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SPECIALIZATION IN THE EURO AREA: A VERTICALLY INTEGRATED SECTOR PERSPECTIVE

VERY PRELIMINARY DRAFT

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ABSTRACT

The imbalances among countries belonging to the European Monetary Union (EMU) have been analysed under several angles in recent years, (i.e. productivity growth, institutional characteristics, labor market policies, external trade balance, etc…), but often neglecting the evolution of economic and productive structures. In this work we aim to fill this gap analyzing the countries specialization through the differences in the inter-industrial linkages that affect economic systems competitiveness and production processes. The integration of specialization indexes in the input-output subsystem approach applied to the most recent released of the WIOD data (2018). Results show that disparities are growing in the composition of productive structure and they are even more pronounced when we consider intersectoral dynamics; in particular, when Knowledge intensive business services are addressed to satisfy the manufacturing final demand and when we control for manufacturing subsystem technological intensity.

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1. Introduction

In recent years, the attention of scholars and policy makers mainly focused on "monetary integration" and its consequences for the European Monetary Union (EMU) countries, while less attention has been paid to "real disintegration" (Bagnai and Mongeau Ospina, 2017).

The studies on imbalances among EMU countries analyse such phenomena under several angles (i.e. productivity growth, institutional characteristics, labor market policies, external trade balance, etc…), but often neglecting the evolution of economic structures. Put it another way, the phenomena of nominal and real divergence/convergence have been the object of several works, but the structural divergence/convergence among EMU countries still is an under-researched issue. Among the few contributions on this topic Palan and Schmiedeberg (2010), for example, provide evidence for European countries about structural divergence/convergence looking at intersectoral (agriculture, manufacturing, services) and inter-industry (for branches of agriculture, manufacturing and services) dynamics. The results point to a persistent intersectoral convergence, while the results at industry level are mixed, but showing a trend toward divergence for high-tech industries. Finally, two works of the European Central Bank (ECB) (MPC, 2004; Mongelli *et al.*, 2016) show the changes in the economic structure in European countries, pointing out not only the relevance for the transmission of monetary and fiscal policies, but also their crucial role as factors determining the degree of resilience in front of negative phases of the business cycles and the potential productivity growth.

While looking at this issue the horizontal perspective is a privileged point of view to analyze the evolution of economic structure specialization. This approach considers economic sectors as divided from one another and no interdependence is assumed (Syrquin, 2010). Hence, it offers a partial understanding of the phenomenon at stake. The technological progress has expanded the diffusion of inter-industry linkages in the economic system, and the intermediate stages of the value chains have become increasingly important in final production (Silva and Texeira, 2008). Another well-established notion claims that the economies have shown a gradual deindustrialization trend in terms of production and employment, supporting the emergence of a post-industrial knowledge economy (Tregenna, 2009; Rodrik, 2016), in which the manufacturing firms have deepened their interaction intermediates with other tertiary activities.

Therefore, these aspects have made the distinctions between sectors or industries obsolete mainly because traditional sectoral boundaries are becoming more blurred, causing some difficulties in the determination of the role of each industry in the economic system (Ciriaci and Palma, 2016; Di Berardino and Onesti, 2018). What emerges from this perspective is that, notwithstanding the relevant results obtained, it suffer from an intrinsic difficulty in measuring the indirect effects of the reorganization of economy. Structural change is not only an important element accompanying the process of transformation of economies but also a feature of the adjustment of these economies to the requirements of structural convergence in Euro area (Lechman and Olcyz, 2011).

