MULTI-SPEED EUROPE IS ALREADY THERE: CONVERGENCE AND DIVERGENCE

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September 14, 2018

Preliminary and incomplete draft. Please, do not cite, distribute or put online this version

Abstract

This paper looks at a set of European Union countries, addressing the much debated issue of economic convergence and divergence. The selected countries are divided into four groups, according to economic and geopolitical factors, mostly based on their relation with the industrial core of Europe, namely Germany. Firstly, we highlight the wide heterogeneity between them with respect to GDP per capita and labour productivity. Secondly, we point to a similar heterogeneity in indicators which are generally considered representative for the performance in innovative activities. At this point, we investigate whether any process of convergence has taken place in the past two decades among this groups of countries. By applying a standard methodology on economic convergence on all the indicators we are able to distinguish different patterns of convergence and divergence among the different groups. Finally, we move to investigate whether different paths of structural change and the connected shifts of workers among sectors are at least partially accountable for such different performances: the preliminary answer we reach seems to confirm this hypothesis.

Keywords: Convergence; Divergence; Productivity; National System of Innovation; Structural change.

JEL classification: F62; F63; O11; O14; O57.

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1 Introduction

According to the European Union institutions and its official documents, integration within the European Union - especially within the euro area - should have induced economic convergence among member countries. This view has long been supported by an important (and to many extent 'dominant') part of the economics profession, basically relying on a fundamental pillar of neoclassical economic theory: decreasing marginal productivity of capital and labour within the production function. Broadly speaking, free movement of capital (and labour), lower cost of transactions and a shared institutional framework would guarantee optimal conditions for 'spontaneous' optimal allocations of resources, able to pave the way for convergence (European Commission (1990), Blanchard and Giavazzi (2002)). 25 years have passed since the Maastricht treaty was signed, yet the picture remains rather controversial. As shown by many studies, the most recent one being a 2018 IMF analysis (Franks et al. (2018)), claiming the existence of a spontaneous and homogeneous pattern of convergence would now be a naive proposition.

Taking this latter study as a reference point, we will argue that there are further specifications to be made. In particular, as a first insight this essay will further investigate the heterogeneity characterizing EU countries: they can be split in different groups, with a high degree of homogeneity within them. Secondly, given these groups, each displaying peculiar features, we argue that the clear-cut narratives based on divergence and convergence patterns seem to represent extreme simplifications: the groups are characterized by distinct trajectories. Furthermore, relying on a specific stream of growth literature, with this essay we aim to enrich the concept of economic convergence: thus, we will consider further indicators than those usually applied for analyzing such dynamics. Most notably, a set of indicators which broadly speaking capture the characteristics of the national systems of innovation considered. There are clearly different patterns characterizing the groups; however, focusing in particular on the two peripheral groups, we will show that a paramount role is played by the so called processes of structural changes: different patterns in the shifts of workers between economic sectors heavily affect the overall performance of the EU countries object of this study. Finally, we will raise a few points for further research on the complex dynamics involving the EU member states: issues such as the reshaping of trade patterns or the different industrial policies affecting their performance in economic development.

2 Theoretical background

The mentioned view on the spontaneous convergence within the EU can be contextualized in the broader framework of neoclassical growth theory, stemming from the classic Solow 1956 model (Solow (1956)). The model relies on standard neoclassical assumptions, and reaches the conclusion that cross-countries differences in productivity growth are the result of the different amounts of capital that each worker (within different countries) is set to operate. Given the assumption of the decreasing marginal productivity of factors, in fact the marginal productivity will decline as far as a given country gets richer. Thus, in the long run all countries will be characterized by the same rate of growth in GDP per capita, as this will be determined by the rate of technological progress. An often overlooked pivot of this theoretical construction is that technological progress has to be considered as exogenously determined: technology is seen as a common good, at hand's reach for any country which can therefore freely move on the available production function.

Broadly speaking, our approach moves instead from the belief - and the data that we show point to this same direction - that 'Country-specific factors are, through various channels, assumed to influence the process of technological change, and thus give the technologies - and the process of technological change - of different countries a distinct 'national' flavour' (Fagerberg (1994)). This seems to hold even within the European economic and monetary union. As argued in the framework of the Technology-Gap Theory (TGT) of growth, the capitalist world economy (hence even the EU) consists of countries with very different levels of economic and technological development. This is key in the process of growth (and catching up), particularly when considering the concept of 'social capability' developed by Abramovitz in his 1986 seminal paper (Abramovitz (1986)), and describing the different capacities of nations to exploit the opportunities for catching up. This is of extreme relevance in a context of changing trade patterns between countries, and in a context of fast development of Global Value Chains, where the 'technological congruence' plays a big role. Indeed the Technology-Gap Theory of growth assigns crucial importance to international technology flows in explaining growth patterns across the globe, hence across Europe. The assimilation of foreign knowledge is conditional on social and other capabilities being present in the economy, and such capabilities require a major concerted investment in institutions in a broad sense: 'innovation and technology is not a public good and does not diffuse freely and instantaneuosly' (Verspagen et al. (2015)). Moreover, such investments are costly and take a high degree of state capacity: economic policy, in particular industrial policy and innovation policy, plays a crucial role. For instance, Lall (1992) recognizes the importance - at the national level

- of physical investment, human capital and technological effort. With respect to the European framework, Verspagen (2010) applies a similar theoretical approach and reaches the conclusion that some regions' institutional (in a broad sense) framework, as it has been developed in recent decades, puts them at an advantage with respect to other peripheral regions, as it potentially allows them to absorb foreign technology in a much more efficient way. As we will show, our results are consistent with this view, and bring further elements to it.

The National Innovation System lens of analysis underlies our work: we use it in the broader definition, including all learning and innovation activities in a country regardless where they take place. A national system of innovation consists of firms operating within a common (national) 'knowledge infrastructure' and a common institutional and political framework. It is to be noted that from a theoretical point of view a broader definition of innovation system in geographic terms (e.g. a continental or European system of innovation) is not conceived in the literature. This can be supported by many theoretical insights, still the EU is often used as a term of international comparison by the European Commission and the OECD (Dosi et al. (2006)). One of the results of this paper is a neat denial of the possibility to use the EU level of aggregation for this kind of comparative analyses. In addition, our understanding of the National System of Innovation theoretical framework heavily relies on an evolutionary and historical approach, which highligths the importance of geopolitical, cultural, historical specificities of countries and groups of countries. These influence common patterns, not only of growth, but of overall development in a broader sense: 'factors such as history, culture (values, norms, etc.), language, and institutions knit individuals, firms, and institutions together in a very specific way, and [...] this has important consequences for technological progress' (Fagerberg (1994)). As knowledge spillovers are geographically concentrated, this can lead to geographical hierarchies of economic development, or core-periphery patterns (Verspagen (2010)): better said, knowledge and technological investment can have a big influence on the development of core-periphery relationships within the EU. To this respect, it is absolutely key to keep track of trade in intermediate goods (particularly, high technology goods) and thus the productive connections unfolding in the framework of the EU, also considering that knowledge transfer has important tacit and learning by doing dimensions.

Ultimately, improvements in living standards, measured in terms of GDP per capita, depend on the capacity of countries to acquire and develop productive and technological capabilities. This is normally supposed to translate first into higher labour productivity levels. It is widely recognized that '[i]nternational differences in labor productivity quite closely correlate with differences in

per capita income and, dynamically, so do labour productivity growth and income growth' (Dosi et al. (1994), p. 23). Therefore, long-term productivity growth constitutes the engine the process of economic development. A countrys rate of productivity growth relative to others represents a good summary indicator on whether it is 'Catching Up, Forging Ahead, and Falling Behind' (Abramovitz (1986)).

The rate of productivity growth itself is both demand-driven (Kaldor (1966); Verdoorn (1949)) and also structurally dependent on the ability of firms to adopt organizational and technological innovation in their productive activities (Dosi (1988)). In turn, this is positively influenced by the performance of their respective national systems of innovation (Lundvall (1992); Nelson (1993)). At the same time, overall productivity is largely determined by the structural composition of the economy, with certain sectors (notably manufacturing) being several times more productive than others (McMillan and Rodrik (2011). Economic specialization, understood as a process of structural change (Pasinetti (1983)), has a crucial importance for the economic destiny of a country.

The empirical analysis of the following sections will therefore be guided by these theoretical lens. As it will be noticed, combining the three analytic frameworks mentioned above (i.e. TGT, National System of Innovation, Structural change theory of economic development) brings up several elements potentially very helpful in explaining the existing heterogeneity among EU member states, as well as their successful or failed attempts to converge to higher levels of economic prosperity.

