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Abstract

Following the EU enlargements in the decade of 2000s, the economic significance of many eastern European Countries (EECs) was raised compared to southern EU countries, which still enjoy higher levels of development and standards of living. The phenomenon was aggravated from the worsened economic performance of the latter since the beginning of the crisis, resulting in a halt of their convergence process. This paper examines the basic factors underlying differences in growth paths between the eastern and the southern periphery of Europe through a country-level panel data econometric analysis. We identify the core variables determining economic growth for European countries and we conclude that differences in the economic performance between eastern and southern EU countries result from the different levels of their corresponding growth-driving variables.

Key words: growth differences in EU countries, shift of economic dynamism, panel data, fixed effects, random effects, Arellano-Bond.

JEL code: B, O

1. Introduction

With the EU enlargement towards eastern European countries from the decade of 2000s, the new division between 'West' and 'East' replaced the North-South division which traditionally expressed the core-periphery pattern within the EU. Yet, the eastern group of countries has shown remarkable dynamism over the years and resilience during the years of crisis, reflected in higher growth rates and values in a number of economic indicators in comparison to the EU average and the southern group. Thus, despite the historic similarities among the two groups of countries, mainly found in the structural weaknesses of their economies, the greater effort on the part of eastern Member States to adjust their model of governance to European average standards - long before their EU accession and since the period of their transition to the market economy - must have influenced positively their future paths (see for example, Samary 2011 and Caraveli 2016, 2017).

This development was assisted by the higher transfers of money from the European Commission to tackle the low development levels of Eastern Member States (EMS). In addition, the already established single market which the new Member States found in 2004 placed them in a privileged position compared to the southern group at the time of its entrance. At the same time, the combined effect of structural deficiencies and high debt levels in the countries of the southern periphery resulted in the much lower growth rates and a halt in their convergence process, i.e. divergence from the EU average.

This paper identifies the basic factors underlying differences in growth paths between the eastern and the southern periphery of Europe. To our knowledge, very few studies have dealt with the specific topic (see for example, Pascariu and Frunza 2011 and Caraveli 2016, 2017) though the determinants of growth of EECs have been often a topic of research and empirical investigation (see for example, Samary 2011, Pascariu and Frunza 2011, Rozmahel et al. 2013, Podkaminer 2013, Lessenski, 2014). In the second section, we conduct a descriptive statistics analysis, illustrating the different average levels and trends for a set of variables between eastern and southern EU countries. This analysis highlights the differences in the path of a series of variables, which will later be shown

to be the core determining factors of all Member States' positive or negative growth. These include a set of macroeconomic variables, as well as education, innovation and a proxy of economy-openness. In the third section, we conduct country-level regression analysis using fixed effects, random effects and the Arellano and Bond 1991 estimator to establish the determining role of the variables presented in the second section for the economic growth path of EU countries. The last section concludes by summarizing the empirical findings and assessing their significance in the context of the EU core-periphery pattern.

2. Qualitative analysis

In the present section, we classify all EU-28 countries according to their geographic location as eastern, southern or western-central. The eastern Members' group consists of Bulgaria, Czech Republic, Estonia, Croatia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia and Slovakia. The southern Members' group consists of Greece, Spain, Italy, Cyprus, Malta and Portugal. And the central Members' group consists of the rest of the EU countries. [2]

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[2] All the series presented in the current section and the section with the econometric analysis were obtained from Eurostat, with the exception of the FDI series, which was obtained from OECD. Appendix 1 contains a brief description of the series used.

Figure 1: GDP per capita in PPS, 2016 (EU-28=100)
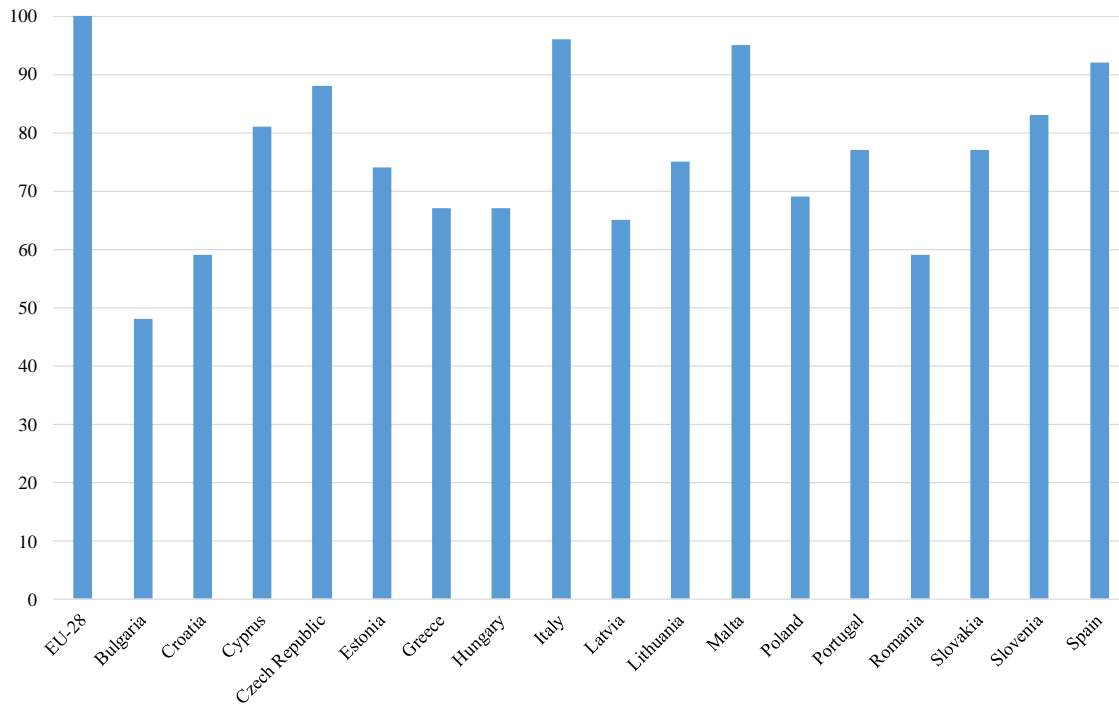
Figure 1 compares GDP per capita (in PPS) as a percentage of the EU average for the six southern and the eleven eastern Member States for year 2016. While overall, the eastern group shows relatively lower levels of development, a number of countries show higher values than Greece and Portugal (both of which were severely hit by the economic crisis). On average though, it is clear that southern countries display a higher mean GDP per capita as a percentage of the EU average compared to the eastern countries.

The growth process in the two groups of countries, measured by the trend in GDP per capita (in chain linked volumes), from 2000 to 2016, is shown in *figure 2*.

Figure 2: GDP per capita (in thousand euros, chain linked volumes, 2010)

Southern Member States

Greece — Spain — Italy — Cyprus — Malta — Portugal

Source: Own representation based on Eurostat data.

Eastern Member States

Bulgaria — Czech Republic — Estonia
Croatia — Latvia — Lithuania
Hungary — Poland — Romania
Slovenia — Slovakia
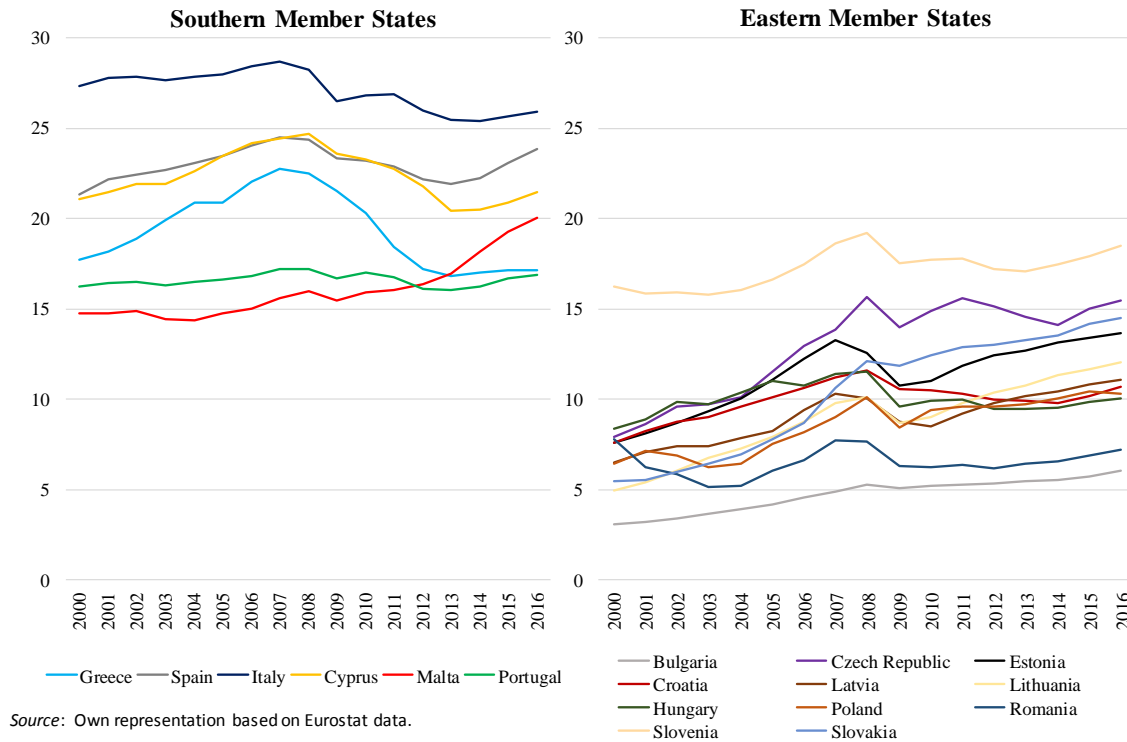
A rising trend is evident in the eastern group denoting a 'catching-up' process with the EU average. A more or less constant overall trend is observed for most countries of the southern group, denoting stagnant growth, with some countries showing a marked falling trend since about 2008 (notably Greece) when the crisis struck European countries.

