LONG-RUN DYNAMICS OF REGIONAL COMPETITIVENES IN FINANCIAL AND INSURANCE ACTIVITIES

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Abstract:

In order to analyse the long-term economic evolution, we started from the hypothesis that, at regional level, the ability of the economic sectors to support their own development and the evolution of productivity are relevant indicators for sectoral competitiveness. To this end we tested for 104 Union European regions (NUTS-1 level) the extent to which the regional efforts to support research activities cause the development processes in the financial and insurance activities. As a methodology, we used unit root tests in panel, dynamic panel analysis, and cointegration models. We have identified a stable long-term relationship between productivity and the dynamics of research activities, and also that the increase in productivity in financial and insurance activities exceeds, on average, the overall increase in productivity at the regional level.

Keywords: *regional productivity, financial and insurance activities, dynamic panel analysis, cointegration models.*

JEL Classification: C23, C58, R11.

Introduction

According to the European Commission definition, "regional competitiveness is the ability of a region to offer an attractive and sustainable environment for firms and residents to live and work." (Annoni & Dijkstra, 2019, p. 3). For analysing the long-term economic development, we started from the hypothesis that, at regional level, the ability of the economic sectors to support their own development and the evolution of productivity are relevant indicators for sectoral competitiveness. This approach comes near to the World Economic Forum concept, according to which competitiveness is defined as "the set of institutions, policies and factors that determine the level of productivity" (Schwab & Sala-i-Martín, 2017, p. ix).

On the other hand, in literature, it is widely recognised that "high quality human resources are fundamental to national development and related technological and economic growth" (Chou & Chang, 2008, p. 224) and "the economic growth of a country is influenced by the state of human resources in science and technology" (Achelia, Asmara, Akbar, & Tasrif, 2017, p. 494). In this framework, we analysed the relationships between *the human resources employed in science and technology in financial and insurance activities* and the development of these activities in European NUTS-1 regions.

1. Data and Methodology

We used the annual data regarding the regional gross value added, employment and human resources employed in science and technology. The analysed data refer, on the one hand, to all the activities carried out at regional level and, on the other hand, to f*inancial and insurance activities*. The data are from Eurostat, cover the European NUTS-1 regions, over the period between 2000-2018.

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Table 1:

Sources of data

o.	*Regional Series*	*ymbol*	*Source: Eurostat*
.	Gross Value Added	VA	"Gross value added at basic prices by NUTS 3 regions" [nama_10r_3gva], Million euro, NACE_R2 (2000-2017)
.	Gross Value Added in *Financial and insurance activities*	IA_GVA	
.	Employment	MP	"Employment (thousand persons) by NUTS 3 regions" [nama_10r_3empers], NACE_R2 (2000-2017)
.	Employment persons in *Financial and insurance activities*	IA_EMP	
.	Persons employed in science and technology	RST	"Employed HRST by category, NACE Rev. 1.1 activity and NUTS 1 regions (1999 - 2018)" [hrst_st_rsec] and "Employed HRST by category, NACE Rev. 2 activity and NUTS 1 regions (from 2008 onwards)" [hrst_st_rsec2], thousand persons (1999-2018)
.	Persons employed in science and technology in *Financial and insurance activities*	IA_HRST	

As a methodology, we used unit root tests in panel, Granger causality tests, dynamic panel analysis and cointegration tests.

The regional series are generated by non-stationary processes, but they have stationary dynamics. Unit root tests for the data series, for the differenced series, and for the rate of change are presented in *Annex 1*.

In the models we used the following definitions:

The symbol …	means …
$(FIA\_W)_{it} = \left(\frac{FIA\_GVA}{FIA\_EMP}\right)_{it}$	Productivity (W) in Financial and Insurance Activities (FIA), region *i*, year *t*
$W_{it} = \left(\frac{GVA}{EMP}\right)_{it}$	Global Productivity (all economic activities) in region *i*, year *t*
FIA	Regional financial and insurance activities
GVA	Regional gross value added
EMP	Regional employed persons
HRST	Regional persons employed in science and technology

2.Human resources employed in science and technology and the dynamics of financial and insurance activities

2.1. Regional gross value added in financial and insurance activities

To analyze the impact of human resources employed in science and technology (HRST) on regional gross value added in financial and insurance activities (FIA_GVA), we have built a panel data model as follows:

$r(FIA\_GVA_{it}) = a_0 + a_1 r(FIA\_HRST_{it}) + a_2 r(GVA_{it}) + \mu_i + \delta_t + e_{it}$,

where

- ✓$r(GVA_{it})$ denotes the growth rate of gross value added for region *i*, year *t* (for all the economic activities);
- ✓$r(FIA\_GVA_{it})$ means the growth rate of gross value added (GVA) in financial and insurance activities, for region *i*, year *t*;
- ✓$r(FIA\_HRST_{it})$ signifies the dynamics of human resources employed in science and technology, in financial and insurance activities, for region *i*, year *t*;
- ✓μ_i assesses for the regional-specific (fixed or random) effects (the particularities of each region)
- ✓δ_t specific (fixed or random) time effects (the particularities of each year);
- ✓e_{it} is the idiosyncratic errors variable (which varies across time and regions).

The model coefficients have the following significance:

- ✓a_0 is a dimensional coefficient,
- ✓a_1 evaluates the impact of employment in S&T [r(FIA_HRST)] on the dynamics of gross value added in FIA
- ✓a_2 estimates the impact of the general conditions related to regional economic dynamics [r(GVA)] on the gross added value of the FIA.

The output of the panel data model is the following:

$$r(FIA\_GVA_{it}) = \underset{[2.060]}{0.0181} \cdot r(FIA\_HRST_{it}) + \underset{[25.365]}{0.9231} \cdot r(GVA_{it}) + \delta_t + u_{it}$$

(under estimators, in bracket, t-statistic). In regression equation, u_{it} is the residual variable. The coefficients that evaluate the connection between gross value added growth out of financial and insurance activities [r(FIA_GVA)] and the dynamics of human resources employed in science and technology, in the same activities [r(FIA_HRST)], respectively the regional gross value added growth for all economic activities [r(GVA)] are significantly different from zero: for a_1, $p(H_0) < 0.02$, and for a_2, $p(H_0) < 0.01$. The model, without specific (regional) individual effects, but with specific (fixed) time effects, is significant. The F-stat associated with the hypothesis of redundancy (for fixed time effects) is F(18,1186) = 8.66, with prob(F) < 0.01%.

The model explains 44% of the total variation of the "gross value added in financial and insurance activities" from its mean (R2 = 0.4365) and is significant as a whole: F-statistic = 339.2, so the probability of null hypothesis (H_0: all the coefficients are zero) is almost zero.

The regional gross value-added growth in financial and insurance activities is positively influenced by the dynamics of human efforts made for the development of research activities and for the activities related to technology advance (marginal impact is $\hat{a}_1 = 0.018$). The dynamics of activities in FIA follows the overall evolution of regional economic activities, with a sub-unitary (but close to one) coefficient of marginal impact ($\hat{a}_2 = 0.923$).

2.2. The regional productivity in financial and insurance activities

We analyze the regional impact of human resources employed in science and technology on productivity in "financial and insurance activities", where the productivity was measured as ratio between gross value added (FIA_GVA_{it}) and employment (FIA_EMP_{it}) in the respective sector (thousand euro/persons, *i* is an index of region and *t* – time). Regional series that measure productivity for all the economic activities (W) are not stationary. If the series are calculated in the first difference, or as annual change rates, then the probabilities attached to the unit root hypotheses in the panel (common or individual) are almost zero, for all standard tests. We assume, therefore, that the stochastic processes that generate the series of regional productivity is I(1) but the dynamic series (calculated both in first difference and as annual change rates) are stationary. The series that estimate productivity in "financial and insurance activities" (FIA_W) are stationary. The nature of the series, analysed by the panel unit root tests is presented in *Annex 1*.

a. The causality relationships

Regional series on "human resources employed in science and technology, in financial and insurance activities" (FIA_HRST) and regional productivity for all the economic activities (W) are not stationary. The series productivity in "financial and insurance activities" (FIA_W) is stationary. We therefore apply the Toda-Yamamoto version of the Granger causality test. For $p_{max} = 11$, lag order selected by all the usual criterion is p = 9. The application of the Granger causality test (Toda-Yamamoto version) for the VAR(9) model leads to the following results:

Table 2. Granger causality test (Toda-Yamamoto version)

Null Hypothesis:	Chi-sq	df	Prob.
FIA_HRSTdoes not Granger CauseFIA_W	9.760	9	0.3703
Wdoes not Granger CauseFIA_W	66.162	9	0.0000

Source: VAR Granger Causality/Block Exogeneity Wald Tests in EViews, based on Eurostat data (see Table 1). Sample:1995 2017. Included observations: 474.