3 One Europe or more 'Europes'?

We divide the sample of European countries of this study into four groups, relying on a set of criteria based on 'historical-cultural-geopolitical' considerations. First, our sample is composed by a set of heterogeneous countries with respect to their historical trajectories within the EU, thus summarizing different historical patterns. All the founding members (with the exception of the tiny Luxembourg) are included. To them, we have added Spain, Greece, and Portugal, which are gathered together with Italy in a group named 'Periphery'. They share common historical ties and cultural-political characteristics: as we will see, this is reflected by their economic indicators as well.

Austria and Finland accessed together in 1995, and due to their economic characteristics and bonds with countries pivotal in the euro project, settled themselves immediately on the pattern of

joining the euro from its creation: indeed, these very features brought us to gather them in the same group with Germany and the Netherlands, the richest countries of the eurozone, with which they share a tight economic and cultural relation. This is the economic and cultural 'Core' of the EU.

France and Belgium make for the other driving wheel of the European project, a francophone nucleus with a complex historical relation with the German-centred neighbouring region. We will see that also the selected economic indicators show a substantial homogeneity between them, while differentiating these two countries from the Core (and the periphery at the same time). It should be obvious by now why we labeled this group 'Semicore'.

We included in our sample the Visegrad group, composed by Eastern European industrialized countries (all of them are part of the OECD), members of a political alliance testifying their tight bonds. Thus, Poland, Czech Republic, Slovakia and Hungary make for the fourth group object of our analysis, named 'Gersphere' for reasons which will soon be explained: such reasons make for the premises of this work, its linking thread, and raise hints for further investigation, as we will bring up in the concluding section of the paper.

Table 1 presents a synthetic indicator for the degree of integration in productive activities among Germany and the other countries included in the sample, as measured by the foreign value added (or 'import') content of Germany's exports - sometimes referred to as backward linkages in global value chains (Organisation for Economic Co-operation and Development (2015)) - weighted by manufacturing value added of the country of origin. In other words, the table reports the share of manufacturing value added of a given country which is exported to Germany by that country and then used by German firms in the production of final goods that are eventually exported. It is a standard measure of economic integration within global value chains. The results show a high degree of integration between Germany and all the countries which we have gathered in the Gersphere group. Their level of integration is comparable (indeed, in every case but Poland) to the level of Austria, which shares obvious cultural, historical, and economic ties with Germany. The aforementioned countries clearly stands out and this economic indicator is therefore crucial to ascertain the existence of a group of countries (i.e. the Gersphere), which can be considered together in the proceeding analysis due to their production linkages with the manufacturing powerhouse of Europe.

Other scholars have highlighted these important factors when analysing the relationship between Germany and its eastern neighbours (e.g. Sinn (2006); IMF European Department (2013)).

Group	Country	2011
Core	Austria	6.29%
	Finland	2.19%
	Netherlands	2.62%
Periphery	Greece	1.33%
	Italy	2.37%
	Portugal	1.94%
	Spain	1.99%
Semicore	Belgium	3.56%
	France	2.48%
Gerpshere	Czech Republic	7.57%
	Hungary	6.83%
	Poland	4.38%
	Slovak Republic	6.86%

Table 1: Foreign value added (or 'import') content of Germany's exports. *Source*: Author's elaboration based on OECD and UNIDO data

On the other hand, others have pointed out the reshaping of trade which have affected European countries, especially after the onset of the crisis, and especially those dynamics which let differences between those eastern countries and other peripheral countries (Mediterranean periphery) emerge (Celi et al. (2017)). Thus, we believe a centre-periphery approach to be extremely relevant as an interpretative key for the EU scenario. However, these studies, generally speaking, do not explore in depth the possibility that the heterogeneity between these peripheries might actually be the outcome of a medium to long run process of different patterns of industrial policy. In fact, exploring other indicators meaningful for the theoretical background which we rely on, we uncover that this might actually be the case, and that the EU-level of aggregation seems to be less significant than the grouping that we propose, where national peculiarities stand out and hint that a larger relevance should be given to historical-cultural-geopolitical factors, rather than the reading provided by the economic theory of smooth transfers of productivity between highly integrated countries.

As a matter of fact, we will show in the following sections that these distinct groups of countries display a broad heterogeneity between them and at the same time a substantial homogeneity within them for a wide range of economic indicators. This appears to be the result of an evolutionary process which has taken place in the whole period considered, and at an even higher pace in the years following the global crisis[1].

[1] Archibugi and Filippetti (2013), which has been of inspiration for this work, reaches slightly different conclusion; however, their analysis draws on a different methodology and, most importantly, it confirms the crisis as a turning point: in some cases reversing the process from convergence to divergence, in some others exacerbating divergence.

4 Different indicators, same heterogeneity

The European Union is often portrayed as a homogeneous club of countries. They are all established liberal democracies, with similar institutional settings. Nevertheless, when it the focus gets narrower, the picture is much more complex and perhaps controversial. The most common indicator of living standards that is found in the literature is GDP per capita. Recent available data shows that within the EU we see a substantial degree of difference between member States. Looking at the countries in our selection, we can see that the level of GDP per capita[2] of certain Core countries (e.g. Germany, The Netherlands) is almost twice as much as some other ones in the Periphery (e.g. Greece and Portugal) and in the Gersphere (e.g. Hungary and Poland). Although values within each group are relatively homogeneous (with the exception perhaps of the Periphery), the heterogeneity of countries in the sample as a whole is relatively high. The average values for each group[3] illustrate this inter-groups heterogeneity.

Country	GDP per capita (2016)	Labour productivity (2015)
Austria	43,069	54.1
Finland	38,494	50.6
Germany	43,076	59.2
Netherlands	46,295	61.5
Core	**43,394**	**58.8**
Greece	23,754	31.3
Italy	33,621	48.0
Portugal	27,224	32.3
Spain	32,796	46.9
Periphery	**32,259**	**45.4**
Belgium	41,273	64.4
France	37,208	59.4
Semicore	**37,849**	**60.2**
Czech Republic	30,643	34.7
Hungary	24,716	31.4
Poland	24,921	28.4
Slovak Republic	29,040	38.4
Gersphere	**26,379**	**31.4**

Figure 1: 'Production' indicators. *Source*: Author's elaboration based on OECD data

The same appears to be valid also for other indicators, hourly labour productivity[4] above all. Not surprisingly, the countries with a higher level of labour productivity are also relatively better off in terms of GDP per capita, mirroring the degree of heterogeneity among countries.

[2]Measured in US Dollar 2010 constant prices at Purchasing Power Parity.

[3]The average values for each group are calculated using the relative within-group size of each country in terms of GDP.

[4]Measured in GDP per hour worked.

Works on the field are generally focused on the fundamental variable of per capita GDP (and GDP growth differentials), sometimes (as in the case of the quoted IMF paper) enriched by the analysis of nominal economic indicators. Besides, there is a significant and growing literature on the evolution of trade flows, which interestingly came to highlight roughly the same grouping of countries even concerning patterns of trade and deficit/surplus[5]. However, little if no analytic attention has been given to the state and dynamics of indicators representing the technological development and the innovation capabilities of the national systems of innovation involved. This is a lamentable gap in the literature, as the stability of the grouping of the considered countries across the board of the indicators seems meaningful: this seems to point to member States' intrinsic national and country-specific features of their own system of innovation and production.

We thus look at the most recent innovation indicators (Dosi et al. (2006), representing the underlying factors of a higher level of productive capacity (see section 2). The figures tell similar results with respect to 'production' indicators, only with some minor alterations in the ranking. Core and Semicore countries have performed much better in recent years relative to the Periphery and Gerspere, sometimes twice or three times as much.