As growth usually takes place in a few dynamic regions in each country, *figure 3* shows the trends in the wealthiest regions of the same Member States. These trends reveal an increasing divergence among leading regions and the rest, showing that growth in eastern EU Member States is taking place at the expense of internal cohesion.

Figure 3: Regional GDP per capita (in thousand euros, chain linked volumes, 2010)

Wealthiest southern regions

Attiki (EL)
Comunidad de Madrid (ES)
Provincia Autonoma di Bolzano/Bozen (IT)
Kypros (CY)
Malta (MT)
Área Metropolitana de Lisboa (PT)

Source: Own calculations and representation based on Eurostat data.

Wealthiest eastern regions

Yugozapaden (BG)   Praha (CZ)
Eesti (EE)   Kontinentalna Hrvatska (HR)
Latvija (LV)   Lietuva (LT)
Közép-Magyarország (HU)   Mazowieckie (PL)
Bucuresti - Ilfov (RO)   Zahodna Slovenija (SI)
Bratislavský kraj (SK)

Assuming that labor productivity (measured by the compensation per employee in PPS) is an important determinant of GDP growth, *figures 4* and *5* show the same trends in this variable for countries and their wealthiest regions, respectively (see also Caraveli 2017).

Figure 4: Labor productivity (in thousand euros)

Southern Member States — Eastern Member States

GDP per person employed
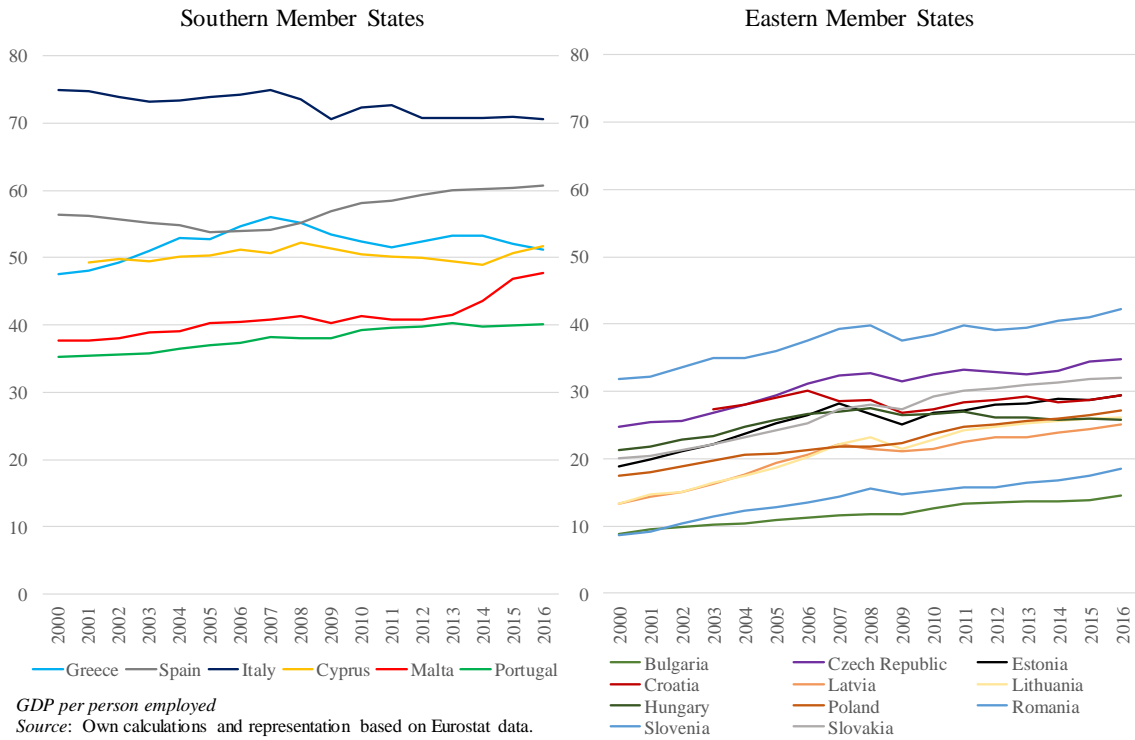*Source*: Own calculations and representation based on Eurostat data.

Figure 5: Regional labor productivity (in thousand euros)

Wealthiest southern regions — Wealthiest eastern regions

Regional GDP per person employed.
Missing values for Kontinentalna Hrvatska (HR) and Zahodna Slovenija (SI).
Source: Own caluculations and representation based on Eurostat data.
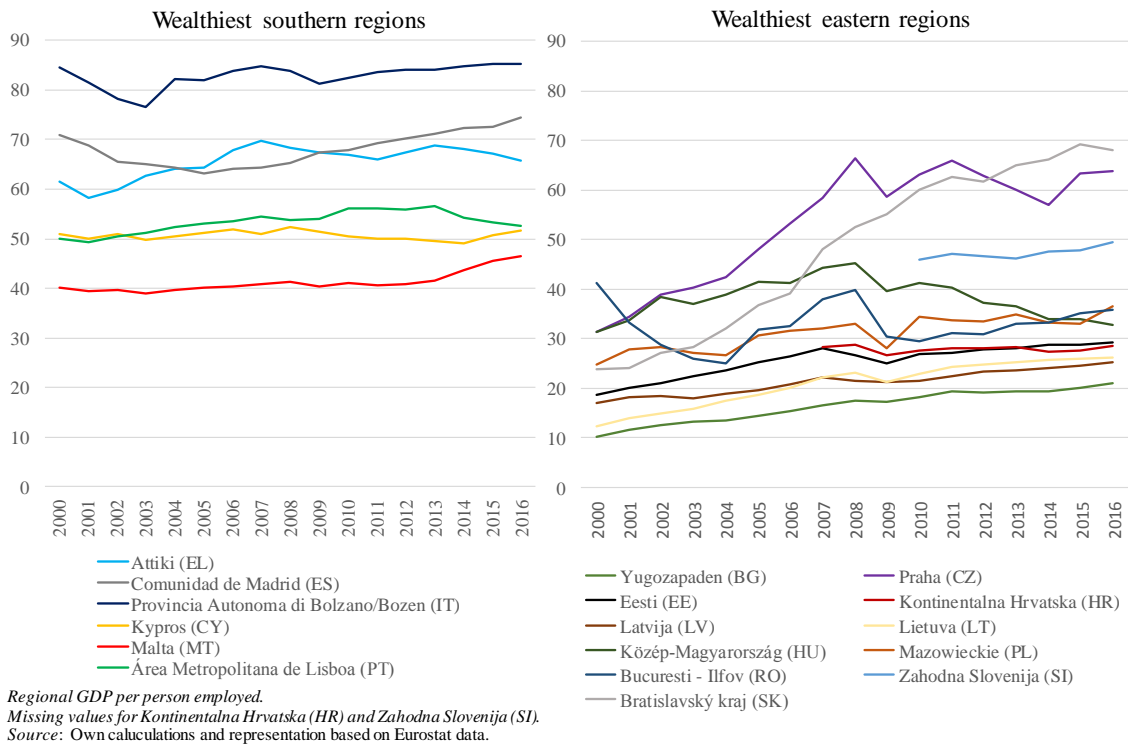
Figures 6 and *7* reveal the significance of cohesion policy funding in both the previous programming period (2007-13) and the current period (2014-20) for the economic performance of certain EECs (most notably Poland), although the allocation of these funds also favors some countries of the southern periphery (e.g. Italy and Greece), as well as some countries of the EU core (e.g. France and Germany).