The Granger causality test (Toda-Yamamoto version for nonstationary series) *does not* reject, at conventional significance levels, the null hypothesis that human resources employed in science and technology, in regional financial and insurance activities (FIA-HRST) *does not* cause the regional productivity from these activities (FIA_W). If we reject the non-causality hypothesis, the risk of error is 37%, higher than the standard 5% threshold. Instead, the test rejects a non-causal hypothesis regarding the relationship between productivity at the all regional economic activities (W) and productivity in the "financial and insurance activities" (FIA_W).

The series "regional productivity growth" for all the activities [r(W)] and for financial and insurance activities [r(FIA_W)] as well as "human resources employed in science and technology, in regional financial and insurance activities" [r(FIA_HRST)] are stationary. This means that, for the analysis of the intercorrelations between the transformed variables, the standard Granger causality test can be applied. First, we select lag = 4 in VAR model (see *Annex 2*). The Granger causality test for the VAR(4) model leads to the following results:

Table 3. Granger causality test for the VAR(4) with the dynamics of variables

Null Hypothesis:	^{2}	f	rob.
r(FIA_HRST) does not Granger Cause r(FIA_W)	.2974		.1780
r(W) does not Granger Cause r(FIA_W)	9.0762		.0000

Source: VAR Granger Causality/Block Exogeneity Wald Tests in EViews, based on Eurostat data (see Table 1). Sample (adjusted): 1995 2016. Observation included: 845.

Regional data *do not reject*, at conventional significance levels, the null hypothesis that the annual growth rate of human resources employed in science and technology [r(FIA_HRST)] *does not*

cause the growth of productivity in financial and insurance activities [r(FIA_W)]. If we reject the non-causality hypothesis, the error risk (0.178) is higher than the conventional significance levels of 0.05. Instead, the test suggests a causal relationship from the growth rate of productivity at the regional level [r(W)] to the [r(FIA_W)] – increase rate of productivity in financial and insurance activities (the probability attached to the null hypothesis of non-causality is almost zero).

b. The Dynamic Panel Data

Since the series "regional productivity growth" for all the activities [r(W)] and for financial and insurance activities [r(FIA_W)] as well as "human resources employed in science and technology, in regional financial and insurance activities [r(FIA_HRST)] are stationary and the Granger causality tests do not reject all the interrelations between these variables, we run a Dynamic Panel Data model. These models are designed for panels with a large number of cross-sections and a short time series (Arellano & Bond, 1991)

Table 4. Dynamic Panel Data Model

Dependent variable: r(FIA_W) – regional productivity growth in "financial and insurance activities"

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$r(FIA\_W_{t-1})$	-0.057899	0.003274	-17.68229	0.0000
r(FIA_HRST)	0.037807	0.000472	80.07144	0.0000
r(W)	0.783349	0.001415	553.4193	0.0000

Method: Panel Generalized Method of Moments. Transformation: first differences
Sample (adjusted): 2001 2017, cross-sections included: 75, total panel observations: 1022
White period instrument weighting matrix.
Instrument specification: @din(FIA_W, -2). Constant added to instrument list
Arellano-Bond Serial Correlation Test: AR(1) = -5.511 (prob. = 0.000), AR(2) = 1.398 (prob.=0.162)

Source: EViews, based on Eurostat data (*see* Table 1)

In the model, all the coefficients are significant at conventional levels (1%). The coefficient of AR(1) in Arellano-Bond test is significant and negative, and AR(2) is insignificant, which means that the errors (innovations) are not correlated. Moreover, the J-test for over-identifying restrictions has an associated prob(J-statistic) = 0.2429 > 0.05.

According to the results from previous table, the productivity dynamics in "financial and insurance activities" [r(FIA_W)] is subject to a weak inertial negative effect and the increase of global productivity at the regional level [r(W)] was largely transferred on the productivity of the financial and insurance services. The growth of "human resources employed in science and technology, in regional financial and insurance activities" [r(FIA-HRST)] was slightly positively correlated with the productivity in "financial and insurance activities" [r(FIA_HRST)].

c. The long-term relationship (cointegration)

We test for a long-term relationship (cointegration) between productivity in financial and insurance activities (FIA_W), human resources employed in science and technology, in regional financial and insurance activities (FIA-HRST) and regional productivity – all the economic activities (W). Seven out of 11 Pedroni Residual Cointegration Tests reject the Null Hypothesis of no cointegration (included observations: 2730; cross-sections included: 75 (30 dropped); no deterministic intercept or trend). The tests are detailed in *Annex 3*.