Because of the gap in the literature and of the flaws in the current perspective of analysis the present work has a twofold value added. On the one hand, we aim at filling the gap in the literature about the changes in the productive systems of the EMU member countries in the 2000s. On the other hand, we address this topic by adopting a methodological approach that is different from the traditional analysis. Following the terminological specification as Palan and Schmiedeberg (2010), who label agriculture, manufacturing and services as sectors, and the manufacturing branches as *industries*, we want to provide a new perspective of analysis based on manufacturing and industries subsystems to analyse the potential structural changes in EMU countries of the manufacturing sector and its industries in the 2000s. Specifically, following Pasinetti's input-output subsystem approach, the paper analyses countries specialization through the differences in the inter-industrial linkages that affect economic systems competitiveness and production processes. The subsystem is an analytical representation of the economic structure that represents all the activities that are directly and indirectly needed to satisfy final demand for a specific good or service. Therefore, this perspective completes the information on the way in which the organization of economic system and within manufacturing is changing and it can identify a causal relationship that involves intermediates linkages.

Moreover, in previous works, the subsystem approach has been essentially used to measure the extent of the outsourcing process in manufacturing and to test the deindustrialization hypothesis (Montresor and Vittucci Marzetti, 2011; Ciriaci and Palma, 2016; Sarra et al, 2018; Di Berardino and Onesti, 2018). Consequently, this paper is the first study that adopts the subsystem approach to investigate inter-country structural convergence.

In order to empirically address our objective, we adopt the WIOD database (latest release) that covers a time span from 2000 to 2014 and we measure the evolution of subsystems specialization using the Krugman specialization index and looking at convergence/divergence trends among 19 EMU countries. Preliminary results show that disparities are growing in the composition of productive structures and they are even more pronounced when we consider intersectoral dynamics; in particular, when business services, KIBS in particular, are addressed to satisfy the manufacturing final demand and when we control for manufacturing subsystem technological intensity.

The reminder of the paper is organized as follow. The next section has the objective of providing a review of the background literatures that constitute the foundation of the present work and span from the Optimal Currency Area (OCA) theory, which helps in understanding the determinants of the convergence/divergence processes, to the works on the integration among manufacturing and services, in order to analyse the vertical integration processes in the different countries examined. Section 3 describes the methodological approach and section 4 show the results and provide comments and interpretations. The last section is left to preliminary remarks.

2. Background literature

2.1 Convergence in EMU countries

In investigating the convergence/divergence processes among EMU countries there is consensus on the nominal convergence experienced by them since the Euro inception, especially for price stability and long term interest rate (Toader and Gidiu, 2012), but at the same time it cannot be neglected that the process of real convergence stopped at the end of the 90s and started declining with the Great Recession and the sovereign debt crisis. As stressed by Galletti "[…] nowadays, a widespread consensus exists over the claim that nominal convergence, i.e. convergence in nominal variables like inflation and interest rates, was not followed by real and structural convergence." (Galletti, 2018, p.8).

At the very basis of the divergence process lies several elements, which have been stressed by works belonging to Optimal Currency Area (OCA) literature. Focusing the attention on studies belonging to the this literature is functional and suffice for this paper's scope in order to list some of economic and institutional elements that connote the EMU countries heterogeneity and that gives rise to asymmetries and processes of real divergence. According to the OCA theory there are specific dimensions that can be used in order to discriminate between unions of countries which could be better off outside a monetary union and groups of countries that could benefit by the establishment of a monetary union. These dimensions are at least three: symmetry, flexibility and economic/trade integration (e.g. De Grauwe, 2016). The higher the degree of each dimension for a group of countries, the higher the probability they enjoy benefits from a monetary union that overcome the costs associated to the monetary union itself: put it another way, that group of countries constitute an OCA.

Since the settlement of the EMU, the predictions on its survival and prosperity expressed by scholars were largely at the antipodes: the optimists stressed the fueling role of a single market/single currency for the Euro countries' growth and integration (e.g. Gaspar and Mongelli, 2003; EC, 1990); the sceptics (e.g. Krugman, 1993; Lane 2006) predicted a process of divergence across Euro countries, mainly driven by institutional heterogeneity, asymmetric countries' behaviours (Bolthon and Carlin, 2013) and lack of labour market flexibility. Divergence and asymmetries in EMU countries were also envisaged by Krugman (1991), who based his work on the U.S. experience that shows high levels of specialisation among U.S. states, despite the single currency. Other scholars, are even harsher in criticising the EMU, stressing the absence of

a real convergence among EMU countries (e.g. Bagnai and Mongeau Ospina, 2017) and also questioning the virtues of nominal convergence, since low interest rates could also be responsible for capital mis-allocation in southern countries, but not in northern ones (Gopinath *et al.*, 2015), exacerbating asymmetries within EMU. The EMU criticisers also discard by way of evidence the thesis of Frankel and Rose (1998): the endogenous forces of a monetary union that should lead to convergence do not seem to be able to counteract diverging forces in the EMU.

