating the Effect of Dividend Policy and Company Size on Company Value. *Business and Management Studies*, 4(2), pp. 35–51. https://doi.org/10.11114/bms.v4i2.3274.
23. Nasution, M.S. (2020). Pengaruh Kebijakan Hutang Terhadap Nilai Perusahaan Perbankan Yang Terdaftar di Bursa Efek Indonesia. *Journal of Islamic Accounting Research*, 2(1), pp. 1–16. https://doi.org/10.52490/j-iscan.v2i1.862.
24. Nurwulandari, A. (2021). Effect of Liquidity, Profitability, Firm Size on Firm Value with Capital Structure as Intervening Variable. *Atestasi: Jurnal Ilmiah Akuntansi*, 4(2), pp. 257–271. https://doi.org/10.57178/atestasi.v4i2.271.
25. Rahmadani, Y., Saputra, A.R.P., & Abdullah, S.M. (2025). Green Transformational Leadership, Organizational Commitment and Green Human Resource Management on Green Innovation Performance at the Government Sector. *Journal of Human Resource Management - HR Advances and Developments*, 28(1), pp. 49–61. https://doi.org/10.46287/hvuh5474.
26. Rubach, C., Dicke, A.-L., Safavian, N., & Eccles, J.S. (2023). Classroom transmission processes between teacher support, interest value and negative affect: An investigation guided by situated expectancy-value theory and control-value theory. *Motivation and Emotion*, 47. pp. 575–594. https://doi.org/10.1007/s11031-023-10013-6.
27. Saini, G., Jena, L.K., Gupta, S., & Mahale, G. (2025). Understanding green behaviours through the lens of self-determination theory. *Measuring Business Excellence*, 29(1), pp. 76–96. https://doi.org/10.1108/MBE-07-2024-0110
28. Sari, I.A.G.D.M., & Sedana, I.B.P. (2020). Profitability and liquidity on firm value and capital structure as intervening variable. *International Research Journal of Management, IT and Social Sciences*, 7(1), pp. 116–127. https://doi.org/10.21744/irjmis.v7n1.828.

29. Shafiq, M.A., Iqbal, S., Kumar, N., & Khan, F.A. (2023). Corporate Social Responsibility and Brand Loyalty in Punjab's Banking Sector: Exploring the Mediating Role of Corporate Branding. *Pakistan Journal of Humanities and Social Sciences*, 11(2), pp. 853–863. https://doi.org/10.52131/pjhss.2023.1102.0397.
30. Shyju, P.J., Singh, K., Kokkranikal, J., Bharadwaj, R., Rai, S., & Antony, J. (2021). Service Quality and Customer Satisfaction in Hospitality, Leisure, Sport and Tourism: An Assessment of Research in Web of Science. *Journal of Quality Assurance in Hospitality & Tourism*, 24(1), pp. 24–50. https://doi.org/10.1080/1528008X.2021.2012735
31. Silviatun, R. & Saputra, A.R.P. (2024). The Influence Greening of Organizational Culture, Work Environment, and Work Discipline on Green Employee Performance. *Revue africaine de management - African Management Review*, 11(1), pp. 68-82. DOI: https://doi.org/10.48424/IMIST.PRSM/ram-v11i1.48374
32. Suryani. & Melasari, R. (2023). The Effect of Debt Policy and Dividend Policy on Company Value with Company Size as a Moderation Variable. *MANKEU (Jurnal Manajemen Keuangan)*, 1(2), pp. 128–148. https://doi.org/10.61167/mnk.v1i2.46.

Financial Studies

“Victor Slăvescu” Centre for Financial and Monetary Research
Casa Academiei 13, Calea 13 Septembrie, Building B, 5th floor
Bucharest, 050711, Romania
Phone: +40 21.318.24.19
E-mail: s.vraciu@icfm.ro