The results of estimating the cointegration relationship are as follows:

$$(FIA\_W)_{it} = \underset{[2.076]}{0.400713} \cdot (FIA\_HRST)_{it} + \underset{[318.052]}{2.075559} \cdot W_{it}\ ,\ R^2 = 0.9289$$

Note: t-statistic in [.]; Method: Panel Fully Modified Least Squares (FMOLS), periods included: 18 (2000-2017), regions included: 75; total panel (unbalanced) observations: 1157; panel method: weighted estimation; cointegrating equation deterministic: C

The long-term equilibrium relationship between regional *Productivity in Financial and Insurance Activities* (FIA_W) and *Persons employed in science and technology in FIA* (FIA_HRST) is positive and significantly different from zero (0.40): At the regional level, efforts to develop scientific

activities and those that generate technological progress are associated with an increase in efficiency in *Financial and insurance activities*.

The coefficient that associates the dynamics of *regional productivity in financial and insurance activities* with *global regional productivity (all NACE activities)* is greater than two (2.076). Given that the variables are expressed in the same unit (percentages), this means that the increase in regional productivity in financial and insurance activities exceeds about twice, on average, the regional increase in productivity, all NACE activities.

Table 5. Regional productivity

	All NACE activities (W)	Financial and insurance activities (FIA_W)
Mean	48.07206	87.32256
Median	50.62326	86.15721
Maximum	122.8619	298.1374
Minimum	2.445763	7.576440
Std. Dev.	20.78572	43.09719
Common observations	1287	

Source: EViews, based on Eurostat data (*see* Table 1)

Furthermore, statistical calculations confirm the results of the cointegration analysis: the main characteristics of the distribution of series "Regional productivity in Financial and insurance activities" (e.g. mean, media, maximum and minimum values, even standard distribution) are about twice as large as the corresponding features of the series "Regional productivity, all NACE activities" (see table 6).

Conclusions

The regional gross value-added growth, in FIA (financial and insurance activities), is positively influenced by the dynamics of human efforts made for the development of research activities and for the activities related to technology advance. The dynamics of FIA follows the overall evolution of regional economic activities, with a sub-unitary (but close to one) coefficient of marginal impact (0.923).

The Granger causality test (Toda-Yamamoto version for nonstationary variables) do not reject at conventional significance levels the null hypothesis that HRST (human resources employed in science and technology) in FIA *does not* cause the regional productivity from these activities. Instead, the test rejects a non-causal hypothesis regarding the relationship between *regional productivity* (all NACE activities) and *regional productivity in FIA*.

If we analyse the annual growth rates, regional data *do not reject* the null hypothesis of non-causality between the increase in *human resources employed in science and technology* and the growth of *regional productivity in financial and insurance activities*. Instead, the test suggests a causal relationship from the growth rate of *regional productivity* (all activities) with the increase rate of *productivity in financial and insurance activities*.

According to the results from the Dynamic Panel Model (Arellno-Bond methodology), the dynamics of productivity in "financial and insurance activities" is subject to a weak inertial negative effect and the increase of productivity at the regional level (all activities) was largely transferred on the productivity of the FIA. Furthermore, the growth rate of "human resources employed in science and technology in regional financial and insurance activities" was slightly positively correlated with the productivity in "financial and insurance activities".

We also tested for a long-term relationship (cointegration) between productivity in FIA, HRST in regional FIA and regional productivity – all the economic activities. We found that the long-term equilibrium relationship between regional *productivity in* FIA and HRST is positive and significantly different from zero, which means that the efforts to develop scientific activities are associated with an increase in efficiency in *financial and insurance activities*.

The coefficient that associates the dynamics of *regional productivity in financial and insurance activities* with *global regional productivity (all NACE activities)* is greater than two (2.076). Given that the variables are expressed in the same unit (percentages), this means that the increase in regional productivity in financial and insurance activities exceeds about twice, on average, the regional increase in productivity, all NACE activities.