*Figure 6: **2007-2013 Cohesion policy** - Allocated funds (in billion euros)*
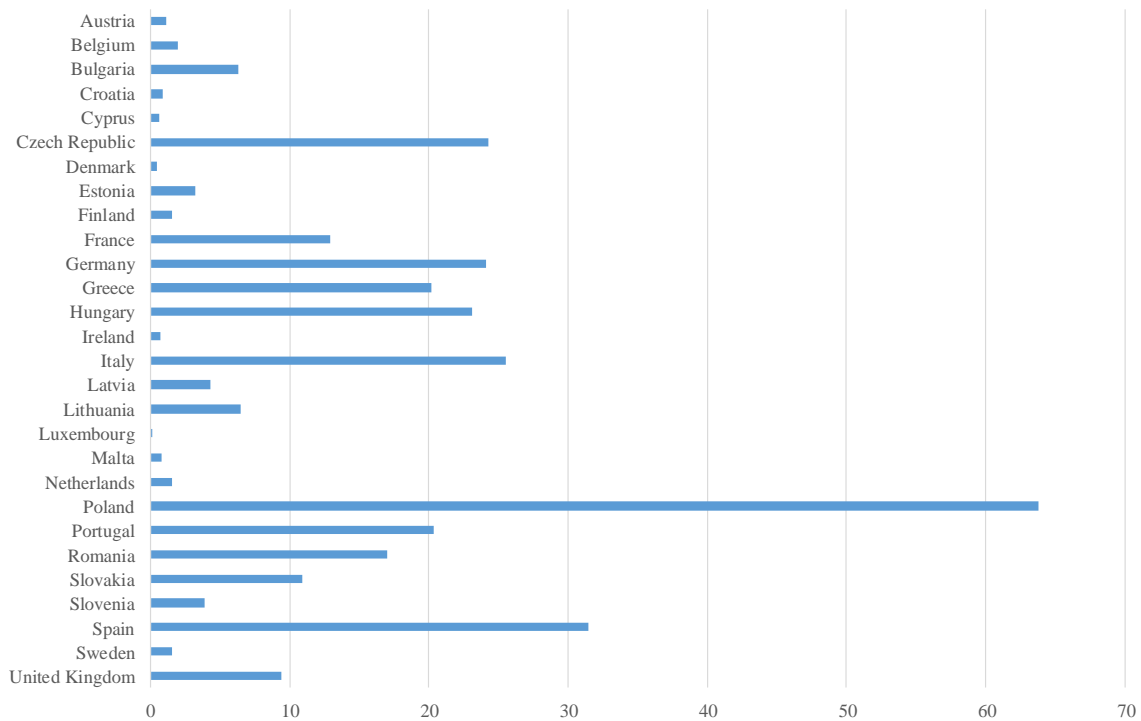
Source: Own calculations and representation based on data from ESIF Open Data Platform - https://cohesiondata.ec.europa.eu/

Figure 7: **2014 - 2020 Cohesion policy -** *EU and national contributions to planned financing*
(in billion euros)
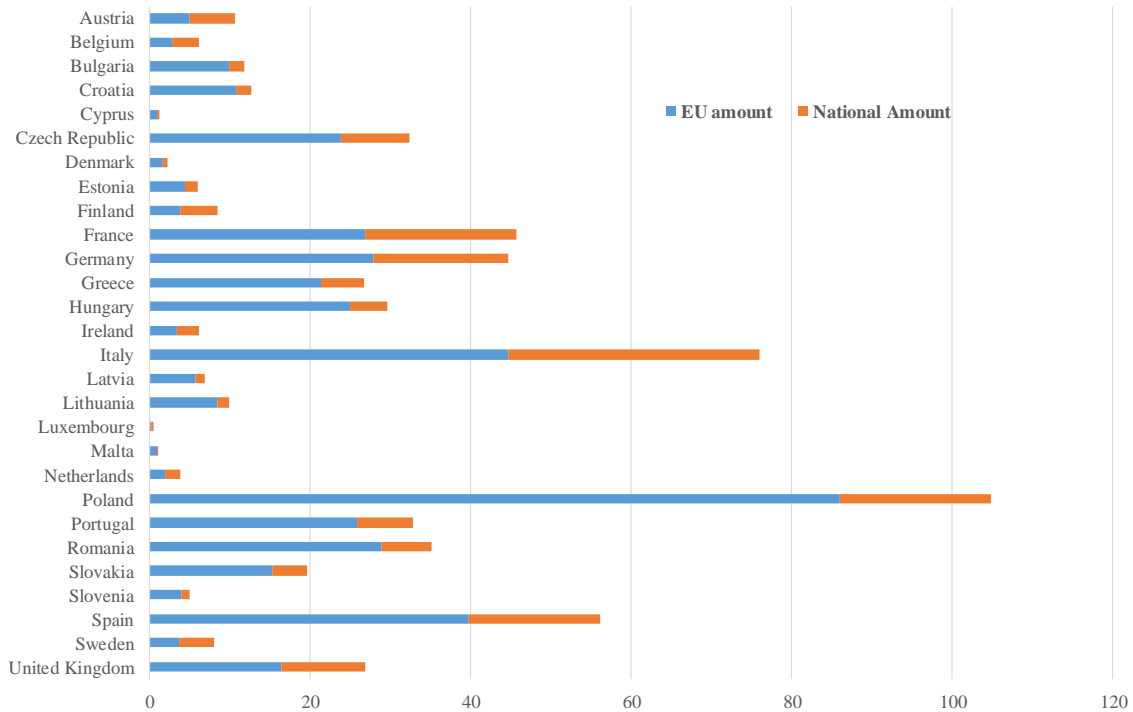
Source: Own calculations and representation based on data from ESIF Open Data Platform - https://cohesiondata.ec.europa.eu/

The much higher and rising government debt of the southern EU countries in comparison to that of eastern countries, appearing in *figure 8*, has obviously affected negatively the formers' growth paths and general economic performance.

Figure 8: Government consolidated gross debt (percentage of GDP)
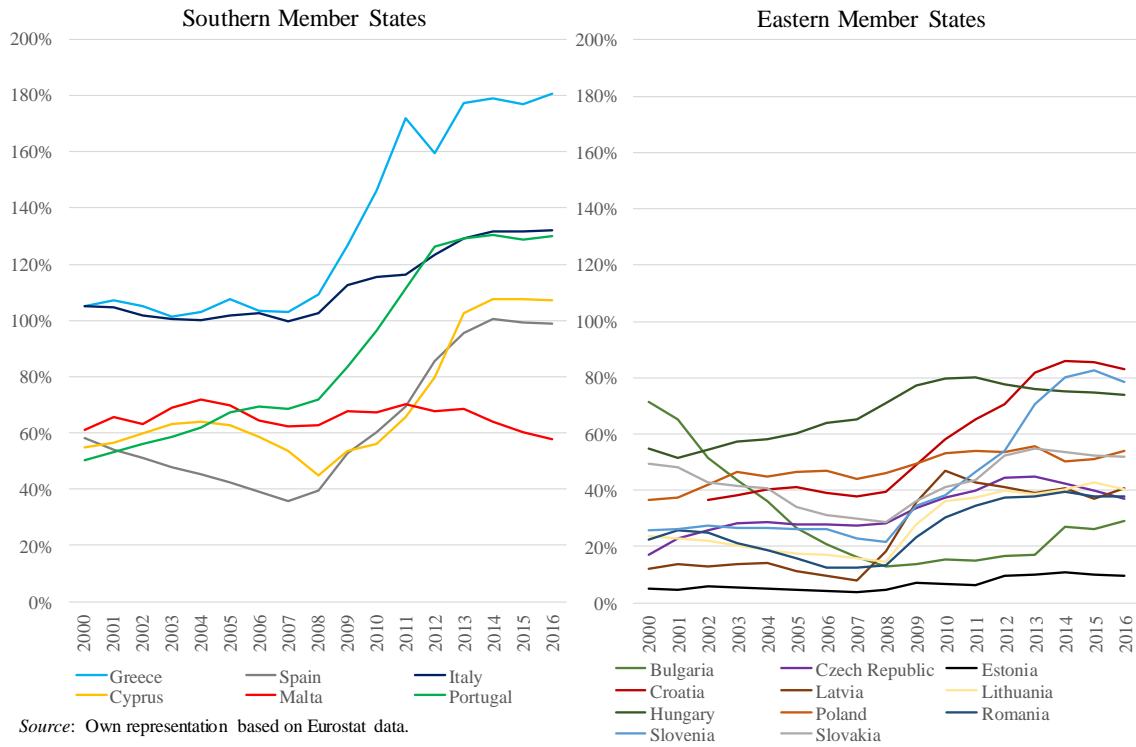
The lower level and slightly falling trend of southern countries' Gross Capital Formation (*figure 9*) must also have exerted a negative impact in their economic performance through the impact in productivity levels.