Innovating from the established literature (e.g. Nelson (1993), Dosi et al. (2006)), our indicator of research and development is not the usual GERD (Gross Expenditure on Research and Development) over GDP. Instead, we have decided to compute a standardized measure of R&D, dividing the absolute amount of GERD in each country by its total population[6]. This has been done because in the following section the pattern of R&D expenditure is analyzed through time. Therefore, the classic R&D over GDP indicator would have been highly susceptible to the fluctuations of the denominator, which has been through quite significant drops in peripheral countries after the 2008 crisis: this would have biased the data markedly, as some countries would have shown a better performance in R&D spending simply as a result of GDP falling more than absolute GERD. GERD over population is instead a much more stable indicator across time. In 2015 it indicated that Core countries perform slightly better than the Semicore, around three times better than the Periphery and four times better than the Gersphere. Nevertheless, the difference between the two latter groups is only minor and not always coherent (i.e. Czech Republic performs better

[5]This coincidence had already been emphasized in Brancaccio (2012), where one of the first critiques to the optimistic view of Blanchard and Giavazzi (2002) was put forward: as already hinted, according to the latter within a highly integrated union trade deficits would have entailed a higher productivity growth in the future (hence growth of income and eventually the possibility to repay debt). Instead, countries displaying a tendency to an increasing foreign debt were also those showing a lacklustre productivity performance. This tendency has definitely strengthened in the meanwhile.

[6]The unit of measure for GERD is millions USD 2010 constant prices at Purchasing Power Parity, while the population has been considered in thousands.

than any Periphery country, while the figure for Italy is almost twice as much as for Poland).

Patents statistics, although not completely reliable[7], reveal major differences among these countries, with a high level of patenting in Core and Semicore countries, and an infinitesimally small patenting effort in all the peripheral countries (the two groups together) with the only exception of Italy (whose figure - weighted by population - is nonetheless less than one fifth of the average of the Core).

Less dramatic but still substantial is the difference in terms of the number of researchers over labour force, where Semicore countries perform slightly better than any other group. Quite surprisingly, the Periphery and the Gersphere display similar values in this respect.

Country	GERD over population (2015)	Patents over population (average, 1995-2013)	Researchers over labour force (in thousands, 2013)	High-tech exports (% of exports, 2013)
Austria	1.34	40.7	9.3	13.7
Finland	1.10	64.6	14.5	7.2
Germany	1.24	74.0	8.5	16.1
Netherlands	0.91	75.2	8.5	20.4
Core	**1.19**	**71.2**	**8.6**	**16.2**
Greece	0.23	1.3	6.0	7.5
Italy	0.44	13.5	4.6	7.2
Portugal	0.34	1.4	7.2	4.3
Spain	0.39	4.7	5.3	7.7
Periphery	**0.40**	**8.8**	**5.1**	**7.2**
Belgium	1.00	42.8	9.4	11.5
France	0.82	41.6	9.3	25.9
Semicore	**0.85**	**41.8**	**9.3**	**23.6**
Czech Republic	0.58	2.0	6.5	7.8
Hungary	0.33	3.9	5.8	10.3
Poland	0.24	0.7	4.1	14.8
Slovak Republic	0.33	0.8	5.4	16.3
Gersphere	**0.33**	**1.5**	**4.9**	**12.9**

Table 2: 'Innovation indicators'. *Source*: Author's elaboration based on OECD data

Finally, the share of high-tech exports over total exports reports remarkably low values for the Periphery, compared to every other group, Gersphere included. The latter is surprisingly displaying figures that are not so dissimilar from those of the Core, hinting to a possible similarity in their exports specialization.

The underlying picture of the figures presented in Table 2 is the following: the European Union presents a high level of heterogeneity among its member States, with respect to economic performance and innovation capacities. The classification is generally stable across various indicators,

[7] Values for patents fluctuate substantially across years, therefore a 19 years average has been considered in this case.

with Core and Semicore countries leading, Periphery and Gersphere lagging behind. This first result is what has motivated the central part of this work, as it has pushed to investigate whether any process of convergence has taken place in the past two decades among these groups of countries. If this was the case, one would expect them to reach similar levels in the future, meaning that the EU as a whole will become a more homogeneous area, also in economic and technological terms. The picture, as it will appear from our empirical assessment, is more complex and requires further specifications.

5 Multi-speed Europe: convergence and divergence

This section is thus devoted to the investigation of the historical trajectory which has brought to the current static picture, as we are facing such a broad heterogeneity between the EU members considered. Firstly, we look at convergence in terms of GDP per capita, following the methodology presented in Franks et al. (2018). Two types of convergence measures are identified, relying on the seminal paper by Sala-i-Martin (Sala-i-Martin (1996)): σ convergence and β convergence. The two indexes reflect different aspects of the phenomenon of convergence, therefore - as the author who elaborated them insists - both are needed to analyse a set of elements in their historical development. Whereas σ convergence captures whether the cross-country variation of a given indicator reduces over time, β convergence relates to the mobility of individual countries within the given distribution in the sample.

σ convergence would thus appear if the value of that coefficient decreases progressively through time:

$$\sigma = \frac{standard\ deviation}{sample\ mean} \tag{1}$$

On the other hand, β convergence requires the correlation to display a negative and possibly high β value:

$$\gamma_{i,t,t+T} = \alpha + \beta log(y_{i,t}) + \epsilon_{i,t} \tag{2}$$

Where $\gamma_{i,t,t+T}$ is equal to country i annualized growth rate of the considered indicator between t and $t+T$, and $log(y_{i,t})$ is the logarithm of the level of the same indicator at time t.

However, given the striking heterogeneity which has emerged in the previous section, in this work we introduce a novelty in the methodology, with the goal of bringing to surface the potential presence of 'convergence clubs' (Sondermann (2014))[8]. Our σ convergence is in fact based on the coefficient of variation within different samples: (i) the total sample of countries considered in this paper; (ii) the total sample minus Gersphere countries; (iii) the total sample minus Periphery countries. We have applied such strategy in a few cases also for the β convergence, which in general is computed by correlating the initial value of a given variable (in log terms) with its rate of growth throughout the period: a necessary (but not sufficient) condition for convergence to be at play is higher initial levels for a given indicator corresponding to above average rates of growth.

The time span used for each indicator goes from 1995 to the latest available data for each of them (depending on the indicator, 2013, 2015 or 2016: the actual final figure available is accounted for in each corresponding graph).

Results for GDP per capita for the total sample are broadly in line with those of Franks et al. (2018), who look at a slightly different time period and consider a relatively larger sample of EU countries. If all countries are considered, convergence appears in terms of a lower variability through time (σ convergence) and also with respect to a catching up process over the period (β convergence). However, when the sample is split excluding first the Periphery and then the Gersphere some interesting results emerge. Convergence is stronger without the Periphery, while the picture is completely reversed if the Gersphere is dropped from the sample: the resulting sample is in fact characterized by actual divergence (Figure 2). The conclusion is that even if the coefficient of variation of the overall sample decreases through time, this is essentially explained by the catching up of the Gersphere, which more than compensates for the Periphery actually further falling behind.

The β coefficient (Figure 3) for the overall sample is solidly negative, while no significant correlation appears in the sample without the Gersphere. This confirms that, in terms of GDP per capita, Gersphere countries have converged towards higher levels, while Periphery countries (with the minor exception of Spain relative to Austria and Germany) have actually diverged from the Core economies.

The same identical and inequivocal pattern is found in the case of labour productivity. If the total sample is considered, we find both σ and β convergence. The coefficient of variation among

[8]The same intuition was applied in Neven and Gouymte (1995), although with a completely different approach; in any case, to our knowledge, this has not been explored further in more recent literature.