One of the features the detractors of EMU point out as a determinant of asymmetries and divergence is the heterogeneity of institutional setting of countries belonging to the EMU. This aspect has also been stressed within the Variates of Capitalism (VoC) literature, which specifically highlight the political differences[4] as elements behind the lack of convergence.

In synthesis, "both the advocates and the critics of the single currency stressed the convergence effects – or the persisting shortage of convergence – as motivations to bolster the single currency, or not." (Galletti, 2018, p.6).

While the attention of many scholars was focused on real and nominal convergence, less attention has been paid to the structural convergence (Palan and Schmiedeberg, 2010), which influences in the long run the real convergence (Alexoaei and Robu, 2018) among countries. Heterogeneity in productive structures among countries can be a potential catalysing factor for an (un-)even growth, triggering a real divergence process. An element that play a pivotal role in structural divergence/convergence is given by the productive structures of each countries and by their development: the more similar they become, the higher the structural convergence and, thus, the more likely will be the synchronisation of business cycles and the process of real convergence.

The role of specialisation and concentration of production activities in determining the path toward divergence among countries was stressed in a seminal work about twenty years ago by Krugman and Venables (1996), who shown how reducing trade barriers (e.g. transportation costs in their model) may lead to industry agglomeration, especially when the countries have comparative advantages. Contrary to this view there is a position that recognise in the EMU a source of greater intra-industry trade and, consequently, of more similar economic and productive structures among its countries (EC, 1990). However, irrespectively of the EMU as an endogenous force for convergence (e.g. Frankel and Rose, 1997), there are structural changes in the productive systems of EMU countries that are not counterbalanced, since now, by EU or EMU level politics and policies (e.g. the provisions of EU funds for lagging countries and/or regions to promote the localisation of firms and industries in the EU periphery), which may explain part of the real divergence path of the EMU countries. Despite the importance of the productive structures and its evolution in determining the synchronisation of the economic cycles among the EMU countries and, ultimately, explaining the process of structural divergence/convergence, very few works have been conducted on this issue as put forward by Mongelli *et al.* (2016), who show that specialisation in EMU is a widespread phenomenon with particularly negative consequences, also in terms of economic divergence, when countries specialise in less efficient and low productive sectors due to resources misallocation.

2.2 Intermediates linkages and the vertical perspective of the economy

When looking at structural convergence between countries two main features tend to emerge: economic structure and structural change. In fact, economies are subject at ongoing process of transformation. Inherent in this process the understanding of the role of the economic sectors becomes key. In particular, the analysis on structural change have suggested the need for a more accurate interpretation of the importance of manufacturing in the economic system as a whole. In fact, catching up across the countries seems to be affected most by the intensity and growth rate of specialization in manufacturing sector and its industries (Rodrik, 2016). The driver of convergence is intersectoral change, as the shares of the three

[4] Although important it is out of the papers' scope to deepen the interesting positions of the scholars that analysed the EU and EMU countries using the VoC conceptual tools (e.g. Johnston and Regan, 2016; Johnston et al., 2014; Hermann, 2005)

aggregate sectors are getting increasing similar over time due to industrialization and tertiarization processes (Hohenberger and Schmiedeberg, 2008).