Figure 9: Gross capital formation (percentage of GDP)

Southern Member States · Eastern Member States

Greece — Spain — Italy — Cyprus — Malta — Portugal

Bulgaria — Czech Republic — Estonia — Croatia — Latvia — Lithuania — Hungary — Poland — Romania — Slovenia — Slovakia

Source: Own representation based on Eurostat data.
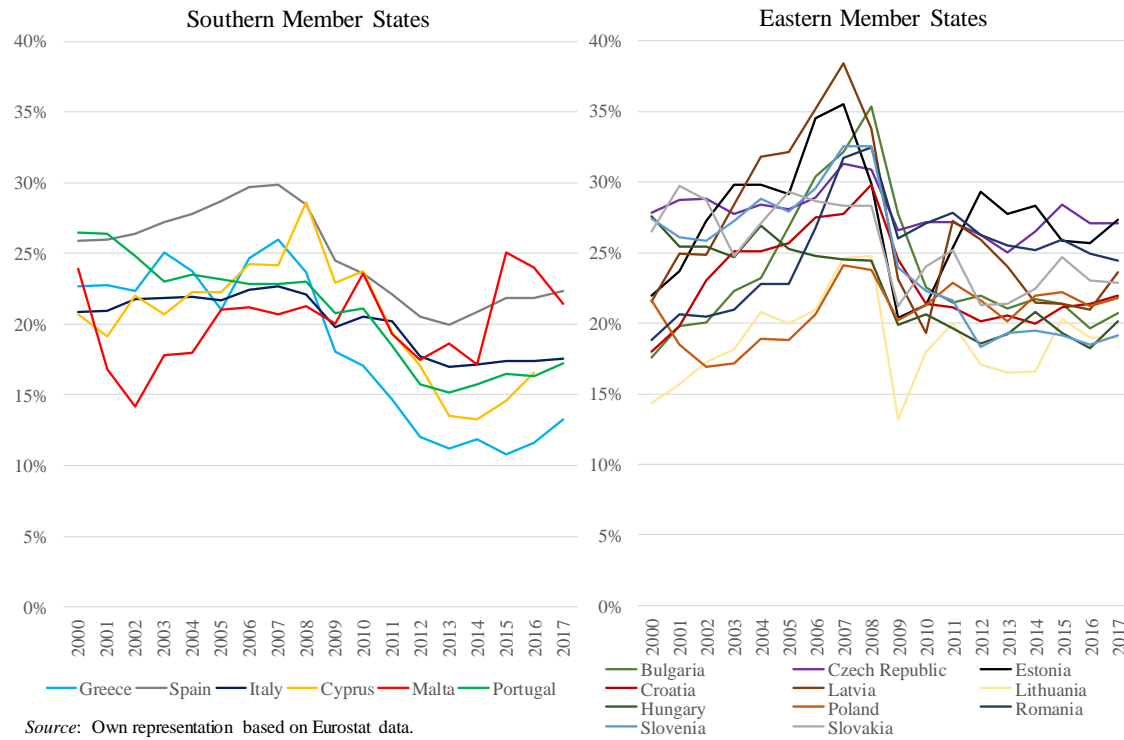
A similar negative impact must have been exerted by the relatively low share of FDI in southern countries' GDP, though a falling trend in this indicator is observed in many eastern countries between 2005 and 2016 (*figure 10*).

Figure 10: Inward FDI financial flows (percentage of GDP)

Southern member states

Eastern member states

Greece — Spain — Italy — Portugal

Czech Republic — Estonia — Latvia
Lithuania — Hungary — Poland
Slovenia — Slovakia

Data not available for Bulgaria, Croatia, Cyprus, Malta and Romania.
Missing values for Hungary, Italy, Lithuania, Slovakia and Slovenia.
Source: Own representation based on OECD data.
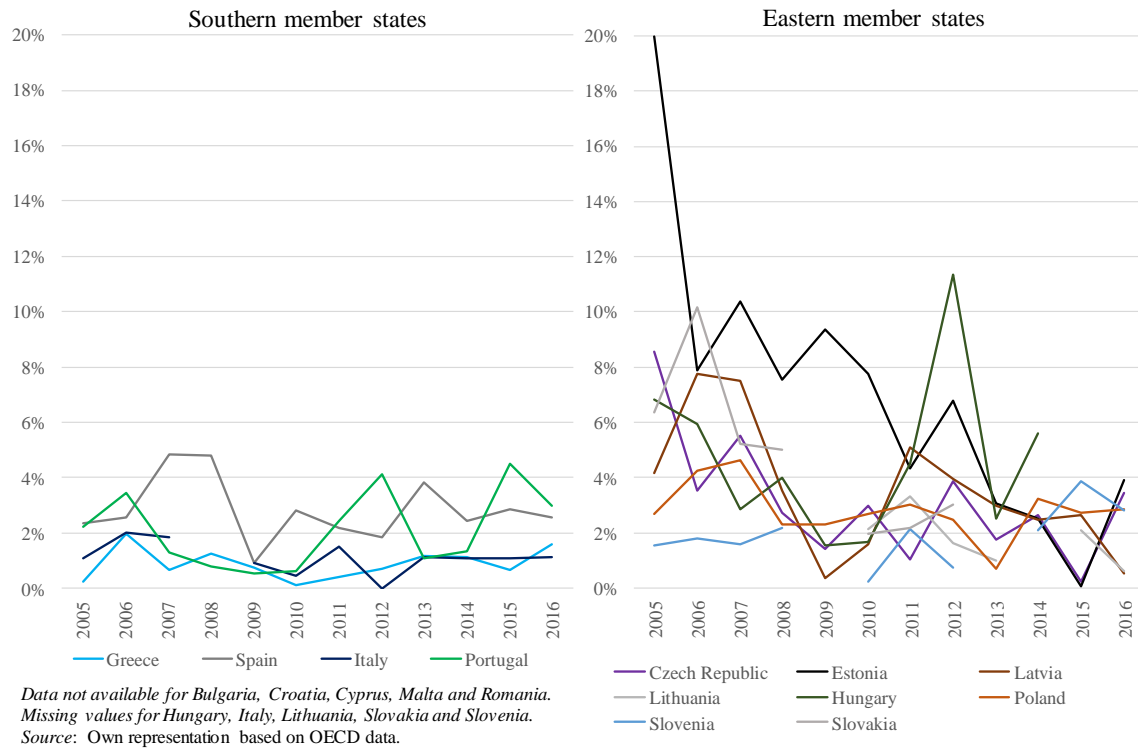
Exports of goods and services as a whole *(figure 11)* appear to be a main source of the eastern countries' dynamism. This is more evident when exports of goods are shown separately in *figure 12*.

Figure 11: Exports of goods and services (percentage of GDP)

Southern Member States

Eastern Member States

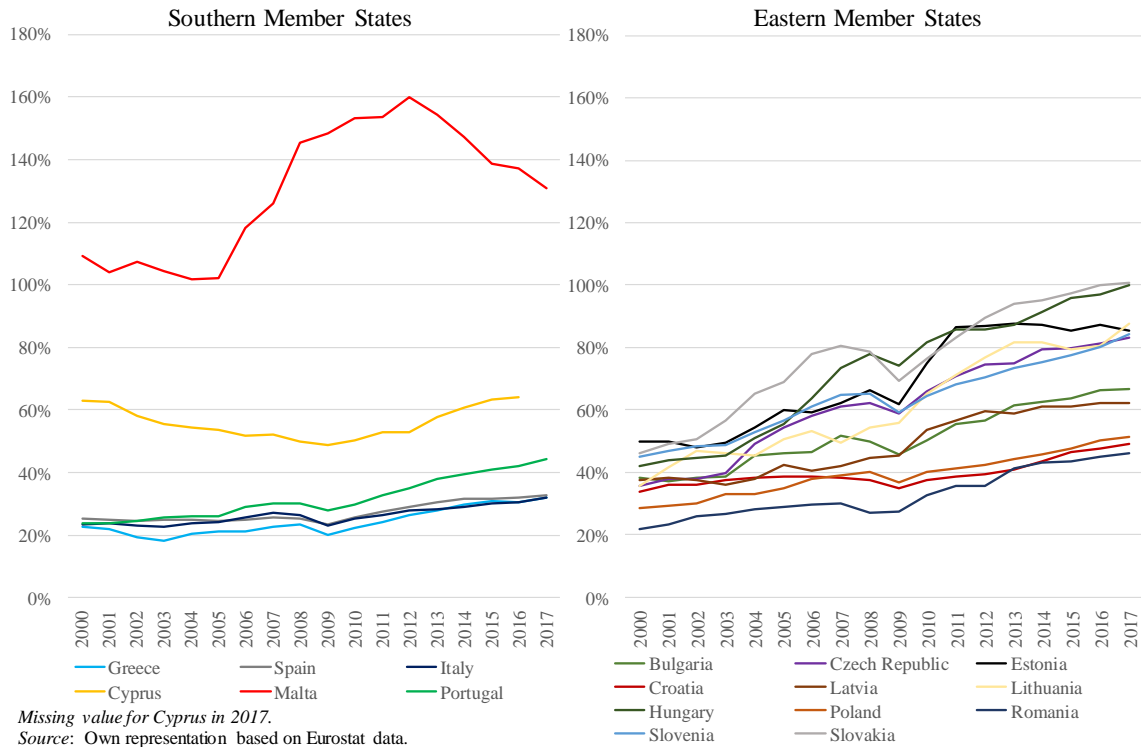*Missing value for Cyprus in 2017.*
Source: Own representation based on Eurostat data.