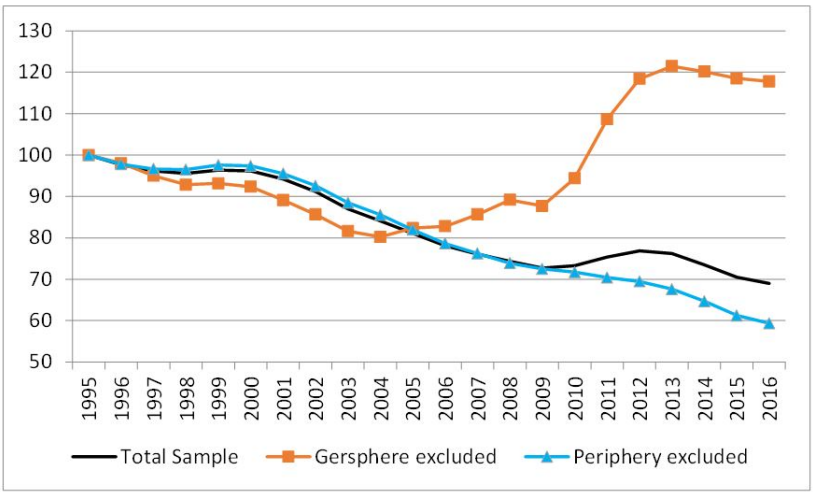


Figure 2: GDP per capita σ convergence. Author's elaboration

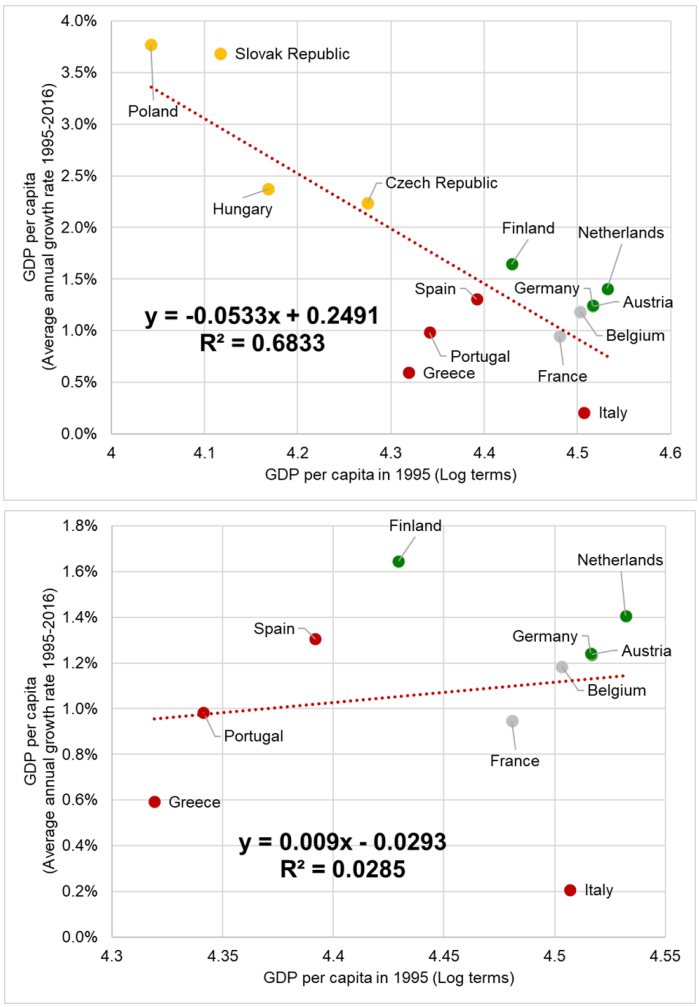


Figure 3: GDP per capita β convergence: total sample (top) and Gersphere excluded (bottom). Author's elaboration

all countries becomes progressively lower, but this is once again explained by the Gersphere moving towards higher productivity levels (Figure 4). If the sample is divided as before, stronger convergence appears by leaving out the Periphery, while no convergence results when the Periphery is pooled together with Core and Semicore countries. This is quite evident with the β exercise illustrated in Figure 5. In fact, the non-convergence would be actual divergence if only Spain and Italy (which account for about 85% of GDP in the Periphery), with their dismal performance, were to be considered. Both countries have registered significantly low productivity growth rates, twice or three times less than Core and Semicore countries, despite being on similar levels in 1995.

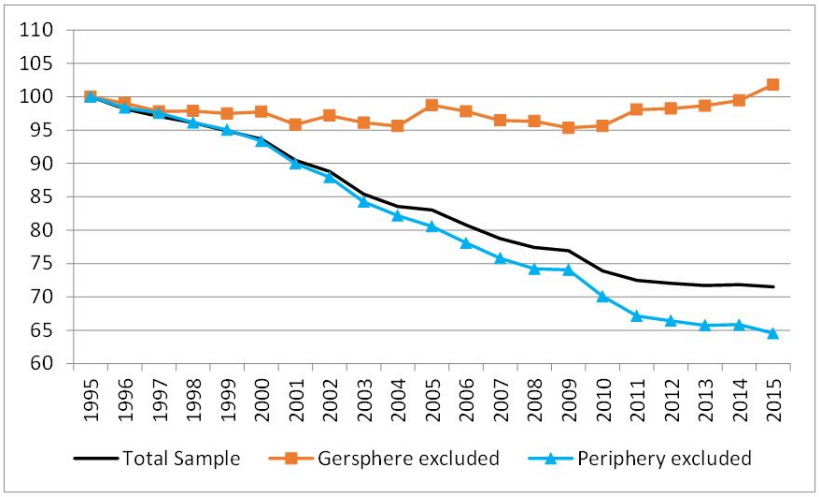


Figure 4: Productivity σ convergence. Author's elaboration

Nevertheless, when the convergence analysis is applied to innovation indicators the dichotomy convergence-divergence become less pronounced, at least with respect to the number of patents and the number of researchers. In those cases, a broad moderate convergence pattern is present in each different sample, either excluding and including the Gersphere and the Periphery (Figure 6, middle and bottom). In the case of patents, Hungary behaves as an outlier with respect to its group, with an actual decrease in the value, relative to 1995, despite an initial higher level. With respect to the number of total researchers, Poland and Italy display growth rates much below than average, while Portugal and Czech Republic considerably outperform every other country. This results in a much lower fitness of the regression.

In the case of Gross Expenditure on Research and Development (GERD) over population, σ convergence is stronger when the Periphery is excluded (Figure 7), yet it starts appearing only from 2007 onwards. The reduction in variation is moderate and fluctuating in the sample without the Gersphere after 2005, while it is basically non-existent in the preceding years. Also in this

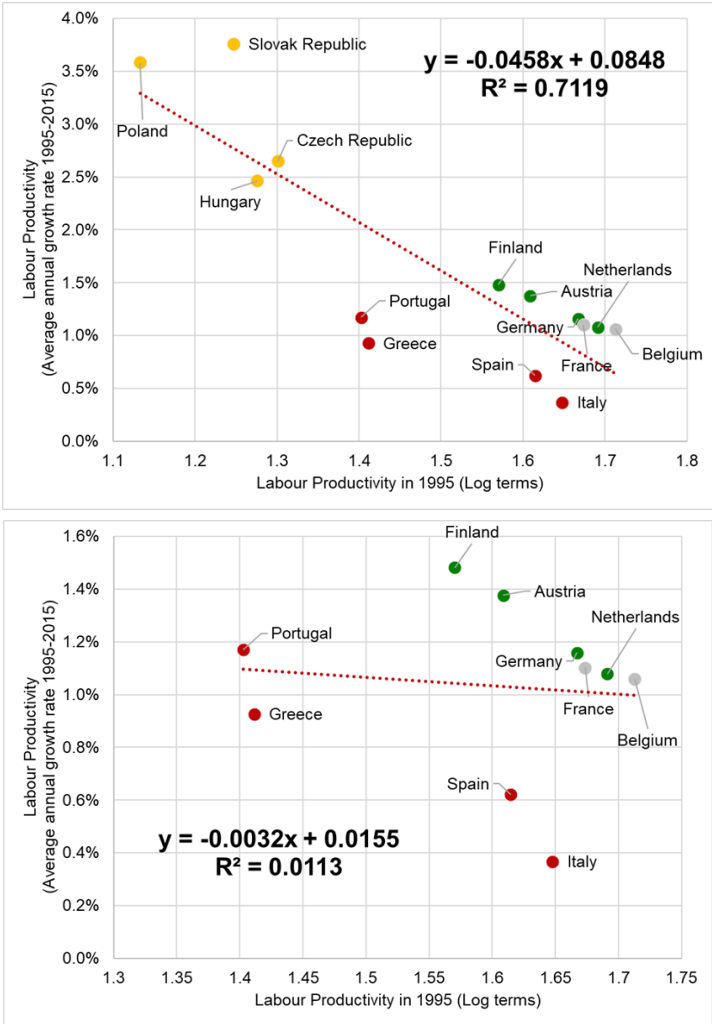
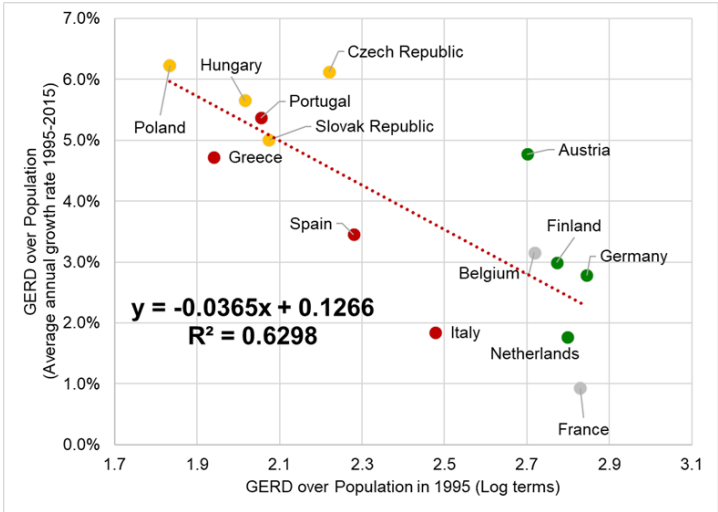
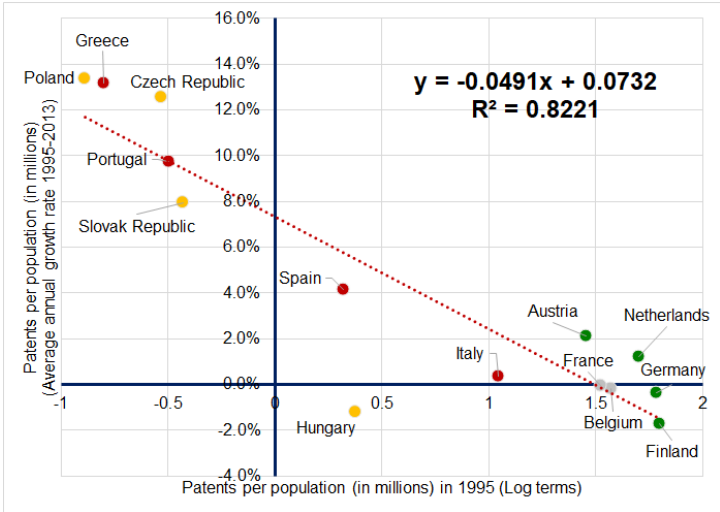


