DE GRUYTER
OPEN

DOI: 10.2478/ijme-2014-0021
International Journal of Management and Economics (Zeszyty Naukowe KGŚ)
No. 39, July–September 2013, pp. 51–69; http://www.sgh.waw.pl/ijme/

Malgorzata Runiewicz-Wardyn
Kozminski University, Warsaw

The role of knowledge absorption and innovation capability in the technological change and economic growth of EU regions

Abstract

The framework of the endogenous growth models and empirical evidence argue that two dimensions determine a region's ability to narrow its technological gap and improve its productivity growth. The first is its absorptive capacity, e.g. its ability to imitate foreign advanced technologies. The second is its innovative capability, namely the extent to which it is able to produce new, advanced knowledge. Thus, the narrowing knowledge absorption and innovation gaps between regions improve a region's productivity level and move it up the value chain towards specialization in knowledge-intensive and high value-added activities. The following paper attempts to contribute to the existing empirical findings and theoretical discussion on the inter-linkages between knowledge absorption, innovation capability, determined technological change, and economic growth of EU regions. The author's results show that despite the fact that the EU has a long tradition in education and new knowledge generation, there is a very modest ability to make EU regions more productive and grow them. The important role of productivity and knowledge-based sectors in improving EU regional prosperity suggests to carefully examine which knowledge activities drive productivity and the catching-up process of the EU regions. Overall, prospects for catching up will depend largely on how regions balance higher education and R&D priorities and place emphasis on the above activities. These results may be regarded as supportive of recent EU regional policy based on the Lisbon and Europe 2020 Strategies of Smart Growth.

Key words: knowledge absorption, innovation capability, technological change, growth.
JEL: O1; O3; O4; J24; J25;

Introduction

The framework of the endogenous growth models and empirical evidence argue that two dimensions determine a region's ability to narrow its technological gap and improve its productivity growth. The first is its absorptive capacity, e.g. its ability to imitate foreign advanced technologies. The second is its innovative capability, namely the extent to which it is able to produce new, advanced knowledge. The narrowing knowledge absorption and innovation gaps between regions induces technological change and improves a region's productivity level and move up the value chain towards specialization in knowledge-intensive and high value-added activities (changes in productivity have been emphasized by growth theories as an important measure of technological change) [Solow, 1956; Arrow, 1962; Romer, 1986].

In the reference to first capacity economic theory has argued strongly that education and learning should be considered important factors for narrowing the knowledge absorption and innovation gaps [Lucas, 1988; Vanhoudt et al., 2000; Tondl, 2001; Badinger and Tondl, 2003; Runiewicz-Wardyn, 2008]. In addition, a higher level of education is considered to have a direct impact on research capacity [Romer, 1990]. Most theories, like the "milieu innovator theory" and the "learning region" or "regional innovation systems" theory, assume a direct linkage between knowledge production, innovation and regional economic performance. All these theories share the idea that there is a positive relation between knowledge created in a particular region and the region's economic performance.

Despite the growing empirical literature on successful cases of the innovation driven growth of regions, the capabilities to turn innovation into regional growth is different among the regions. Very few attempts have been undertaken to empirically investigate the role of knowledge and innovation capability in technological change and regional growth within the European regions to date, especially by recently joined Member States regions. Most studies in this field are carried out for single European countries, EU-15 regions[1], or other advanced economies such as the US or Canada. The following paper attempts to contribute to the existing empirical findings and theoretical discussion on the inter-linkages between knowledge absorption and innovation capability and determined technological change, and economic growth of EU regions. The paper analyzes the EU-25 regions[2] on NUTS2 regional level[3], with a few exceptions: Ireland, Denmark, and Germany, for which data was available only on the national and NUTS1 level. The period of analysis covers the years 1998–2009.

The paper proceeds as follows. First section aims to outline some theoretical frameworks for the concept of knowledge and innovation, and its role in technological change and economic growth of regions. Section two provides some useful facts and figures that highlight the heterogeneity of the European regional landscape regarding wealth and knowledge-creation capabilities. Different kinds of indicators are examined. Firstly, the positioning of European regions in terms of GDP *per capita* is realized. Secondly, the respective knowledge absorption, transfer, and diffusion capacities of the EU regions by looking at patent data, R&D expenditures, and human qualification levels are identified. In sum, this section aims to provide a clear picture of the current innovative potential and technological capabilities of European regions. Finally, third section analyzes the role of knowledge creation and innovation capability in the technological change and economic growth of EU. The paper ends with a number of conclusions and policy implications.

Knowledge absorption, innovativeness, and catching up of regions in empirical studies

With reference to knowledge absorption capability only a few empirical studies have addressed the role of education for economic growth. Most of them concern issues of the experience of the US [Gottlieb and Fogarty, 2003; Glaeser et al., 1995], and, to lesser extent, the EU regions [Badinger and Tondl, 2003; Tondl and Vuksic, 2003]. For instance, Gottlieb and Fogarty [2003] studied 75 large US metropolitan areas and concluded that higher number of residents with at least a bachelor's degree in 1980 was associated with higher *per capita* income and employment levels 17 years later. Because of knowledge spillovers, the most educated metropolitan areas in the US had their *per capita* incomes 20 percent above the average, whereas the least educated had incomes 12 percent below the average. The authors defined "education attainment" as the proportion of adults aged 25 and older with four or more years of college. Similarly, Glaeser et al. [1995] found evidence that human capital is significant to explain the growth of cities. Specifically, education levels are closely related to subsequent income and population growth. However, in the other studies mainly in [Fuente and Domenech, 2006; Vandenbussche, Aghion, and Meghir, 2006] the relationship between human capital and productivity is not unambiguous.

Furthermore, empirical studies have found that education and technological progress are of much higher importance than factor accumulation, based on the experience of EU-15 regions [Vanhoudt et al., 2000; Badinger and Tondl 2002], investigated EU regions in the 1990s and linked human capital explanations to the catching-up theory. Their results indicate that regional income growth is positively linked to labor participation and its educational attainment, whereas Wintjes and Hollanders [2010] showed that the impact of knowledge and technology factors on GDP *per capita* varies across different types of regions. For lagging types of regions (Southern and Eastern European) business R&D has a positive impact on GDP *per capita* while for other, wealthier EU regions, education and training have a positive impact on GDP *per capita*. Higher education is also an important prerequisite for lagging regions for technological catching up. However, the studies provide slightly mixed evidence for growth regressions of EU-10 countries.