Figure 12: Exports of goods (percentage of GDP)

Southern Member States

Eastern Member States

Source: Own representation based on Eurostat data.
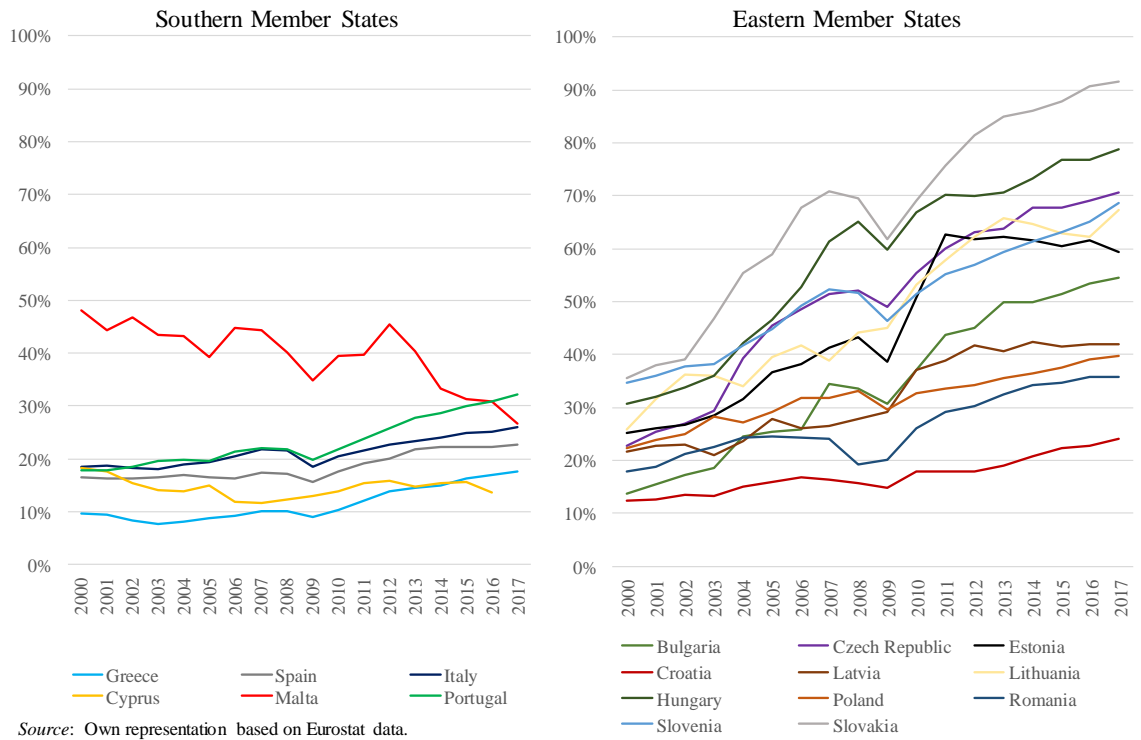
On the other hand, the exports to import ratio *(figure 13),* a proxy of economy-openness, shows a higher overall rising trend for the southern group of countries and a declining trend between 2000 and 2008 for a number of eastern countries. This reflects the importance of imports from the west for these countries' industrialization and modernization before and during their accession period, but also their continuous dependence on such imports in the current period.

Figure 13: Exports to imports ratio (goods and services)
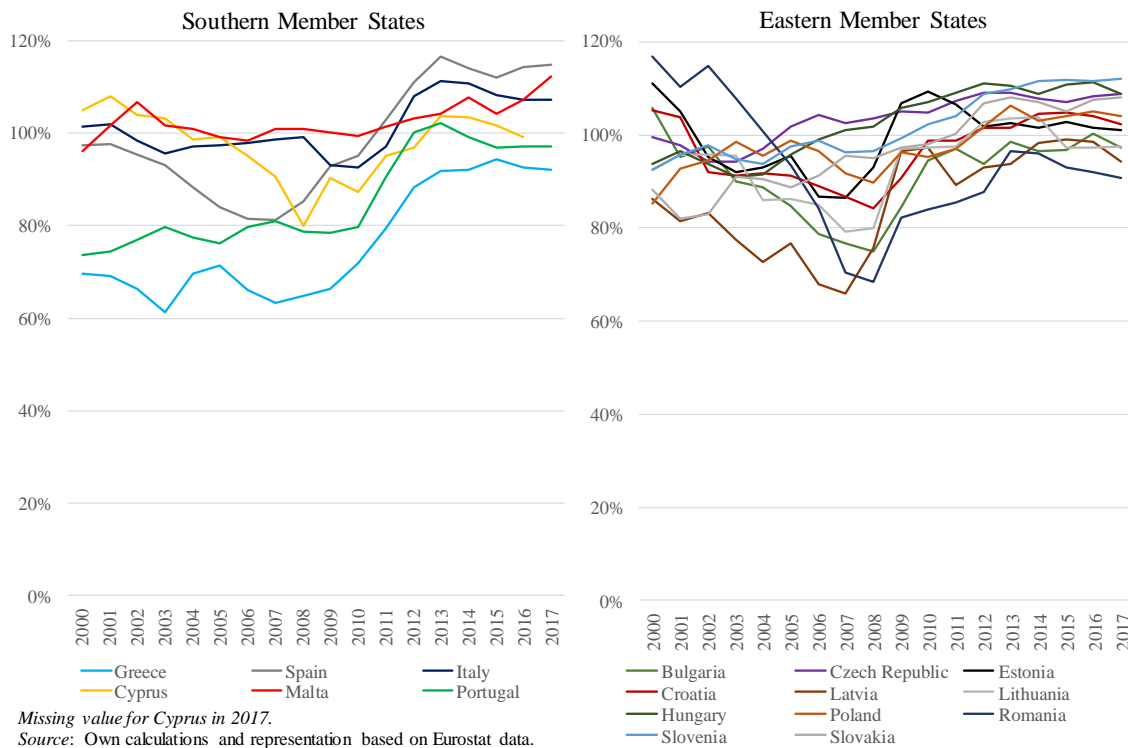
Figure 14 shows the much higher government size, measured by 'taxes on products', for the majority of the eastern group, which must exert a negative impact on growth.