Figure 5: Productivity β convergence: total sample (top) and Gersphere excluded (bottom). Author's elaboration





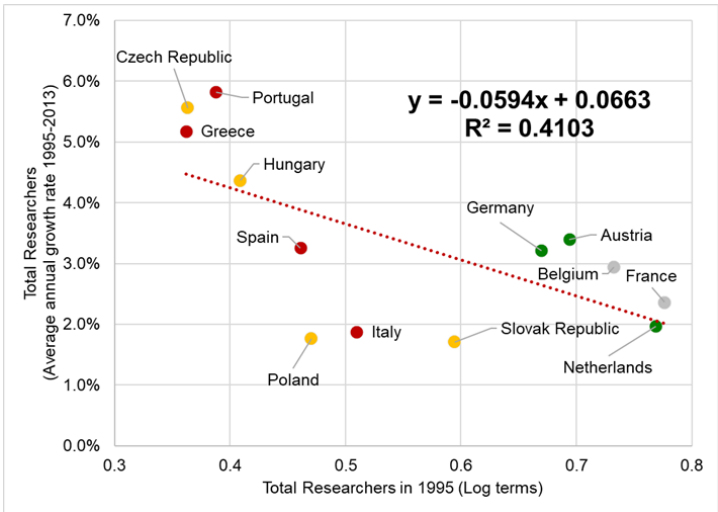


Figure 6: Innovation indicators β convergence. Author's elaboration

case, Spain and Italy perform well below the average, and the same *caveat* highlighted in the case of productivity applies. The β value for the overall sample is relatively high and significant but it would not be so if only Spain and Italy were to be confronted with the leading groups (Figure 6, top). All Gersphere countries show instead high growth rates of GERD over population, signalling that an effective convergence on that indicator has been taking place, especially in recent years.

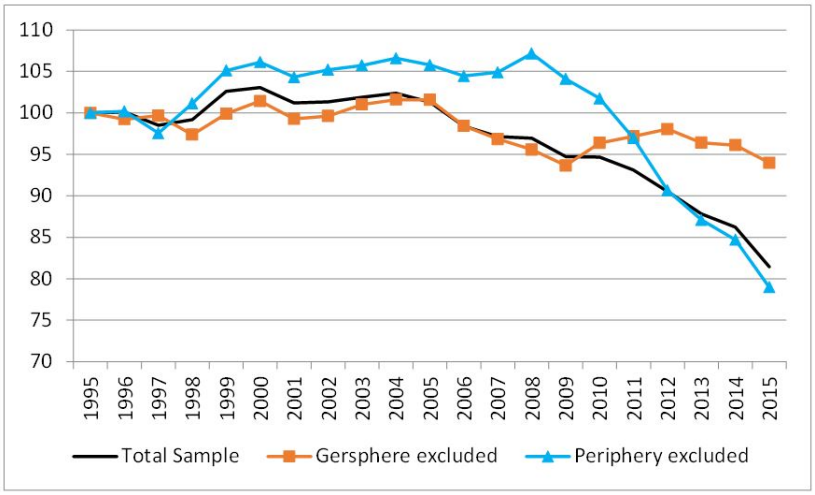


Figure 7: GERD over population σ convergence. Author's elaboration

However, the most telling indicator among the four related to the performance of the National System of Innovation is the share of high-tech exports over total exports. Here the pattern of strong convergence for the Gersphere and divergence for the Periphery is once again extremely visible. The coefficient of variation (Figure 8) falls by more than 40% in the sample without the Periphery (in line with the values for GDP per capita and productivity), while it fluctuates a lot around the initial value if the Gersphere is instead excluded.

At the same time, the β value for the latter sample is almost zero, as well as the correlation. In the overall sample (Figure 9), Gersphere countries are all well located above the trend line, showing a consistent above average performance, while the opposite happens with the Periphery countries. Italy and Greece have effectively reduced their share of high-tech export, since 1995.

The overall convergence of the indicator 'high-tech exports' is decisively driven by those exact countries that have progressively become more and more integrated in the German supply chain of exports (mostly of medium-high value added): those countries, i.e. the Gersphere plus Austria, have experienced a significant increase in the share of high-tech exports, hinting to a positive effect implicit in the integration with the German production matrix.

In conclusion, it seems that the reason of the stronger convergence of Gersphere countries in

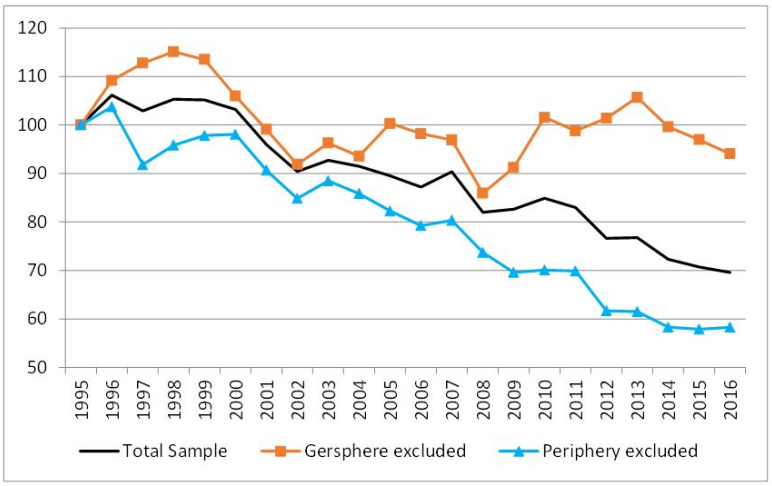


Figure 8: High-tech export as a percentage of manufacturing export σ convergence. Author's elaboration

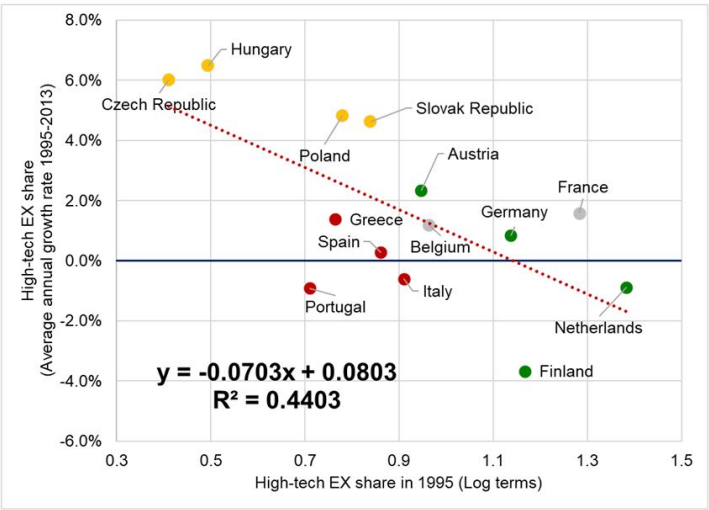


Figure 9: High-tech export as a percentage of manufacturing export β convergence. Author's elaboration

terms of GDP per capita and labour productivity cannot be limited to their slightly better performance in the traditional indicators of input and output of innovation (with respect to the Periphery). Nevertheless, the figures presented so far might suggest that those countries have been able to embark on a process of upgrade towards more sophisticated production and thus export goods, while some of the Periphery countries (e.g. Italy and Portugal) have seen their ratios declining over the years. Arguably, demand factors - we have made reference in Section 2 to the Kaldor-Verdoorn approach - play a key role in determining the structural composition of the economy and its commercial ties with the most technologically advanced productions in the Core[9], thus shall be an important factor for the explanation of convergence trends in general indicators such as productivity and living standards. However, consistently with the analysis developed so far, the limited scope of the following section concerns a comparison of structural change paths, able to shed some light on the patterns highlighted so far.