The empirical analysis on UK enterprises carried out by the Abreu et al. [2008] showed that absorptive capacity at the firm-level were the major determinants of regional variations in innovation performance. The presence of a larger share of R&D employees is positively associated with innovation, particularly for manufactured goods. Tondl and Vuksic [2003] suggest that the rate of secondary school attainment in the population plays an important role in regional growth. This should not be surprising, since the EU-10 shows a fairly high level of educational attainment. Fidrmuc [2000] also proposes that secondary education has a positive impact on growth, whereas Campos [2002] argues that it has a negative impact. Campos suggests that in many Central and Eastern European countries, despite the high level of educational attainment of the average worker, the composition of the stock of human capital (in terms of their work occupations) has proved to be inadequate in addressing the needs of a modern market economy (see also Okoń-Horodyńska [2008]).

With reference to innovative capability – according to the new growth theory – productivity growth specifically links the performance of regional innovation systems [RIS]. An obvious difficulty lies in the simultaneity of productivity and innovation performance at regional level, together with the lack of comprehensive data. Usually, studies focus on firm-level analyses, where data is available on different types of innovation (product and process) introduced by firms. The available empirical evidence generally suggests that the direct effect of research activity or innovative capability on productivity growth – frequently measured by the ratio of R&D expenditures to output – is positive and substantial [Jakobsen and Onsager, 2008]. An early example is the firm- and industry-level work of Griliches [1980] and Jaffe [1989] for the United States. In his research framework, Jaffe [1989] observes significant positive effects of R&D spillovers on the firm's position in the technological space. The results of Coe and Helpman [1995] and Guellec and van Pottelsberghe de la Potterie [2004] reveal the important relationship between R&D expenditures and productivity growth for the OECD countries. Griffith, Redding, and Van Reenen [2004], and Cameron, Proudman, and Redding [2005] find indirect and direct effects of R&D on total factor productivity by facilitating technology transfer. Vogel [2012] investigated two channels through which R&D and human capital may affect regional total factor productivity growth in the manufacturing sector, using panel data on 159 EU-15 regions from 1992 to 2005. Relying on endogenous growth model assumptions, she allowed R&D and human capital to influence productivity. Furthermore, the model allows for conditional convergence to a long-run level of total factor productivity relative to the frontier. Her results suggest that total factor productivity convergence takes place over the selected sample period and that geographic distance from the technology frontier matters. Similar findings, based on patents as an imperfect measure for innovation, were achieved by Bosco and Brugnoli [2010]. The authors tested the relationship between RIS and the productivity-based knowledge production function approach, covering 29 OECD countries, with 323 regions for 1995–2008. They found that innovation inputs and outputs are positively related to productivity.

Summing up, although the importance of absorptive capacity and innovative capability for the growth process is widely acknowledged in modeling exercises, the empirical literature has not yet achieved a systematic understanding of how these two dimensions evolve and influence the technological catching-up process in the enlarged EU-25 regions. Sections three of the following paper will take further steps in an attempt to explore how regions' absorptive capacities and innovative activities relate to changes in the productivity level and GDP growth in the EU-25 regions.