Figure 14: Government size/Taxes on products (percentage of GDP)

Southern Member States

Eastern Member States

Greece — Italy — Portugal

Bulgaria — Czech Republic — Estonia
Croatia — Latvia — Lithuania
Hungary — Poland — Romania
Slovenia — Slovakia

Data not available for Cyprus, Malta and Spain. Missing value for Lithuania, Slovakia and Slovenia in 2017.
Source: Own representation based on Eurostat data.
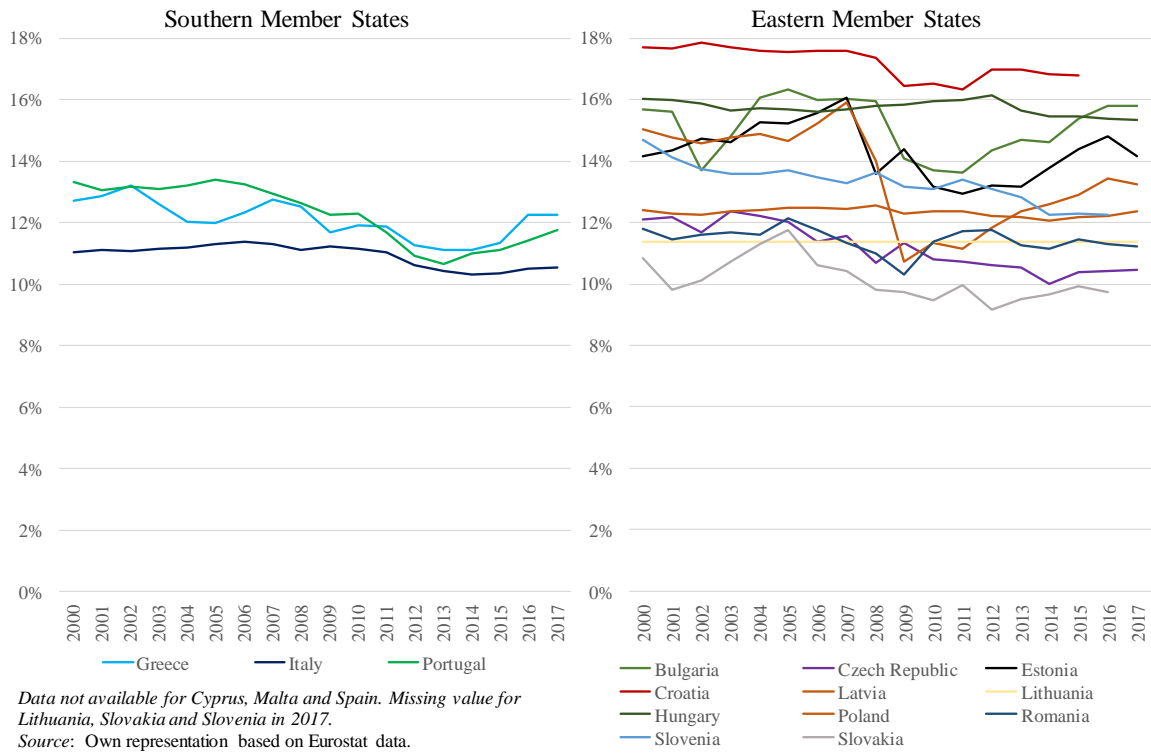
The importance of human capital for growth is widely established. Measured by the level of secondary and tertiary education as a percentage of GDP, in *figure 15* it is shown to be higher for EECs, which must have exerted a positive impact on their overall performance. A rising trend in this variable appears for southern Member States.

Figure 15: Employees with secondary and tertiary education level (percentage of total employees)

Southern Member States

Eastern member states

Greece   Spain   Italy
Cyprus   Malta   Portugal

Bulgaria   Czech Republic   Estonia
Croatia   Latvia   Lithuania
Hungary   Poland   Romania
Slovenia   Slovakia

Missing values for Croatia.
Source: Own calculations and representation based on Eurostat data.
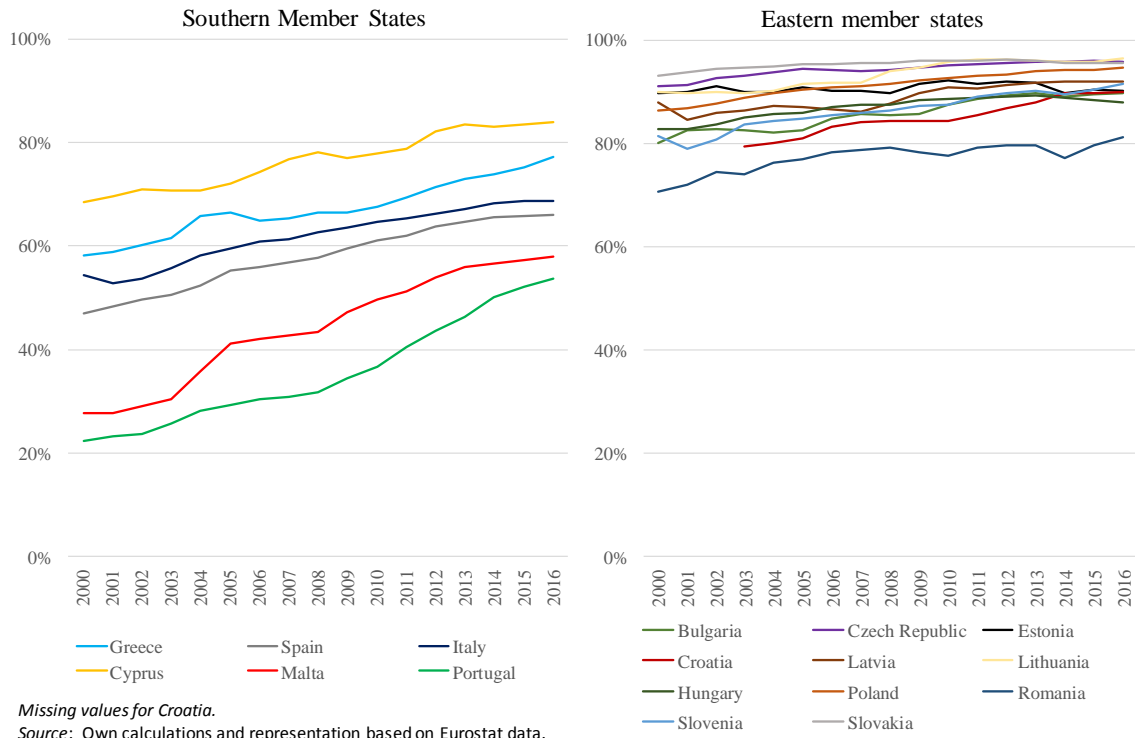
Finally, *maps 1* and *2* confirm the positive relationship, established in a number of studies, between the level of development, measured by per capita GDP, and, on the one hand, the quality of governance (a qualitative variable), on the other hand, a regional innovation index (which could be a measure of competitiveness), with these indicators deteriorating as we move towards the south or the east of the EU (see for example: Rozmahel et al. 2013, Lessenski 2014, Featherstone and Kazamias 2014, European Commission 2014, 2017a).