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Annex 1. Unit Root Tests for regional panel data series

For all the tests:

1. The list of European Regions is for Eurostat, Database, *Regional statistics by NUTS classification*, https://ec.europa.eu/eurostat/data/database.

2. Exogenous variables: individual (regional) effects.

3. Automatic lag length selection based on SIC

For all the tables: *Source*: EViews, based on Eurostat data (*see* Table 1)

A1.1. Panel Unit Root Tests for "Regional Gross Value Added"

a. Regional Gross value added – total, all NACE activities

Sample: 2000 2017

Method	level		1st difference		annual growth rate	
	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
Null: Unit root (assumes common unit root process)						
Levin, Lin & Chu t*	1.96522	0.9753	-17.0443	0.0000	-16.4374	0.0000
Null: Unit root (assumes individual unit root process)						
Im, Pesaran and Shin W-stat	8.16121	1.0000	-14.6725	0.0000	-14.8510	0.0000
ADF - Fisher Chi-square	111.536	0.9999	515.270	0.0000	518.049	0.0000
PP - Fisher Chi-square	122.415	0.9989	568.270	0.0000	797.390	0.0000

The tests suggest that the series "regional gross value added – total, all NACE activities" are I(1) - stationary in differences, and the dynamics is a stationary series.

b. Regional Gross value added in Financial and insurance activities

Sample: 2000 2017

Method	level		1st difference		annual growth rate	
	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
Null: Unit root (assumes common unit root process)						
Levin, Lin & Chu t*	-5.49461	0.0000	-20.6216	0.0000	-19.9097	0.0000
Null: Unit root (assumes individual unit root process)						
Im, Pesaran and Shin W-stat	-2.39235	0.0084	-17.1241	0.0000	-16.6998	0.0000
ADF - Fisher Chi-square	213.406	0.0022	580.054	0.0000	570.684	0.0000
PP - Fisher Chi-square	150.262	0.6572	593.276	0.0000	593.367	0.0000

The tests suggest that the series "regional gross value added in financial and insurance activities" are I(1) - stationary in differences, and the dynamics is a stationary series.

A1.2. Panel Unit Root Tests for "Regional Employment"

a. Regional Employment – total, all NACE activities

Sample: 2000 2018

Method	level		1st difference		annual growth rate	
	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
Null: Unit root (assumes common unit root process)						
Levin, Lin & Chu t*	5.10454	1.0000	-12.6830	0.0000	-16.5089	0.0000
Null: Unit root (assumes individual unit root process)						
Im, Pesaran and Shin W-stat	5.47379	1.0000	-10.6091	0.0000	-17.0190	0.0000
ADF - Fisher Chi-square	169.699	0.2483	389.014	0.0000	597.787	0.0000
PP - Fisher Chi-square	115.801	0.9952	361.298	0.0000	628.018	0.0000

The tests suggest that the series "regional employment – total all NACE activities" are I(1) - stationary in differences, and the dynamics is a stationary series.

b. Regional Employment persons in Financial and insurance activities

Sample: 2000 2018

Method	level		1st difference		annual growth rate	
	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
Null: Unit root (assumes common unit root process)						
Levin, Lin & Chu t*	-5.49461	0.0000	-20.6216	0.0000	-19.9097	0.0000
Null: Unit root (assumes individual unit root process)						
Im, Pesaran and Shin W-stat	-2.39235	0.0084	-17.1241	0.0000	-16.6998	0.0000
ADF - Fisher Chi-square	213.406	0.0022	580.054	0.0000	570.684	0.0000
PP - Fisher Chi-square	150.262	0.6572	593.276	0.0000	593.367	0.0000

The tests suggest that the series "regional employment in financial and insurance activities" are I(1) - stationary in differences, and the dynamics is a stationary series.

A1.3. Panel Unit Root Tests for "Regional Productivity"

a. Regional Productivity, all NACE activities

Sample: 2000 2017

Method	level		1st difference		annual growth rate	
	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
Null: Unit root (assumes common unit root process)						
Levin, Lin & Chu t*	-6.41317	0.0000	-22.7262	0.0000	-20.5476	0.0000
Null: Unit root (assumes individual unit root process)						
Im, Pesaran and Shin W-stat	2.94486	0.9984	-18.6322	0.0000	-16.6744	0.0000
ADF - Fisher Chi-square	155.683	0.5372	632.655	0.0000	576.165	0.0000
PP - Fisher Chi-square	381.165	0.0000	702.787	0.0000	680.662	0.0000