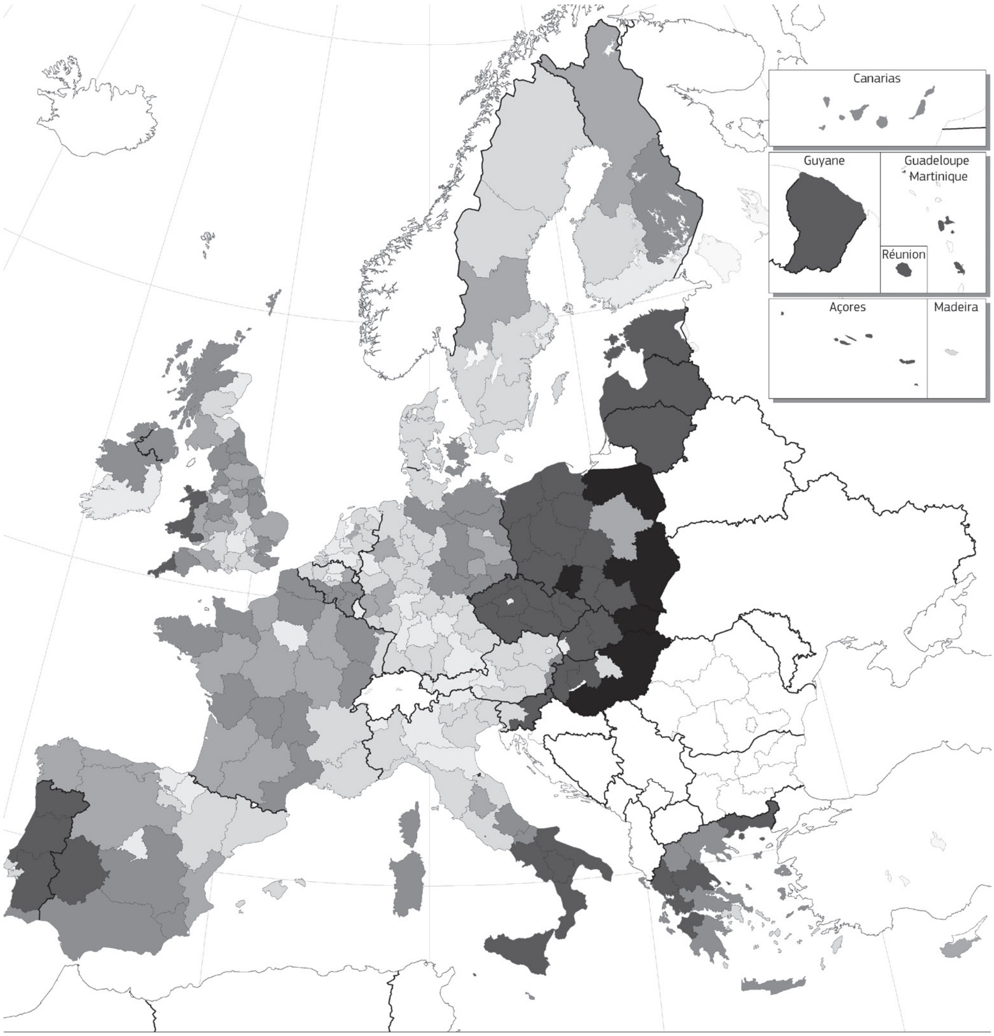
GDP performance in the EU regions

GDP *per capita* is the most frequently used indicator to evaluate and compare the economic performance of regions in terms of wealth creation. This indicator, expressed in purchasing power standards (PPS), has also been used to assess the heterogeneity of the European regional landscape and the average economic situation in each of the EU Member States regions. The Map 1 shows the GDP *per capita* level in EU regions on NUTS2 regional level, with a few exceptions: Ireland, Denmark, and Germany, for which data was available only on the national and NUTS1 level.

Map 1 clearly illustrates an unequal distribution of wealth creation across the EU. Firstly, it reflects a high concentration of wealth creation (above the European average GDP *per capita* for 2009) only in a limited number of regions, extending from the North EU regions to the Benelux, western Germany, western Austria, France, capital region of Spain and the northern part of Italy. Secondly, the three regions with the highest GDP *per capita* over the past years have been Inner London, Brussels, and Luxembourg, followed by Hamburg, Île de France, Wien, Uusimaa, Stockholm, and Madrid. Inner London and Brussels are the wealthiest regions of Europe with a GDP *per capita* of more than twice that of the European average. Thirdly, most regions belonging to the new Member States as well as the southern European periphery, such as the Portuguese, Spanish, southern Italian, and Greek regions, are characterized by relatively low levels of GDP *per capita*.

From the dynamic perspective, all regions performed well. Based on the most recent estimates released by Eurostat (April 13, 2011) the gap between the richest and poorest EU regions has narrowed since 2000. In 2009, only 65 regions had a GDP *per capita* below 75% of the EU average, in comparison to 69 regions in 2000. This represents that 119 million people stayed below 75% of the EU average GDP *per capita*, compared with 131 million people in 2000. As a result, the gap between the richest and poorest EU regions has narrowed since 2000.

MAP 1. GDP per head (PPS) by NUTS, 1/2, 2009



Index, EU27 = 100

- < 50
- 50–75
- 75–90
- 90–100
- 100–125
- > 125
- no data

0 500 km

S o u r c e: Eurostat – REGIO

Eurostat-based regional data reveals that the catch-up process of EU-10 countries with the EU average was of the order of 1.7 percentage points per year between 2000 and 2009. This fast process of catching up was driven by economic integration and restructuring of national economies. GDP *per capita* in the EU-10 Member States rose from 50% of the EU-25 average in 2000 to over 60% in 2009. In 2008, performance was particularly strong, above 3 percentage points. It is also important to mention that the fast catching up in the second half of the period under analysis can be explained partly by the fact that the economic and financial crisis struck first in the EU-15 Member States, some of which, like Ireland, Italy, and Denmark, were already in recession in 2008. On the other hand, among the EU-10, only Estonia and Latvia already had negative volume growth rates in 2008, and the full effects of the crisis became apparent only in 2009. EU average of GDP *per capita* (in PPS) dropped by 6% between 2008 and 2009 [Eurostat. Statistics In Focus*,* 41/2012]. Regional GDP *per capita* dropped sharply in 2009 as compared with 2008 in all EU Member States except for Poland (11 out of 16 Polish regions achieved absolute increases in 2008–2009).

Knowledge absorption capacities of EU regions

In the spirit of technological gap theories, it is argued that technological differences between regions open up the possibility for countries or regions to catch up by imitating the most productive technologies ("advantage in backwardness"). However, the successful imitation of foreign technologies, especially in high-technology fields, requires certain level of human capital (their qualifications), especially in S&T fields. Therefore, absorptive capacity can be proxied by the regional share of S&T human capital and level of tertiary education ratio. Table 1 gives an overview of the current absorption capacities of the EU regions. In general, absorption capacity is particularly strong in the north of Europe and in the EU-15 regions (with the exception of the capital regions of Slovakia (Bratislavsky kraj), Poland (Mazowieckie region), the Czech Republic (Praha region), and Estonia). The Swedish, Finnish, and Dutch regions, followed by a few Spanish, French, German, and Austrian capital regions (Madrid, Ile de France, Berlin, and Wien) have the highest share of S&T human capital and level of tertiary education ratio. Moreover, compared to the French case, all Austrian regions have higher participation rates in tertiary education in comparison with S&T schooling. The German and Belgian regions are in a high position both in terms of participation in tertiary education and S&T human capital.

The majority, however, of French, Austrian, Spanish, and a few Italian regions has only moderate absorption capacities. The absorption capacity of most South Mediterranean regions (Italian, Greek, and Portuguese regions) is generally low.