6 Structural change and conditional convergence

The statistics used in this work attempt to measure different patterns existing within the EU. Using the country level as the analytic focus has some drawbacks: for instance, the relative dynamics of the various economic/productive sectors within a given country may play a uncovered but crucial role in determining the overall performance of the country in terms of productivity growth and all the other variables considered. In fact, the sectoral composition of the economic system may itself be the main determinant of shifting technological hierarchies (upgrading/downgrading) between different countries. In Valentini et al. (2017) it is argued that the structural change from manufacturing activities towards services can happen following two different patterns: either towards service activities with high knowledge content, or with low knowledge content. Da Silva and Teixeira (2012) refer to virtuous structural change as opposed to vicious structural change. An unavoidable reference is to be made to Rodrik's insightful research on the matter (Rodrik (2012); McMillan and Rodrik (2011)). In particular, within this work, we will take into account the notion of conditional/unconditional convergence together with a few remarks on structural change.

First of all, a clarification note is needed: Sala-i-Martin (1996), on which the β and σ indexes that we have estimated are based, proposes a notion of conditional convergence which is fully embedded in the neoclassical paradigm. The argument goes as follows: although the data do

[9]To this regard, see the recent works Deleidi et al. (2018); Tridico and Pariboni (2017), focussed on the specific historical trend of deindustrialization.

not support Solow model's forecast of (unconditional) convergence across countries (i.e. poorer countries growing faster than richer countries, and thus catching-up), a different type of convergence, namely 'conditional' convergence can still be upheld. According to this notion, countries would converge towards their respective steady state: the supposed lack of convergence would thus be explained, in this framework, by the different steady states peculiar of each country (or group of countries with comparable level of development). Here, we do not refer to this notion of conditional and unconditional convergence. Rather, we fully agree with the point made in Rodrik (2012): 'Whatever convergence one can find is conditional: It depends on policies, institutions, and other country-specific circumstances'. Rodrik's research shows instead the existence of a clear pattern of unconditional convergence occurring in the modern sectors of the economy, not in the economy as a whole. This is highlighted by a 'highly robust tendency toward convergence in labor productivity in *manufacturing* activities, regardless of geography, policies, or other country-level influences'.

We have already shown that clear patterns separating the groups of countries that we have built in this study emerge in the case of high-technology exports, signalling the reshaping of the hierarchies in the most modern parts of the economic systems considered. Given Rodrik's results, it is important to consider the evolution of the manufacturing sector across the groups which have become objects of this analysis. With this respect, it is interesting to note the evolution of manufacturing VA shares for each group[10]: Figure 10 depicts a stability in the share for Core and Gerpshere countries and a significant fall for the Periphery and the Semicore. As convergence in productivity takes place in this sector, the evolution of the sector is meaningful for the convergence (or lack of it, or even divergence) of each country as a whole. Moreover, unconditional convergence in manufacturing should not come as a surprise, as this sector produces tradable goods which can be rapidly integrated into global production networks, facilitating technology transfer and absorption. In fact, the reshaping of trade relations across the EU has been highlighted by many recent studies, one of the most recent and complete being Celi et al. (2017): it is a meaningful remark to introduce the empirical evidence which follows.

However, a further specification will be of much help. As clearly stated in McMillan and Rodrik (2011), p.2: 'globalization has facilitated technology transfer and contributed to efficiencies in production. Yet the very diverse outcomes we observe [...] suggest that the consequences of globalization depend on the *manner* in which countries integrate into the global economy. [...]

[10]Later the analysis will shift to the employment share, instead of the VA share.

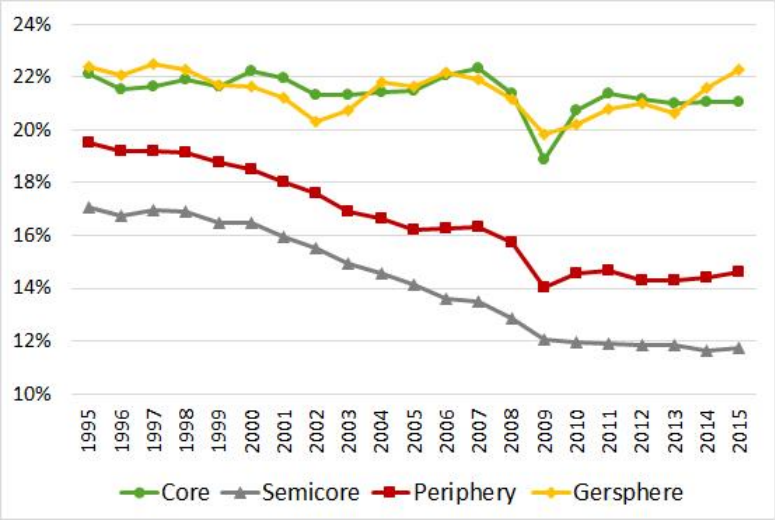


Figure 10: Manufacturing Value Added over GDP. *Source*: Author's elaboration on OECD data

In particular, a high rate of productivity growth within an industry can have quite ambiguous implications for overall economic performance if the industry's share of employment shrinks rather than expands. If the displaced labor ends up in activities with lower productivity, economy-wide growth will suffer and may even turn negative'[11].

As a matter of fact, this seems to have been a decisive factor shaping the different patterns of the two peripheral groups, Gersphere and Periphery. The implication from the empirical exercise shown below seem to point unquestionably to the relevance of the aforementioned dynamic. We have replicated the analysis performed in McMillan and Rodrik (2011), for what concerns the relative expansion/contraction of the economic sectors within a given economy. Sectors have, of course, different performances in productivity. We have thus tested the evolution of the economic sectors of the biggest economies of the two peripheral groups in the period considered; the database we rely on is the *EU KLEMS Growth and Productivity Accounts* (see Jäger (2017)), as it includes the European countries we are interested in. As resumed in Table 3, we use the *EU KLEMS* sectors, but we exclude for each country the two smallest sectors (accounting together for between 0.8% (Italy) and 2.6% (Czech Republic) of the labour market), which are also outliers in terms of productivity values, and the somewhat residual sector gathering the activities of households producing goods and service for own use. It is a rather big sector, whose economic meaning is nonetheless very doubtful. We apply the original labels in order to let the reader easily compare the results with the dataset and with other works based on it.

[11] In addition, one should also consider that 'For a worker, unemployment is the least productive status of all'. The groups of countries analysed in this paper show very different levels of unemployment, consistent with the overall economic performance and with the other indicators presented.

Sectors included in the graph	Label
AGRICULTURE, FORESTRY AND FISHING	A
TOTAL MANUFACTURING	C
ELECTRICITY, GAS AND WATER SUPPLY	D-E
CONSTRUCTION	F
WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES	G
TRANSPORTATION AND STORAGE	H
ACCOMMODATION AND FOOD SERVICE ACTIVITIES	I
INFORMATION AND COMMUNICATION	J
FINANCIAL AND INSURANCE ACTIVITIES	K
PROFESSIONAL, SCIENTIFIC, TECHNICAL, ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES	M-N
PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY	O
EDUCATION	P
HEALTH AND SOCIAL WORK	Q
ARTS, ENTERTAINMENT, RECREATION AND OTHER SERVICE ACTIVITIES	R-S
Sectors exlcuded from the graph	**Label**
MINING AND QUARRYING	B
REAL ESTATE ACTIVITIES	L
ACTIVITIES OF HOUSEHOLDS AS EMPLOYERS UNDIFFERENTIATED GOODS AND SERVICES FOR OWN USE	T

Table 3: Sectors. *Source*: EU KLEMS

Labour productivity is measured in this database as the ratio between value added and employed people[12], differently from what we have done previously in this work, which in principle would be preferable even here: using hours worked avoids biases caused by part-time contracts. Nonetheless, the same indicator we adopt in this section is used by McMillan and Rodrik (2011), although they rely on a different dataset, as they analyse different countries.