The tests suggest that the series "regional productivity, all NACE activities" are I(1) - stationary in differences, and the dynamics is a stationary series.

b. Regional Productivity in Financial and insurance activities

Sample: 2000 2017

Method	level		annual growth rate	
	Statistic	Prob.	Statistic	Prob.
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.93110	0.0000	-27.6317	0.0000
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.23052	0.0129	-22.3193	0.0000
ADF - Fisher Chi-square	205.876	0.0063	722.246	0.0000
PP - Fisher Chi-square	188.768	0.0478	782.988	0.0000

The tests suggest that the series is I (0) - stationary in differences.

A1.4. Panel Unit Root Tests for "Regional Human Resources in Science and Technology Activities"

a. Persons employed in science and technology – total, all NACE activities

Sample: 1999 2018

Method	level		1st difference		annual growth rate	
	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
Null: Unit root (assumes common unit root process)						
Levin, Lin & Chu t*	2.95413	0.9984	-32.4732	0.0000	-34.3210	0.0000
Null: Unit root (assumes individual unit root process)						
Im, Pesaran and Shin W-stat	10.2340	1.0000	-29.8544	0.0000	-31.2198	0.0000
ADF - Fisher Chi-square	118.512	1.0000	1158.35	0.0000	1225.66	0.0000
PP - Fisher Chi-square	122.645	1.0000	1541.24	0.0000	2354.41	0.0000

The tests suggest that the series "persons employed in science and technology – total, all NACE activities" are I(1) - stationary in differences, and the dynamics is a stationary series.

b. Persons employed in science and technology in Financial and insurance activities

Sample: 1999 2018

Method	level		1st difference		annual growth rate	
	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
Null: Unit root (assumes common unit root process)						
Levin, Lin & Chu t*	-6.12516	0.0000	-32.8356	0.0000	-34.5162	0.0000
Null: Unit root (assumes individual unit root process)						
Im, Pesaran and Shin W-stat	-1.15930	0.1232	-29.3165	0.0000	-30.7005	0.0000
ADF - Fisher Chi-square	250.541	0.0068	1109.49	0.0000	1155.37	0.0000
PP - Fisher Chi-square	234.196	0.0399	1745.40	0.0000	1827.74	0.0000

The tests suggest that the series "persons employed in science and technology in financial and insurance activities" are I(1) - stationary in differences, and the dynamics is a stationary series.

Annex 2. VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria
Endogenous variables: r(FIA_W) r(FIA_HRST) r(W)
Exogenous variables: C
Sample: 2000 2017. Included observations: 621

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1825.528	NA	5.67e-07	-5.869656	-5.848249	-5.861336
1	1849.076	46.79160	5.41e-07	-5.916508	-5.830878	-5.883226
2	1884.026	69.11177	4.97e-07	-6.000082	-5.850230	-5.941838
3	1895.131	21.85354	4.94e-07	-6.006864	-5.792790	-5.923658
4	1944.283	96.2462*	4.3e-07*	-6.13618*	-5.85788*	-6.02801*
5	1951.617	14.28909	4.37e-07	-6.130811	-5.788292	-5.997681
6	1959.817	15.89930	4.38e-07	-6.128236	-5.721495	-5.970145
7	1965.889	11.71247	4.42e-07	-6.118804	-5.647841	-5.935751

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: calculations in EViews, based on Eurostat data (*see* Table 1)

Annex 3. The cointegration relationship

The cointegration relationship between "productivity in financial and insurance activities", "human resources employed in science and technology" and "global regional productivity"

Alternative hypothesis: common AR coefs. (within-dimension)

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	1.796400	0.0362	0.208334	0.4175
Panel rho-Statistic	-1.010849	0.1560	-1.257948	0.1042
Panel PP-Statistic	-4.090680	0.0000	-4.801697	0.0000
Panel ADF-Statistic	-2.566487	0.0051	-3.102125	0.0010

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	1.864076	0.9688
Group PP-Statistic	-6.504420	0.0000
Group ADF-Statistic	-3.172324	0.0008

Source: Pedroni Residual Cointegration Test in EViews, series FIA_W, FIA_HRST and W, based on Eurostat data (*see* Table 1)

Likewise, Kao Residual Cointegration Test reject the Null Hypothesis of no cointegration (the associated probability is 0.0001).