TABLE 1. “Social capability” and knowledge absorption capacities of the EU regions (2008)

	X	Students in tertiary education by NUTS2 (2008)					
y		High [S>111877.67]		Medium [41513.67<S<111877.67]		Low [S<41513.67]	
NU S&T by TS2 [2008] as % of totally economic active population	High (H>30.13)	Vlaams Gewest Région wallonne Praha Denmark Baden-Württemberg Bayern Berlin Sachsen Ireland Com. Madrid Île de France	Rhône-Alpes Közép- Magyarország Zuid-Holland Wien Mazowieckie Manner-Suomi Etelä-Suomi East of England London South East South	Région de Bruxelles Brandenburg Hamburg Mecklen.- Vorpommern Sachsen-Anhalt Thüringen Estonia País Vasco Aragón Alsace Midi-Pyrénées	Auvergne Gelderland Utrecht Noord-Holland Noord-Brabant Bratislavský kraj Länsi-Suom Stockholm Östra Mellansverige Sydsverige	Principado de Asturias Com F. de Navarra Cyprus Groningen Friesland Drenthe Overijssel Flevoland Zeeland Limburg Pohjois-Suomi Åland Mellersta Norrland	
	Medium (22.9 0<A<30.13)	Niedersachsen Nordrhein- Westfalen Cataluña Comunidad Valenciana Andalucía Nord - Pas-de- Calais Prov.Alpes-Côte d’Azur Lombardia	Latvia Lithuania Śląskie Pomorskie Lisboa Slovenia North West Yorkshire&H East Midlands West Midlands Emilia-Romagna Lazio	Jihovýchod Moravskoslezsko Schleswig- Holstein Galicia Castilla y León Región de Murcia Picardie Haute-Normandie Lorrain	Pays de la Loire Bretagne Poitou-Charentes Aquitaine Languedoc-Roussillon Steiermark North East [UK] Wales Northern Ireland [UK]	Strední Cechy Jihozápad Severovýchod Bremen Saarland La Rioja Basse-Normandie Bourgogne Franche-Comté Limousin Liguria	Prov. Trento Niederösterreich Kärnten Oberösterreich Salzburg Tirol Vorarlberg Itä-Suomi Småland med öarna Norra Mellansverige

Human resources as	Low (A<22.90)	Veneto	Canarias [ES	Podlaskie	Severozápad	Basilicata
		Toscana	Piemonte	Zachodniopomorskie	Strední Morava	Közép-Dunántúl
		Campania	Marche	Opolskie	Castilla-la Mancha	Nyugat-Dunántúl
		Puglia	Abruzzo	Kujawsko-Pomorskie	Extremadura	Dél-Dunántúl
		Isole	Calabria	Warmińsko-Mazurskie	Illes Balears	Észak-Magyarország
		Sicilia	Sardegna	Centro [PT	Champagne-	Malta
		Łódzkie	Észak-Alföld	Západné Slovensko	Ardenne	Burgenland
		Małopolskie	Dél-Alföld	Stredné Slovensko	Corse	Lubuskie
		Lubelskie	Podkarpackie	Východné Slovensko	Valle d'Aosta	Algarve
		Wielkopolskie	Świętokrzyskie		Pr.Bolzano	Alentejo
		Dolnośląskie			Friuli-Venezia	Reg Açores
		Continente			Giulia	Reg Madeira

Note: The indicator is indexed by the EU-25 average, and the respective values are given in parenthesis.

S o u r c e: Runiewicz-Wardyn [2012].

A common feature of all Polish regions is their low S&T human capital and the high number of tertiary education students. A similar situation is applicable to several other EU-10 regions, e.g. Hungarian and Slovakian regions, along with Latvia and Lithuania, for which the general weakness is low S&T capital.