As it can clearly be seen by the charts in Figure 11 and Figure 12, the patterns of Italy and Spain, the two most important countries of the Periphery, are similar and at the same time neatly distinct from the pattern of the two most relevant countries of the Gersphere, Poland and Czech Republic, which share instead a 'virtuous' structural change. Broadly speaking, between 1995 and 2015, workers have moved from highly productive sectors to sectors with a comparably lower level of productivity in the two largest economies of the Mediterranean periphery. On the contrary, the most important countries of the eastern European periphery have switched to relatively more productive sectors. This is neat even in the case of Poland, where data are available only since 2000. In particular, the points in the diagram which fall above the unit line on the vertical axis represent sectors with a productivity level which is higher than the average: most of them have shown a decrease in employment in Spain and Italy. Both countries show Information and com-

[12]The variable considered is actually *EMP Number of persons engaged*, being more complete than the variable *EMP Number of employees*, as it includes any worker afferent to the sector, either employed, self-employed or employee.

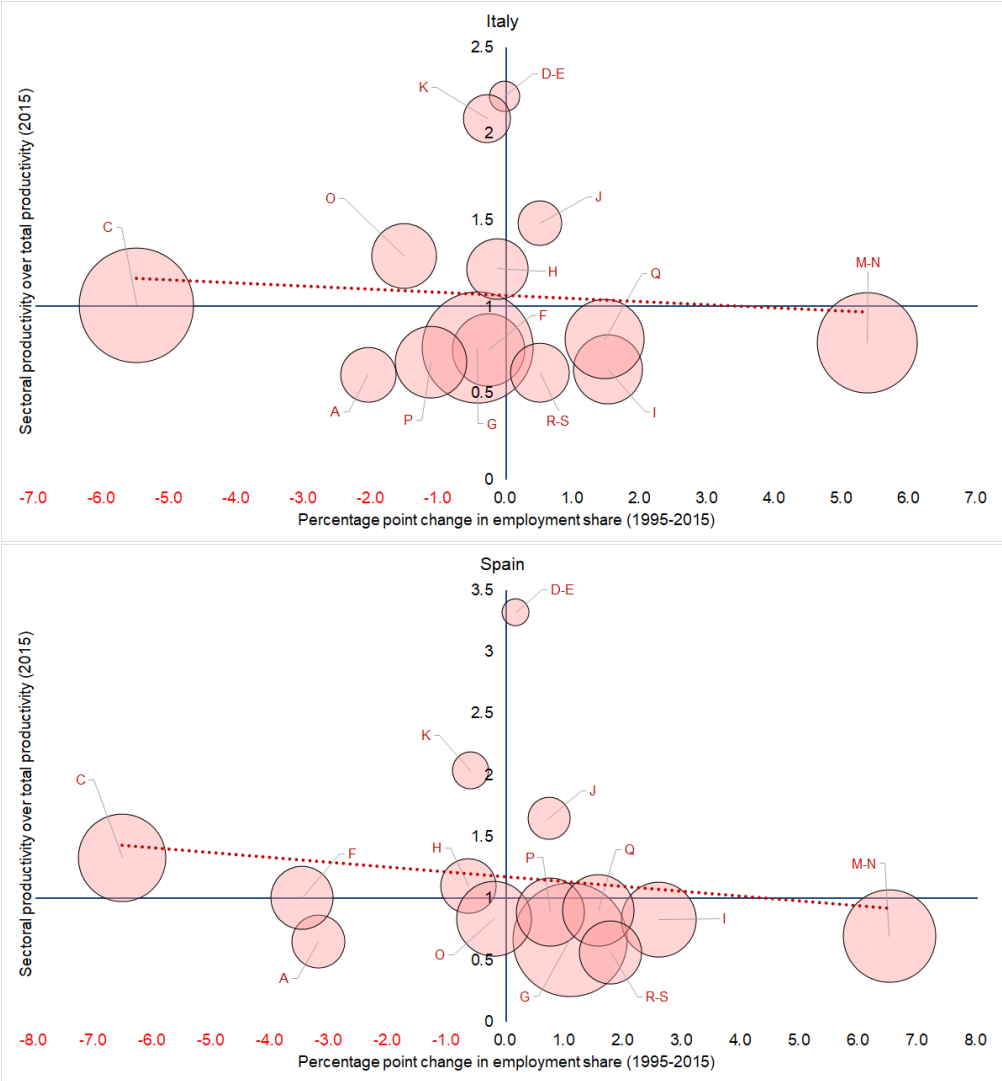


Figure 11: Correlation between sectoral productivity and change in employment shares for selected Periphery countries. Size of circles represents employment share in 2015. *Source*: Author's elaboration on EU KLEMS data

munication (J) as the only high productive sector significantly increasing its employment share, yet this is a sector employing only about 2.5% of the labour force (the size of the circles represents the employment share at the end of the period, 2015). The opposite case is illustrated by Poland, where between 2000 and 2015 there has been a huge drop in the share in the dimension of agriculture (A) over the national economy as a whole (almost 9 percentage points); displaced workers have moved to above-the-average sectors, with the increase of 2.5 percentage points in sector *M-N* (highly productive services), now employing 6.3% of the labour force, being extremely meaningful.

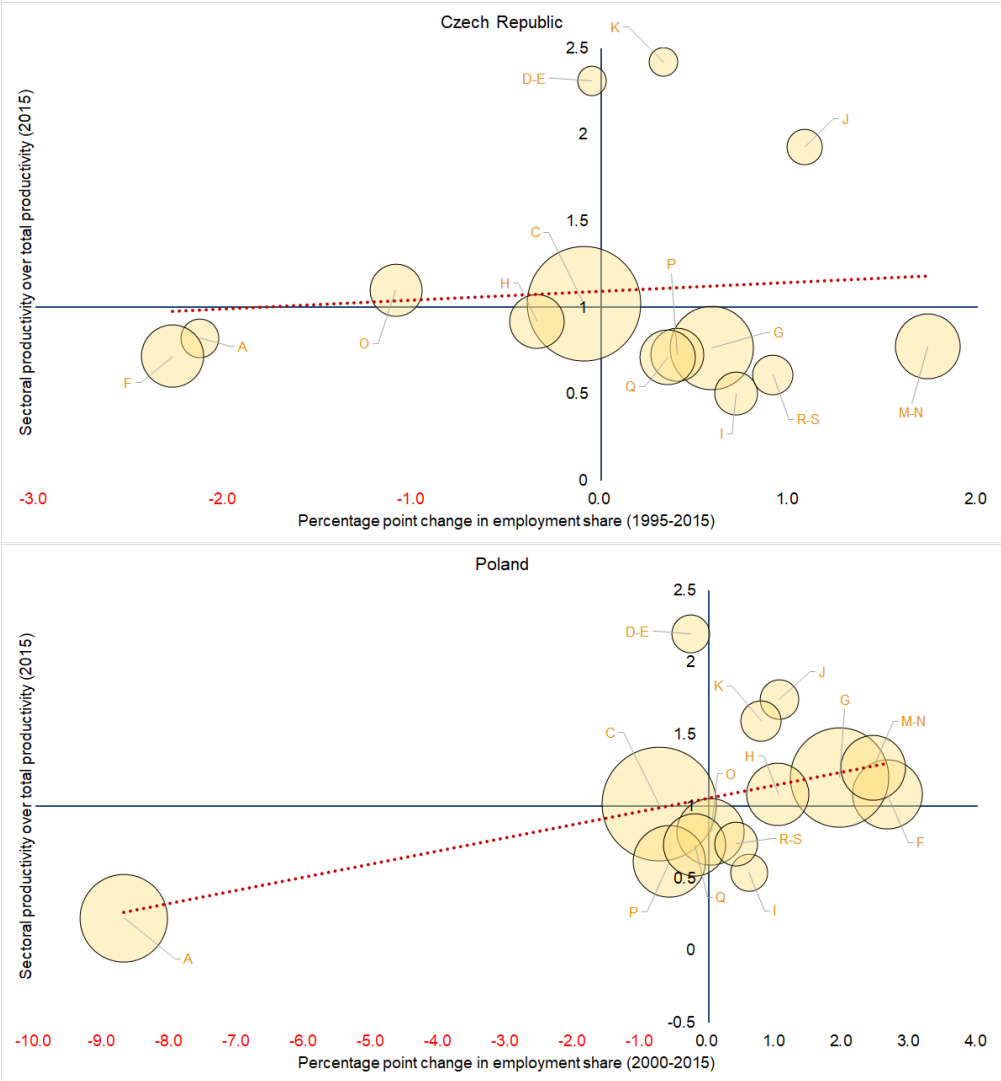


Figure 12: Correlation between sectoral productivity and change in employment shares for selected Gersphere countries. Size of circles represents employment share in 2015. *Source*: Author's elaboration on EU KLEMS data