Map 1: Quality of Government in EU Regions
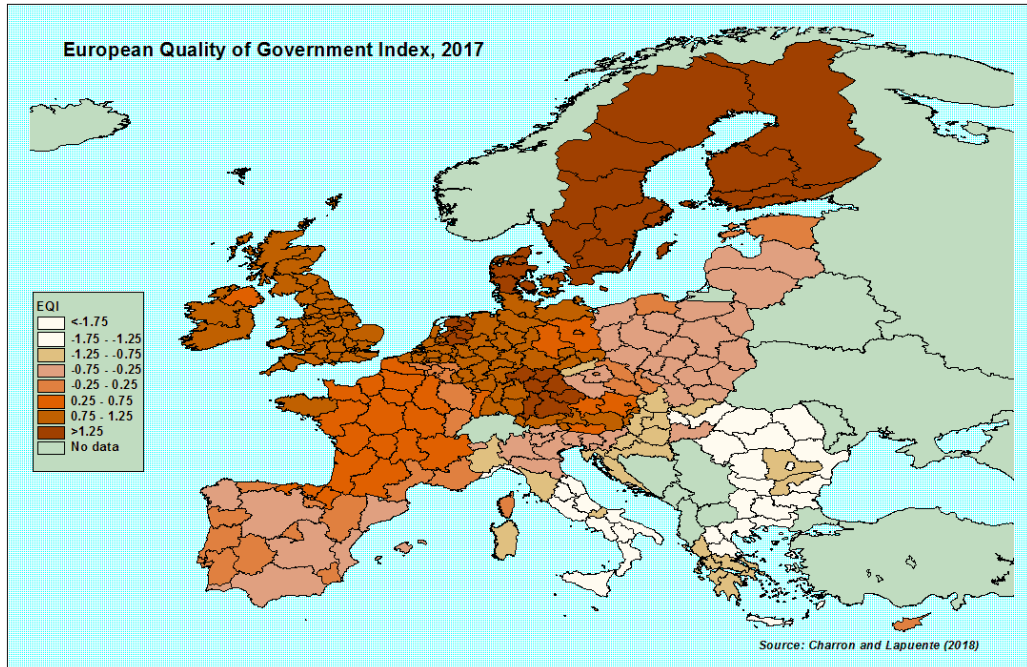
Map 2: Innovation performance at the regional level in the EU
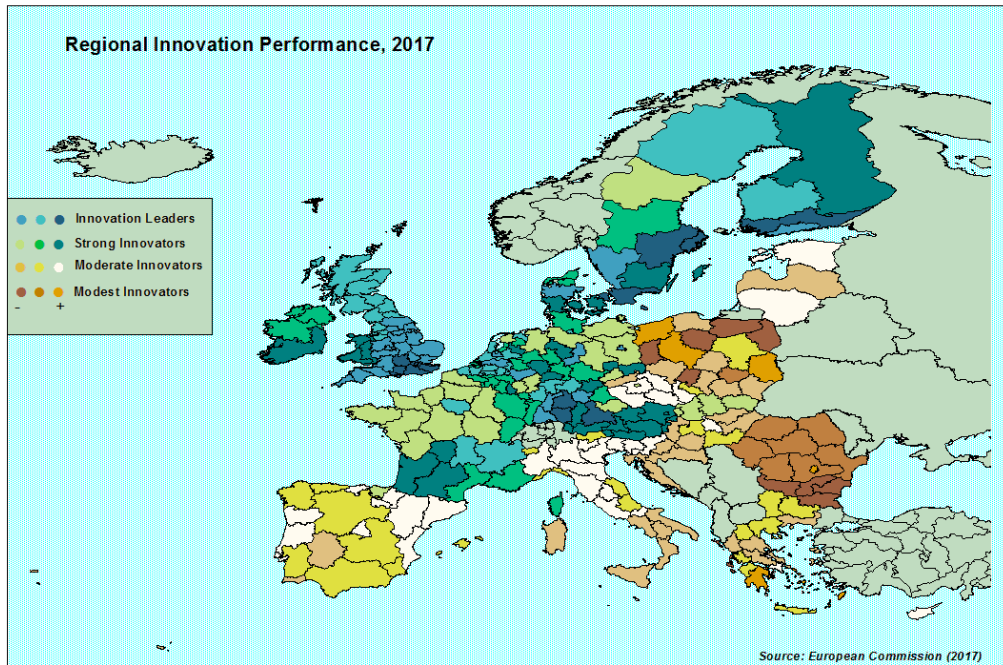
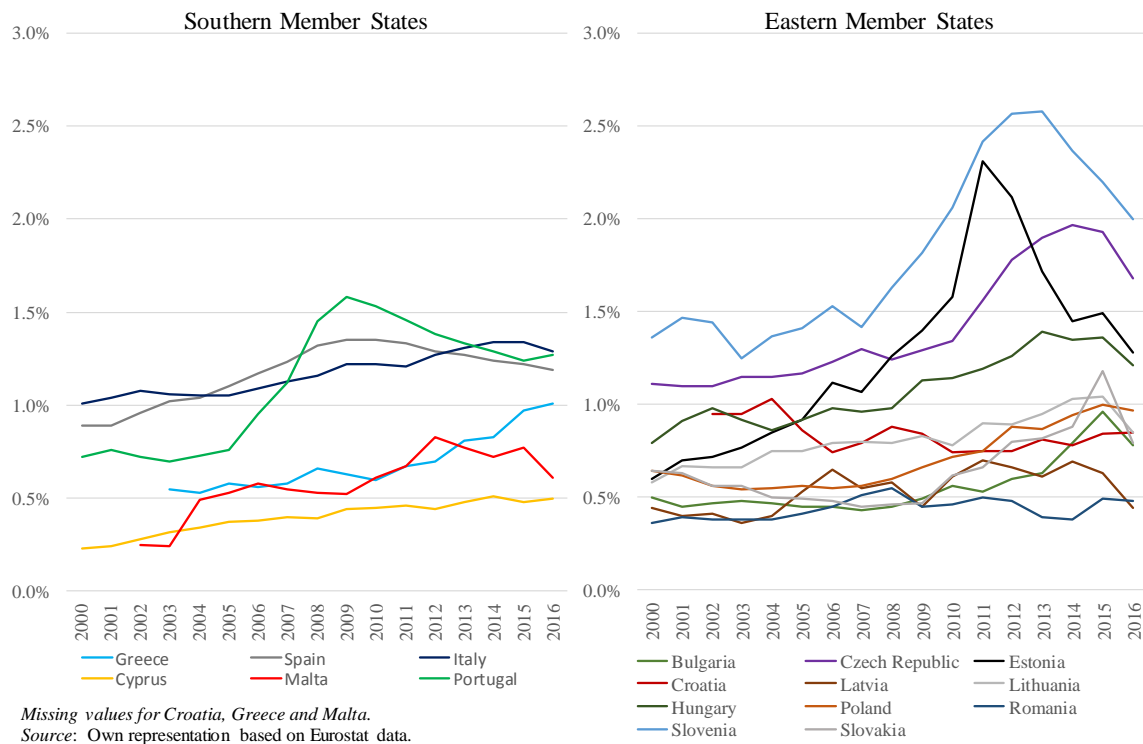In southern and eastern Member States, innovation performance is still highly concentrated in a limited number of regions, primarily the capital regions, while a number of eastern Member States seem to invest more in R&D than southern countries, as shown in *figure 16*. Some notable 'pockets of excellence' include Zahodna Slovenija in Slovenia, Bratislavský kraj in Slovakia, Praha in the Czech Republic and País Vasco in Spain.

Figure 146: R&D expenditure by all sectors (percentage of GDP)

Missing values for Croatia, Greece and Malta.
Source: Own representation based on Eurostat data.

3. Panel data analysis

Having established the different growth paths followed by eastern and southern EU Member States and the trends in their possible determinants, this section seeks to examine if the latter are the key factors impacting on economic growth in all EU countries, using panel data econometrics. We apply fixed effects, random effects and the Arellano-Bond estimator to two models, using data for EU countries from 1995 to 2016. All variables have been expressed in logarithms, which means that all estimates represent elasticities. In the first set of models, we seek to identify the variables involved in the

data generating process of European growth rates. Our base model for these regressions is given by the following equation,

$$GDP\_GR_{it} = \beta_0 + \beta_1 LP_{it} + \beta_2 FDI_{it} + \beta_3 GCF_{it} + \beta_4 EIR_{it} + \beta_5 EST_{it} + \beta_6 GD_{it} + \varepsilon_{it} \quad (3.1)$$

where GDP_GR_{it} represents the GDP growth rate of country i in time t, LP_{it} labor productivity, FDI_{it} foreign direct investment, GCF_{it} gross capital formation, EIR_{it} exports to imports ratio, EST_{it} secondary and tertiary education and GD_{it} government debt.

Table 1: Determinants of GDP growth, Fixed effects

GDP_GR_{it}	Fixed effects					
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
LP_{it}	0.285 (0.113)	0.159 (0.054)	0.180 (0.054)	0.195 (0.100)	0.285 (0.113)	0.246 (0.068)
FDI_{it}	0.007 (0.003)	0.009 (0.002)	0.010 (0.002)	0.009 (0.003)	0.007 (0.003)	0.007 (0.002)
GCF_{it}	- -	0.134 (0.027)	- -	- -	- -	0.108 (0.030)
EIR_{it}	- -	0.140 (0.039)	- -	- -	- -	0.130 (0.045)
EST_{it}	- -	0.093 (0.042)	- -	- -	- -	- -
GD_{it}	-0.039 (0.018)	-0.022 (0.011)	-0.055 (0.010)	-0.029 (0.128)	-0.039 (0.018)	- -
GS_{it}	0.185 (0.087)	0.109 (0.050)	- -	- -	0.185 (0.089)	- -
EXP_{it}	- -	- -	0.080 (0.030)	- -	0.124 (0.047)	- -
IMP_{it}	- -	- -	- -	0.189 (0.042)	- -	- -
ICT_{it}	- -	- -	- -	0.077 (0.027)	0.065 (0.029)	- -
HTE_{it}	- -	- -	- -	- -	- -	0.090 (0.036)

Initially we regress the GDP growth rate (GDP_GR_{it}) against a series of explanatory variables, using fixed effects, obtaining the six models above. This allows us to identify the most important determinants of economic growth for EU countries. *Table 1* presents the results for the first group of regressions. Labor productivity (measured as compensation per employee) (LP_{it}), inward foreign direct investment as a percentage of GDP (FDI_{it}), gross capital formation as a percentage of GDP (GCF_{it}), exports-imports ratio (EIR_{it}), employees with upper secondary, post-secondary and tertiary education as a percentage of total employees (EST_{it}), government size (measured by taxes on products as a percentage of GDP) (GS_{it}), exports as a percentage of GDP (EXP_{it}), imports as a percentage of GDP (IMP_{it}), the size of information and communication technology as a percentage of GDP (ICT_{it}) and the number of high-tech employees as a percentage of total population (HTE_{it}) exert a positive effect on the countries' growth rate, whereas government debt as a percentage of GDP (GD_{it}) has a negative effect upon growth rate.

Table 2 presents the results of the Arellano-Bond 1991 estimator, where a dynamic model is allowed. In both the static and the dynamic cases, we obtain statistically significant coefficients for all the variables. Also, the magnitude of the estimated elasticities does not vary significantly across models.