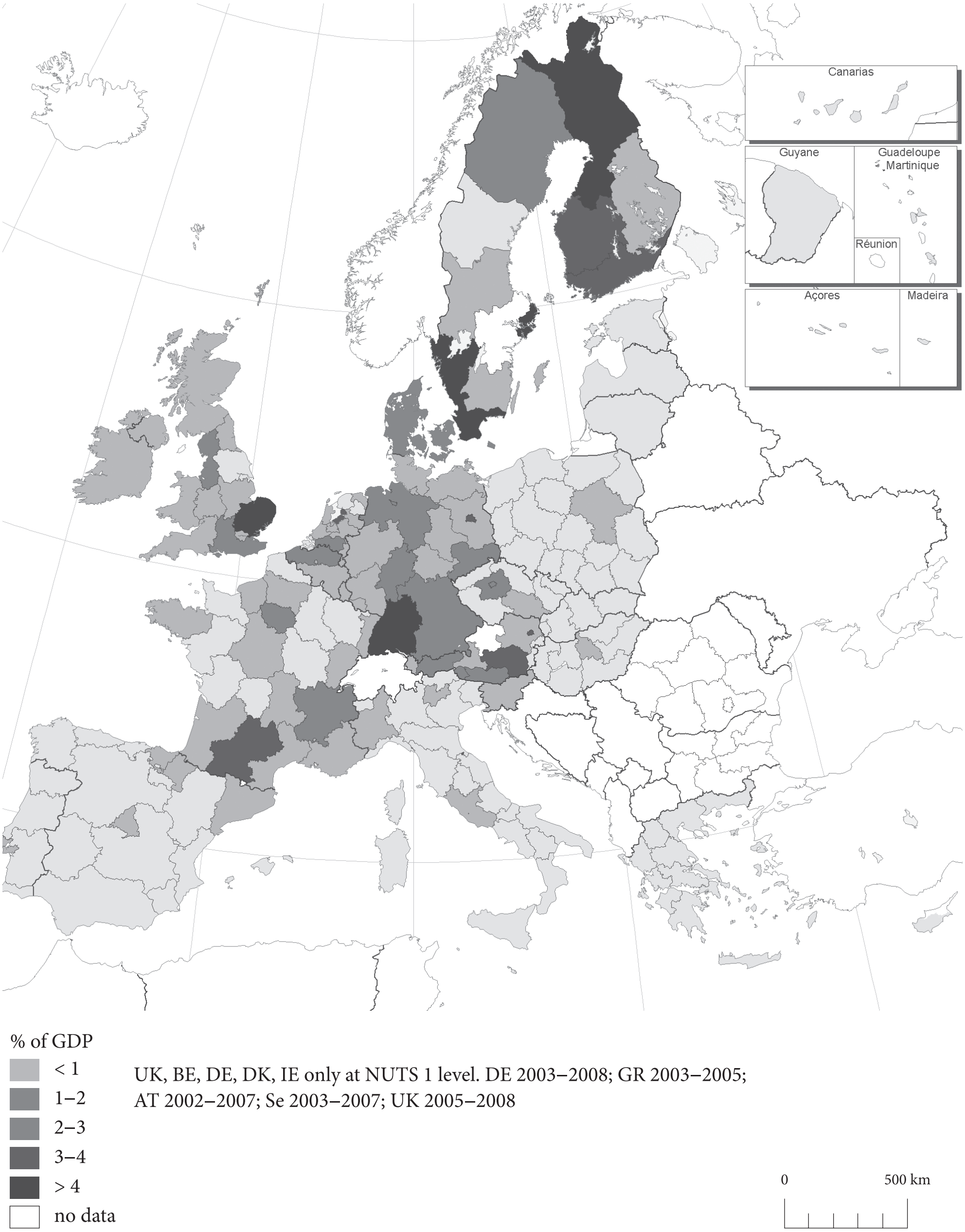
Innovation capabilities of EU regions

Globally, the regions of EU-15 Member States are performing much better in terms of total R&D investments. The regions of Finland, Sweden, Germany, Austria, and France belong to the group of leading regional economies in terms of R&D intensities (with share of total R&D expenditure ranging from 2-3.5% for 2007 [Eurostat, 2011]). Swedish regions are clearly Europe's best performing regions, with R&D intensity about twice that of the European average. For the regions of the recent Member States (EU-10) , R&D intensities are still relatively low, despite strong positive tendencies during the considered period [Eurostat, 2011]. The latter, and smaller states such as Estonia and Slovenia, have caught up significantly. Currently, Slovenia and the Czech Republic outperform some of the EU-15 regions (mainly Spanish, Portugal, and Italian regions) in terms of R&D intensity.

In general, Map 2 shows that R&D intensities tend to concentrate geographically around capital cities or in big metropolitan areas, where they can benefit from the economies of agglomeration and urbanization. The Swedish and Finnish regions are clearly the best performing ones, with Västsverige spending almost 5% on average between 2000 and 2008, followed by Sydsverige (4.3%), Pohjois-Suomi (4.2%), Stockholm (4.2%), and Södra Sverige (4.1%). Similarly, the German regions of Baden-Württemberg (4.2%) and Berlin (3.7%), followed by the Austrian regions of Wien (3.4%) and Steiermark (3.4%), performed very well in terms of average share of R&D expenditure during the considered period. On average, the potential for innovative capabilities of the southern periphery of the EU is relatively weak. This is especially true for the Greek, Portuguese, and Spanish regions. With the exception of the two capital regions, Madrid and Lisbon, the average levels of R&D intensities for the Greek, Portuguese, and Spanish regions are low and range from 0.3–0.5% on average for the period 2000–2008. The only region performing relatively well in business R&D is the Cataluña region in Spain [with the number above 1%].

Among the EU-10's best performing regions are the Czech regions of Střední Čechy (2.5%) and Praha (2.1%), followed by Slovenia (1.30%) and the capital regions of Hungary and Poland – Közép-Magyarország (1.2%) and Mazowieckie (1%). The rest of the EU-10 regions spent well below 1% of their GDP on R&D activities. This is also a common trend for most of the southern regions of the EU-15: Portugal, Spain, Italy, and Greece, with some exceptions for Province Trento in Italy. For many of the EU-10 regions structural funds and public R&S sources have become a significant, if not the main source, of R&D funding.

MAP 2. Average intramural R&D expenditure as % of GDP in EU regions (2000–2008)



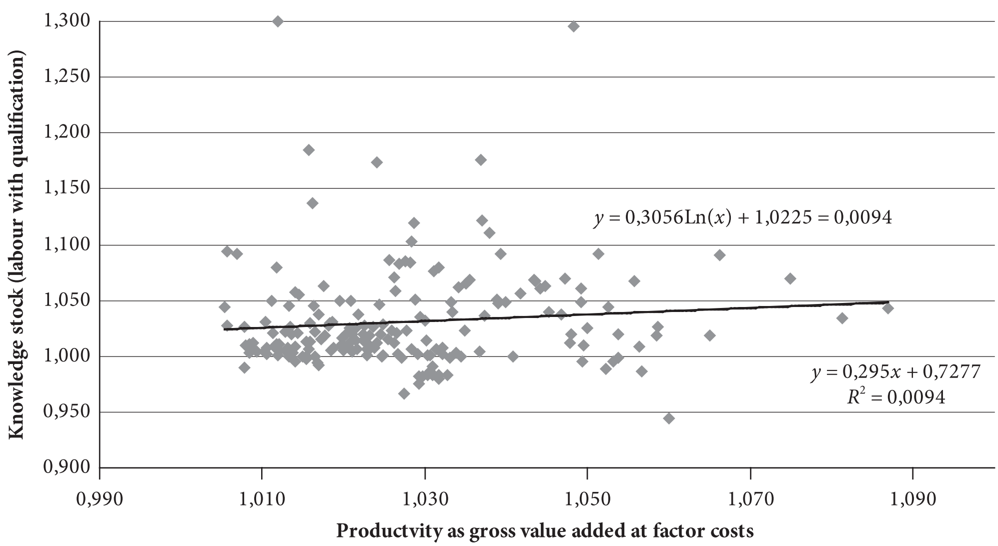
UK, BE, DE, DK, IE only at NUTS 1 level. DE 2003–2008; GR 2003–2005; AT 2002–2007; Se 2003–2007; UK 2005–2008

S o u r c e: Eurostat – REGIO

Knowledge absorption, innovation capability, productivity and growth of EU regions

The aforementioned literature has inspired the author to test what the level is of the spatial autocorrelation of human capital, innovation, and productivity growth in the case of the EU regions. Following theories created by Solow [1956], Arrow [1962], and Romer [1986], in which changes in productivity have been emphasized as an important measure of technological change, there should be a positive correlation between knowledge absorption and innovation propensity and productivity growth of the EU regions. The following section aims to review the average dynamics of the EU regions by using the linear regression measure (linear relationship between the independent (x) and dependent (y) variables; y was built directly from the mathematical equation y = mx + b; linear regression tells the researcher the extent to which x predicts y). Figure 1 shows that a labor force with tertiary education contributes to increased productivity in the EU Member States NUTS2 regions. However, the correlation trend between the average dynamics of the two variables is less optimistic than one should expect. This, perhaps, can be easily explained by the logic that education itself does not affect workers' abilities and productivity. They obviously learn certain valuable skills at school (engineering, com-