Czech Republic tells a slightly different story. In this case, the magnitude of the shifts of

workers is much smaller than the other countries, including Poland for which we have data for a shorter time span. Here, the percentage points of difference range between -2.3 and +1.7, whereas the other countries record much larger shifts. This also means that manufacturing has kept the same employment share it had in 1995, while at the same time experiencing an absolutely impressive growth in within sector productivity (280%, compared to 52% in Italy, for instance). Thus, borrowing the terminology from Cantner et al. (2018), it might be argued that between-sectors effects have been very important for Italy, Spain and Poland, while the within-sector growth of highly productive large sectors of the economy seems to have played a paramount role in Czech Republic[13].

We might conclude the section sharing Cantner and coauthors' final remark: 'we are interested in the structural dynamic lying behind slowdown in productivity and innovative activities rather than in their specific determinants [...] For example, we do not discuss how import-export dynamics (that is the international distribution of production) can affect the PS [Productivity Slowdown]. Nonetheless, issues such as the effects of international trade on productivity growth falls into our explanation of the trends in terms of structural change - as international competition pushes labor to flow across industries with consequent compositional effects on aggregate productivity growth' (Cantner et al. (2018)).

7 Conclusive remarks

This essay contributes to EU studies as it highlights a few meaningful elements:

- the heterogeneity between groups of countries within the EU; they show such a homogeneous character within them and different features with respect to other groups, that one might draw the conclusion that historical, geographical, geopolitical, social elements matter more than the shared membership to a common supranational framework, when it comes to economic/productive performance;
- even more: each country's and group of countries' performance has to be considered with a very broad meaning. Apparently, recalling the National System of Innovation literature (and the connected Technology-Gap Theory), the heterogeneity (and homogeneity within groups)

[13] It is to be stressed that we are not arguing in favour of a 'between sectors explanation' as opposed to a 'within sectors' one. This section has instead been devoted to draw into the analysis the 'sectoral' element which would instead have been neglected, being this work based on the country level of aggregation.

concern a wide spectrum of indicators, mostly related to the 'innovative' and technological development of the economic systems object of the study;

- how is this static picture related to the medium term dynamic of the considered indicators? Is there a clear convergence pattern, as we would expect according to the dominant economic theory, or rather the countries are diverging? The picture is complex. In terms of 'productive' indicators (value added and productivity), there is a clear distinction in the pattern of southern and eastern peripheries: if this distinct patterns are overlooked, no neat statement can be made on the divergence/convergence in the European Union. Considering only the former, divergence is undeniable, even before the 2007 crisis, whereas considering the latter group, one has the impression of the EU as a story of unquestionable convergence. Thus, it would be appropriate to refer to 'convergence clubs' (Sondermann (2014)) (and 'divergence clubs').

- Although this reflects into a completely distinct performance between the two peripheral groups in terms of high technology export in the last 20 years - pointing to a reshaping of trade relations and hierarchies - the indicators related to investment in technology, research and innovation do not seem to account entirely for these different paths. Other elements shall be considered: besides demand factors, and intertwined to them, the evolution of the position of each country in the German-centred productive chain appears to be important.

- However, we have not focussed on this specific element, even though it might be interesting to further investigate the complex causal relations in force; rather, we have tried to shed some lights on the structural dynamics underlying the strikingly different performances in productivity between the two groups of lagging behind countries. The shifts of workers between economic sectors definitely stand out among the elements to be considered. Thus, the ability of each country to manage the displacement of workers from the most productive sectors turns to be key.

In sum, as we have mentioned in the title, multi-speed Europe is already there, and what Sondermann states for the eurozone (Sondermann (2014)) can be the concluding statement for this analysis as well. It is worth quoting at length: 'The convergence tests above suggest the hypothesis of the neoclassical growth model that countries with lower output or productivity level will catch-up over time cannot be confirmed for the euro area. Despite their economic and monetary union, euro area countries have experienced different productivity developments in most sectors,

indicating the presence of factors at work which impact productivity growth systematically and which are - at least partly - *susceptible to policy measures*' (our emphasis)[14].

A few conclusive remarks might be raised. It is worth stressing that in the development of the analysis, we have had in mind a form of competitiveness much less investigated in the literature, which usually focuses on labour cost. Instead, our research questions stemmed from the belief that other elements are more relevant in assessing the differences in the economic performances between EU member States.

Another element which originally stimulated our research concerns the relation that EU countries have with the economic and political core of the EU - most notably Germany. This aspect has then been slightly overlooked in the development of the analysis; however, the investigation has indeed strengthened our informed guess that this relation has been playing a key role in the evolution of European countries (relative) economic conditions. Just a few exemplifying remarks: the group that we have named Periphery has undergone a double displacement of its exports (Celi et al. (2017)): a first one in intermediate goods for production, as Germany has been increasing its productive complementarity with the eastern European countries; another in consumption goods, as the creation of a dual labour market in Germany, with the consequent fall in spending capacity of workers, has caused a diversion of demand towards low quality/low cost imports from Asian countries. Furthermore, as highlighted by Simonazzi et al. (2013), Germany performs different types of offshoring entailing different effects of German activity in partner countries, depending on the nature of each partner country: whether the relation is based on consumer goods and tourism, or it is based on intermediate goods. The structural transformation of German productive system, tending to incorporate its eastern neighbours, has been acknowledged in the literature. However, even the most recent and advanced contributions on the matter have left unexplored the relations of this feature with the innovation policy pursued in the involved countries: has there been an outstanding effort of the group we have labelled as Gersphere in strengthening their national systems of innovation? A comparison of these countries with southern European ones is also largely unexplored: they used to play a comparable role in German value chain, a role which have been playing less and less, being 'substituted' by the Gersphere countries. In the meanwhile, this latter group is involved in a catching up process, while the Mediterranean periphery is lagging behind: not only with respect to European core, but also - more and more - with respect to the

[14]Sondermann's analysis tackles the issue from a slightly different angle: there, the productivity performance in the manufacturing sector - we tend to agree on its paramount importance - becomes the major driver of national productivity performance as a whole. We consider his work, as well as the very recent papers Deleidi et al. (2018); Tridico and Pariboni (2017), as complimentary to the few notes that we have raised in Section 6.

eastern periphery itself. To this regard, an 'advantage of backwardness' (Gerschenkron (1962)) type of explanation is not convincing: in fact Portugal and Greece at the beginning of the period had productivity levels in line with the eastern countries.

This work does not aim at giving exhaustive answers, its goals is to give hints for further reflections, hopefully to be developed through case studies as well. Further research would be needed as well on identifying the causal relation between technology, economic growth and the factor which (jointly) drive them. What can be argued for sure, following Fagerberg and Verspagen (2015) is that: (i) many of the problems that the EU faces today have long term roots (ii) far from being a homogeneous set of countries, the EU consists of different countries, with different dynamics, and different capacities for adapting to changes in the global environment (iii) the 'one size fits all' policies had heterogeneous effects (iv) all of this is not properly tackled - it is actually worsened - by austerity policy (see also Valentini et al. (2017))[15]. Indeed, we believe researching on these issues is pivotal to shed light on the different effects that the global crisis has been having on EU countries (see also 'the real lesson' presented by Storm and Naastepad (2015)). The elements at the core of this study are arguably more significant than the features which are central in the political debate (and to many extents, in the academic debate as well), stressing the supposedly decisive role played by variables such as the public deficit, the public debt over GDP, the rates of interest, and so on.

[15]The theme of 'one size fits all' policies does not apply to fiscal policies only. An intriguing work by Brancaccio and Fontana (2016) insists on some theoretical insights, such as the famous works by Mundell (1961) and by Krugman (1993), showing that monetary unions tend by design to the - uneven between countries - concentration of capitals. It would be interesting to connect in a shared framework this literature with the present results on convergence and divergence.

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