Tables 1 and *2* indicate that labor productivity is one of the key factors determining the GDP growth path for both eastern and southern EU countries. Having established the strong determining role of labor productivity in growth differences, we deploy a second set of regressions which will enable us to identify the variables affecting this factor. Our base model for these regressions is given by equation (3.2),

$$LP_{it} = \beta_0 + \beta_1 PAT_{it} + \beta_2 R\&D_{it} + \beta_3 ET_{it} + \beta_4 EIR_{it} + \beta_5 GS_{it} + \beta_6 GCF_{it} + \varepsilon_{it} \qquad (3.2)$$

where PAT_{it} represents an index of the number of patents, $R\&D_{it}$ research and development expenditures and ET_{it} an index of the employees with tertiary education.

Table 2: Determinants of GDP growth, Arellano-Bond

GDP_GR_{it}	Dynamic Panel		
Variables	**Model 1**	**Model 2**	**Model 3**
LP_{it}	0.192 (0.079)	0.250 (0.125)	0.202 (0.079)
FDI_{it}	0.008 (0.079)	0.006 (0.003)	0.007 (0.002)
GCF_{it}	0.128 (0.034)	- -	0.189 (0.043)
EIR_{it}	- -	- -	0.194 (0.064)
EST_{it}	- -	- -	0.196 (0.090)
GD_{it}	- -	-0.033 (0.017)	-0.048 (0.019)
GS_{it}	- -	- -	0.220 (0.082)
IMP_{it}	- -	0.317 (0.052)	- -
$GDP\_GR_{it}(-1)$	0.172 (0.097)	-0.123 (0.064)	-0.134 (0.071)

Table 3 contains the within estimates for the models considered. The number of patent applications per million of active population (PAT_{it}), R&D expenditure by all sectors as a percentage of GDP ($R\&D_{it}$), employees with tertiary education as a percentage of total employees (ET_{it}), employees with secondary, post-secondary and tertiary education as a percentage of total employees (EST_{it}), students in tertiary education, as a percentage of total population (STE_{it}), exports-imports ratio (EIR_{it}), gross capital formation as a percentage of GDP (GCF_{it}) and the number of high-tech employees as a percentage of total population (HTE_{it}) have a positive impact on the compensation per employee in PPS (LP_{it}), whereas government size as a percentage of GDP has a negative effect on labor productivity.

Table 3: Determinants of labor productivity, Fixed effects

LP_{it}	Fixed effects			
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
PAT_{it}	0.157 (0.008)	0.139 (0.008)	0.092 (0.008)	0.069 (0.009)
$R\&D_{it}$	0.067 (0.022)	0.060 (0.021)	0.087 (0.018)	0.047 (0.019)
EST_{it}	0.187 (0.045) -	- -	- -	- -
ET_{it}	- (0.020)	0.153 (0.019)	0.081 (0.020)	0.070 (0.029)
STE_{it}	- -	- -	0.274 (0.021)	- -
EIR_{it}	0.147 (0.040)	0.139 (0.037)	0.140 (0.033)	0.091 (0.044)
GS_{it}	-0.368 (0.060)	-0.304 (0.057)	-0.266 (0.052)	-0.316 (0.056)
GCF_{it}	0.288 (0.032)	0.297 (0.030)	0.235 (0.027)	0.162 (0.027)
HTE_{it}	- -	- -	- -	0.074 (0.037)

Tables 4 and *5* present the estimation results when random effects and the Arellano-Bond 1991 estimator are used, accordingly. The estimates obtained from fixed and random effects are similar across models and estimation procedures. It is worth noticing that the magnitude of the elasticity of patents with respect to labor productivity is much smaller in the dynamic models, and that the auto-correlation of the labor productivity series appears to be relatively high. All estimates remain statistically significant.

Table 4: Determinants of labor productivity, Random effects

LP_{it}	Random effects			
Variables	Model 1	Model 2	Model 3	Model 4
PAT_{it}	0.166 (0.008)	0.146 (0.008)	0.107 (0.009)	0.080 (0.010)
$R\&D_{it}$	0.076 (0.023)	0.065 (0.021)	0.089 (0.020)	0.056 (0.021)
EST_{it}	0.126 (0.047)	- -	- -	- -
ET_{it}	- (0.021)	0.141 (0.022)	0.076 (0.020)	0.060 (0.034)
STE_{it}	- -	- -	0.239 (0.023)	- -
EIR_{it}	0.121 (0.041)	0.125 (0.038)	0.132 (0.036)	0.072 (0.050)
GS_{it}	-0.384 (0.062)	-0.312 (0.060)	-0.281 (0.057)	-0.340 (0.065)
GCF_{it}	0.262 (0.034)	0.283 (0.031)	0.230 (0.030)	0.158 (0.031)

Table 5: Determinants of labor productivity, Arellano-Bond

LP_{it}	Dynamic Panel	
Variables	Model 1	Model 2
PAT_{it}	0.010 (0.005)	0.010 (0.004)
EST_{it}	0.193 (0.038)	- -
ET_{it}	- -	0.090 (0.016)
EIR_{it}	0.192 (0.026)	0.179 (0.026)
GCF_{it}	0.183 (0.017)	0.191 (0.017)
$LP_{it}(-1)$	0.716 (0.031)	0.694 (0.031)

4. Discussion – Conclusions

The empirical analysis of this paper has shown that labor productivity, foreign direct investment, gross capital formation, exports to imports ratio, exports and imports separately, the percentage of students in secondary and tertiary education, government debt, the size of the ICT sector and high-tech employment influence positively the growth path of EU

countries, whereas the size of government exerts a negative impact on this path. Thus, the empirical analysis attributed the causal relationship between the variables of the qualitative analysis (of the second section) and the growth of GDP and labor productivity. The average level of all these variables was shown in the second section to be higher and with a rising trend for eastern countries, but stagnant in most cases for southern countries. Only government size was shown to have higher levels in southern countries, most evident after the recent debt crisis.

We may then conclude that the regressions of the previous section allowed us to identify the key drivers of growth for EU countries, enabling us to target the factors influencing the asymmetric performance of the two European peripheries. Thus, higher levels of labor productivity, FDI, gross capital formation, exports to imports ratio, higher education of students and employees as well as higher sizes of ICT and employment in high-technology sectors, in combination with lower levels of government debt, are the key indicators in understanding growth differences within the EU periphery (eastern and southern) and the shift of dynamism from the southern to the eastern group.

Since labor productivity was shown to be one key variable for explaining differences in growth dynamics among the two groups, we further searched for the main determining factors of this variable. We established empirically that the higher number of patents, R&D expenditures, education levels of students and employees, exports to imports ratio and gross capital formation lead to higher levels of labor productivity, whereas higher levels of government size to lower ones. The graphical analysis of the second section showed that the countries of the eastern EU periphery have enjoyed higher levels of those variables, compared to southern countries, yet alongside higher government sizes. These results could then explain the gap in labor productivity and growth performance between the two groups.

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Appendix 1

Appendix 1 contains the description of the series that were used in Sections 2 and 3. All series were obtained from Eurostat, FDI was obtained from OECD.

Variable names	Description
GDP_GR_{it}	GDP per capita growth (Chain linked volumes, 2010) - Eurostat
LP_{it}	Compensation per employee (in PPS) - Eurostat
FDI_{it}	(Total) Inward FDI financial flows, % of GDP (Chain linked volumes, 2010) - OECD
GCF_{it}	Gross capital formation % of GDP (Chain linked volumes, 2010) - Eurostat
EIR_{it}	Exports to imports ratio (Chain linked volumes, 2010) - Eurostat
STE_{it}	Students in secondary and tertiary education, % of the total population - Eurostat
ET_{it}	Employed with tertiary education (levels 5-8), % of total employment - Eurostat
EST_{it}	Employees with upper secondary, post-secondary and tertiary education, % of total employment - Eurostat
GD_{it}	Government debt, % of GDP (Chain linked volumes, 2010) - Eurostat
GS_{it}	Government size/Taxes on products, % of GDP (Chain linked volumes, 2010) - Eurostat
EXP_{it}	Exports, % of GDP (Chain linked volumes, 2010) - Eurostat
IMP_{it}	Imports, % of GDP (Chain linked volumes, 2010) - Eurostat
ICT_{it}	Size of Information and Communication Technology, % of GDP - Eurostat
HTE_{it}	High Tech employment, % of the total population - Eurostat
PAT_{it}	Patent applications to the EPO by priority year, per million of active population - Eurostat
$R\&D_{it}$	R&D expenditure by all sectors, % of GDP (Chain linked volumes, 2010) - Eurostat