FIGURE 1. **Average dynamics of human capital (labor with tertiary qualifications) and productivity (the rate of regional gross value added (GVA)) at basic prices in the EU regions (1998–2008)**



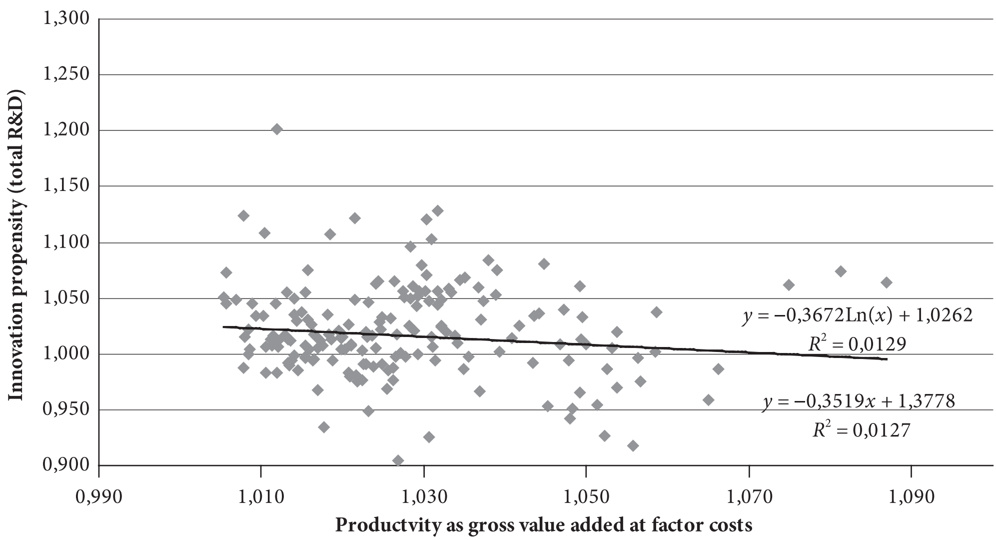
S o u r c e: own calculations.

puter science, signaling models); however, their productivity will depend on the use of these skills and the ability to learn from experience as well as on whether local universities and educational institutions can provide them. The other causes of these results could be differences in sample selection, model specifications, time frames of the analyses, measurement problems and knowledge stock variables used.

Nevertheless, this trend in Figure 1 opens a discussion concerning which skills are needed and whether local universities and educational institutions can provide them.

Furthermore, the presumption that R&D and innovation are the key drivers of economic growth is equally difficult to reconcile with the empirical evidence for the EU regions. Figure 2 shows that productivity growth may not apparently be correlated with innovation propensity growth (as it is proxied by total intramural and extramural R&D expenditures on EU NUTS2 levels). One reason for this negative relationship is that R&D intensity is assumed to have the largest impact on productivity in high-tech industries and services. In particular, basic research is regarded as an essential component for a firm operating in a high-tech industry. Besides, if high-tech companies are characterized by investing a larger share of their budgets into R&D activities, they may also be expected to generate greater value added than firms active in low-tech sectors.

FIGURE 2. **Average dynamics of innovation propensity (total R&D expenditure) and productivity growth (rate of regional gross value added (GVA)) at basic prices in EU regions (1998-2008)**



S o u r c e: own calculations.

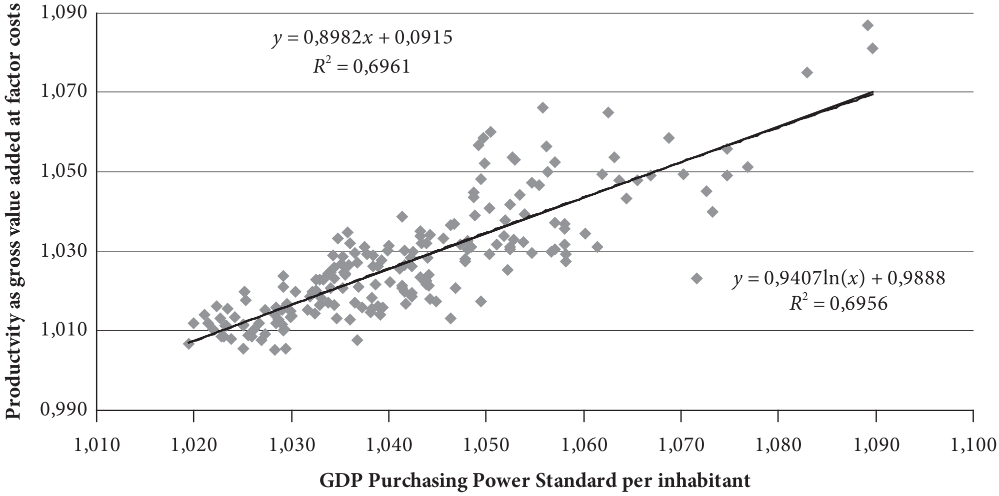
Another explanation may be that in many EU regions with a dominant share of public research institutions, R&D has been slowly incorporated in new technology areas, especially ICT, which has spurred productivity growth in recent years [Lichtenberg, 1993; Guellec and van Pottelsberghe de la Potterie, 2004]. Much of the public R&D addresses the problems of health, environment, and defence and, therefore, has no direct impact on productivity, whereas university R&D is more concerned with basic research and may eventually have an impact on technological innovation at a later stage [Guellec and van Pottelsberghe de la Potterie, 2004]. This lack of flexibility of publicly funded R&D has contributed, at least partially, to the negative impact of R&D expenditure on productivity. Business R&D is very important for a company's productivity growth. Nevertheless, at the EU aggregate level, the business R&D expenditure level has remained almost unchanged since 2000 and is below 1 percent of GDP in barely three quarters of NUTS2 regions [Eurostat, 2010]. The low return on R&D may also explain the small potential of R&D investments to increase productivity.

Moreover, the process of implementation of R&D-based technological innovations, aiming to improve the productivity of each worker, should be accompanied by organizational and learning processes. Some industries have higher rates of innovation and/or involve more complex technologies; therefore, they may require greater investment in learning in addition to R&D activity. The negative relationship between innovation propensity and productivity growth in the EU regions may also stem from inadequate investments in the learning and traineeship process.

The last two charts in this section discuss the relationship between the growth of GDP *per capita*, productivity, and employment in knowledge-intensive sectors. Figure 3 shows that productivity is one of the key factors that determine economic growth and prosperity in the EU regions. If productivity reflects all the technologies available at the time and is driven by innovations, then changes in productivity can proxy technological change. One could conclude that technological change leads to an increase in wages and *per capita* growth of GDP. It also enables the government to collect more income tax revenue and, therefore, it maintains the growth in living standards over the long term.

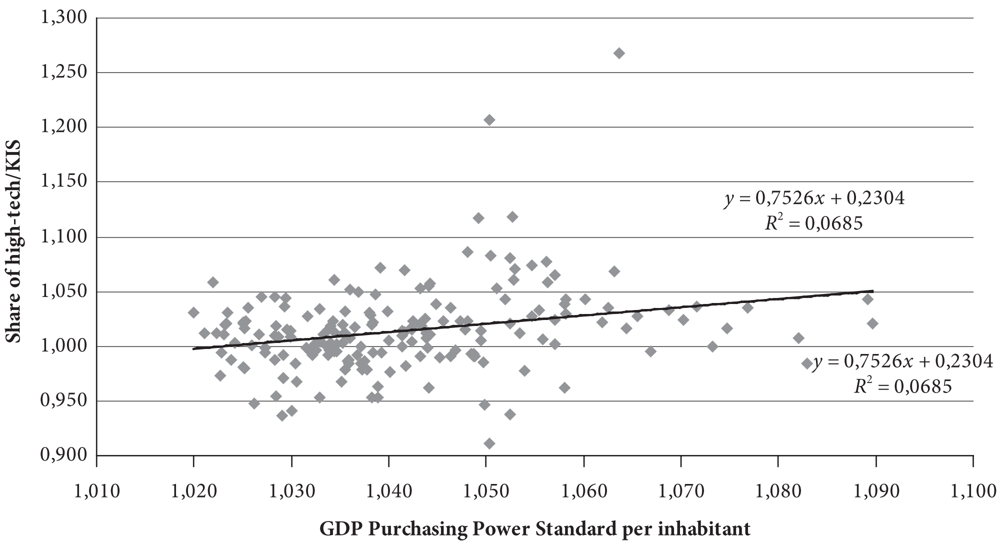
Furthermore, acceleration of technological advancement and an increase in global competition has generated the process of inter-sectoral reallocation in many EU Member States regions, from low- to high-productivity sectors. Firms reduce their activities in sectors with low technological sophistication and move their resources to sectors with higher technology levels, so overall productivity and income increase. Accordingly, there should be a positive relationship between the share of knowledge-intensive sectors and the dynamics of income. Figure 4 displays the log-correlation between average share of high-tech and knowledge-intensive services and GDP *per capita* measured by PPP in the EU Member States regions in 1998–2008. There is a positive but still low correlation between the variables, which can also be explained by the fact that regions with similar levels of GDP *per capita* may have distinct knowledge bases and specialize in different

FIGURE 3. Average dynamics of GDP *per capita* and rate of productivity (regional gross value added (GVA)) at basic prices in the EU regions (1998–2008)



S o u r c e: own calculations

FIGURE 4. Average dynamics of GDP *per capita* and share of high-tech and knowledge-intensive services for the EU regions (1998–2008)



S o u r c e: own calculations

high-tech industries. Since productivity gains are not equally distributed across industry level, this relationship should bring different results across the chart for each industry considered. For example, there is rich literary evidence that occupations related to the ICT industry and services generated the highest growth rate of GDP *per capita*.

To conclude, despite the fact that the EU has a long tradition of education and new knowledge generation, it shows a very modest ability to make EU countries more productive and grow them. The important role of productivity and knowledge-based sectors in improving EU regional prosperity suggests to carefully examine which knowledge activities drive productivity and the catching-up process of the EU regions, as well as if there are any spatial externalities between them. Altogether, figures 1–4 show that the process of technological catching up across EU regions is likely to be slow and uncertain, and requires substantial learning and knowledge spillover efforts.

Conclusions and policy implications

In sum, three decades after the accession of the southern Member States to the EU and almost a decade after the accession of the Central and East European countries to the EU, there are still big wealth disparities within and across its Member States, with the former growing faster than the latter ones. Regions with GDP *per capita* largely above the European average extend from the UK South of England to the Benelux, western Germany, and western Austria, and end in the northern part of Italy. A common feature of regions with high GDP *per capita* is their high technological and innovative potential. The opposite trend in turn was observed in the poorer regions. The latter shows that the technology gap provides a fundamental potentiality for lagging behind regions to catch up. Yet, factual catch up is only possible if the regions lagging behind develop sufficient technological infrastructure to improve knowledge absorption, transfer, and diffusion capacities. In some regions, such as EU-10 countries' regions, RISs are not in place yet. These regions are generally characterized by relatively low business R&D intensities. For these regions, absorption capacity is embodied mainly in university labs and government-led research centers. Capital regions and larger agglomerations have greater potentials for knowledge diffusion because of the relatively better communication infrastructure and population density. It is therefore not surprising that the Bratislava, Közép-Magyarország, Praha, and Mazowieckie regions are among the technological, innovative, and economic leaders amongst the EU-10 group of regions.

From a dynamic point of view, all the EU regions performed well. As a result, the gap between the richest and poorest EU regions has, in fact, narrowed since 2000. In the context of the "technological gap" and endogenous growth theory, it is important to understand what role knowledge spillovers and technological change played during the past decade in the growth and catching up of the EU regions.

Broadly, the results show that technological change in the EU regions depends on social capital and knowledge transfer, and the accumulation of embodied technology capital. Based on these findings, the primary aim of regional economic policy in an enlarged EU should be the promotion of tertiary education and lifelong learning, especially when it comes to mastering science-intensive technology education (natural science, mathematics, information technology, and engineering) as well as innovation management and organization training upon which depend the successful participation of regions in global production networks. Moreover, the results show that employment in high and medium high-tech industries is positively and significantly dependent on the presence of high-tech knowledge-intensive services. The latter implies that governments should be more active in promoting the participation of local universities and companies in global innovation and production networks (via outsourcing and offshoring activities). The latter can be viewed as an opportunity for the EU regions to upgrade their local productive and innovation systems and move towards higher added-value activities. Overall, prospects for catching up will depend largely on how regions balance higher education and R&D priorities and place emphasis on the above strategic scientific fields. These results may be regarded as supportive of recent EU regional policy based on the Lisbon and Europe 2020 Strategies of Smart Growth. In particular, they emphasize the importance of targeted interventions to regional innovation processes, matching the support of knowledge excellence, R&D, and technological innovation with the local industrial dimension and the evolutionary path dependence of each technological field.

Notes

[1] EU-15 Member States include – Austria, Belgium, Luxembourg, Denmark, France, Germany, Ireland, Italy, the Netherlands, Spain, Portugal, Greece, Sweden, Finland, and the United Kingdom. They joined prior to 2004.

[2] All EU current member states except for Bulgaria and Romania.

[3] The NUTS (Nomenclature of Territorial Units for Statistics) is based on the existing national administrative subdivisions of the EU geographical landscape for statistical purposes. The NUTS regulation lays down a minimum population size of 3 million and a maximum size of 7 million for the average NUTS-1 region, and a minimum of 800,000 and a maximum of 3 million for NUTS-2 regions, http://www.europa.eu/.

References

Abreu M., Grinevich V., Hughes A., Kitson M., and Ternouth P. (2008), Universities, Business and Knowledge Exchange, Council for Industries and Higher Education and Center for Business Research, London and Cambridge

Badinger H. and Tondl G. (2003), Trade, human capital and innovation. The engines of European regional growth in the 1990s, in: Fingleton B. (ed.), European regional growth, Series: Advances in Spatial Science, Heidelberg: Springer

Campos B. (2002), Bologna and Initial Teacher Education in Portugal, Education Policy in Europe network, http://tepe.files.wordpress.com/2012/01/tepe_monograph_2010.pdf

Coe D.T. and Helpman E. (1995), International R&D Spillovers, NBER Working Papers, No. 4444, National Bureau of Economic Research, Inc.

Cameron, G., Proudman, J. and Redding, S. (2005), Technological convergence, R&D, trade and productivity growth, European Economic Review, 49 (3), pp. 775–807

EUROSTAT (2012, 2009, 2008), Eurostat yearbook (2012, 2009, 2008), Europe in figures, Luxembourg: Office for Official Publications of the European Communities

Fidrmuc J. (2000), Liberalization, Democracy and Economic Performance during Transition, ZEI Economic Policy Papers, no. B05–2000, Bonn: Centre for European Integration Studies

Fuente A. and Doménech R. (2006), Human Capital in Growth Regressions: How Much Difference Does Data Quality Make? Journal of the European Economic Association, MIT Press, vol. 4(1), pp. 1–36

Gottlieb P.D., and Fogarty M. (2003), Educational Attainment and Metropolitan Growth, Economic Development Quarterly Journal, SAGE Pub., 17, pp. 325–336

Glaeser E.L., Scheinkman J., and Shleifer A. (1995), Economic Growth in a Cross-Section of Cities, Journal of Monetary Economics 36, pp. 117–143

Griliches Z. (1980), R&D and productivity slowdown, American Economic Review, 70(1), pp. 343–348

Guellec D. and Van Pottelsberghe de la Potterie B. (2004), From R&D to Productivity Growth: Do the Institutional Settings and the Source of Funds of R&D Matter?, Oxford Bulletin of Economics and Statistics, University of Oxford, vol. 66(3), pp. 353–378

Jaffe A.B. (1989), Characterizing the "technological position" of firms, with application to quantifying technological opportunity and research spillovers, Research Policy, Elsevier, vol. 18(2), pp. 87–97

Kukliński A. (2001), The role of universities in stimulating regional development and educating global elites, Higher Education in Europe 26(3), 437–445

Lucas R.E. (1988), On the Mechanics of Economic Development, Journal of Monetary Economics, 22, pp. 3–42

Okoń-Horodyńska E. (2008), Edukacja dla innowacji, Nauka i Szkolnictwo Wyższe, 1/31/2008, pp. 34–54

Runiewicz-Wardyn M. (2012), The Innovation Process of European Regions: from Absorption to Knowledge Creation Capacities of European Regions, [in:] Olechnicka A. Capello R, Gorzelak G. (eds.), Universities, Cities and Regions. Loci for Knowledge and Innovation Creation, Routledge, London

Runiewicz-Wardyn M. (2008), Evolution of Factors and Measures of International Competitivenes. The Increasing Role of Knowledge, in: Runiewicz-Wardyn M. (ed.) Knowledge-based economy as factor of competitiveness and economic growth, Wyd. Akademickie i Profesjonalne, Warszawa

Tondl G. (2001), Convergence After Divergence? Regional Growth in Europe, Springer, Wien.

Tondl G. and Vuksic, G. (2003), What makes regions in Eastern Europe catching up? The role of foreign investment, human resources and geography, ZEI Working Papers, B, 12–2003, University of Bonn

Wintjes R. and H. Hollanders (2010), The regional impact of technological change in 2020 – Synthesis report, Brussels: European Commission, DG Regional Policy

Vandenbussche J., Aghion P. and Meghir C. (2006), Growth, distance to frontier and composition of human capital, Journal of Economic Growth 11, pp. 97–127

Vanhoudt P., Matha T. and Smid B. (2000), How productive are capital investments in Europe? EIB PAPERS, Vol. 5(2), European Investment Bank

Vogel J. (2012), The Two Faces of R&D and Human Capital: Evidence from Western European Regions, Economics Series Working Papers, No. 599, University of Oxford, Department of Economics