The traditional analytical view of productive structures 'disparities' mainly focused on a «horizontal» perspective of the economy. However, these analysis are not enough to understand the complexity of structural convergence characterised by forces promoting significant changes in productive structures, since the production processes become more vertically disintegrated. This approach considers economic sectors as divided from one another and no interdependence is assumed. In fact, they focus on the distribution of employment across sectors or industries only and do not to account for intermediates linkages (Palan and Scmiedeberg, 2010). In particular, this approach do not account for the shifting boundaries between markets, and in-house firms' activities (Franke and Kalmbach, 2005) can overestimate or underestimate the role of manufacturing and services in the economic system as a whole (Di Berardino and Onesti, 2018). Empirical evidence confirms an increased blurring of distinctions between manufacturing and services and indicates that the economic activities could be complementary rather than substitutable (Pilat *et al*., 2006). Therefore, in a strongly interconnected context, one of the most important sources of economic growth and of the competitiveness of the economic system more and more depends on the spillover effects between the different activities that composing the productive structure (Barriero De Souza *et al.*, 2016). Therefore, the starting point should be the interrelationships between the structure of production and economic dynamics. A different description of the economic structure is crucial.

A dimension, instead, that contribute to define the structural changes occurring at country level can be analysed through a vertical perspective of the economy. A strand of research known as neo-Schumpeterian, or evolutionary, economics supports this claim, suggesting the importance of vertical linkages, in order to understand the technological process and the sources of economic competitiveness. As Rosenberg (1996: 345), "much of the impact of new technologies in realized through inter-sectoral flows [..] sectors should instead be defined on the basis of their vertical, or inter-links, production processes".

Intermediate inputs and a vertical perspective of the economy comprise an interesting strand of the literature, attracting a growing number of scholars. The concept of vertically integrated sectors, identified by Pasinetti (1965, 1973), is based on the fact that final goods stem from vertically integrated production, which involves different sectors. As illustrated by Scazzieri (1990), this method provides a powerful simplifying tool, which is suitable if one wants to identify «one-way» causal linkages within the complex network of economic relationships. An analysis of transformation processes involves a breakdown of the economy into a number of distinct subsets of relationships. The logic involves the subdivision of each branch based on final goods, so that the contribution of each branch to each process can be identified. The subsystem is an autonomous, vertically integrated production system that includes all the factors that directly and indirectly contribute to satisfying the final demand in manufacturing. In this manner, the analysis of structural change is based on the sequential character of productive processes, identifying a causal relationship that is different from those associated with the theory of the stationary state or of static equilibrium (Scazzieri, 1990). Hence, this empirical framework emphasizes demand-driven growth, in which inter-industrial relationships are identified according to the linkages between final goods and all the inputs to production. This approach indicates that each sector is considered on the basis of its contribution to the production of final goods.

Adopting this methodology it has been shown that direct effects in manufacturing have a smaller role compared to the indirect effects that derive from the linkages within the production system. It follows that a more developed and mature industrial base of a country will increase such effects (Park and Chan, 1989). Indeed, some authors have found that organizational restructuring in several European countries has been achieved through a substantial vertical externalization (Dietrich 1999). Manufacturing firms, attempting to improve their organizational efficiency and reduce costs through the outsourcing of service activities, have played a fundamental role in this shift (McCarthy and Anagnostou, 2004). Consequently, outsourcing to services would actually reflects an overestimation of the reduction in hours worked in manufacturing (Momigliano and Siniscalco, 1982). In this interpretation, outsourcing is a particular kind of structural change that is merely an extension of manufacturing into nonmanufacturing sectors (Montresor and Vittucci Marzetti, 2010).

However, empirical results to quantify these claims are far from conclusive. Rather, Montresor and Vittucci Marzetti (2011), show evidence of deindustrialization in a virtual world composed of the sum of the I-O tables for the main member countries in the Organization for Economic Cooperation and Development (OECD). Sarra *et al.* (2018) indicate that the deindustrialization process affecting the EU27 is not homogeneous. Great differences exist between the EU15 and the other EU countries and among the technological classes of manufacturing. The deindustrialization mainly appears to have been confined within precise technological boundaries throughout the EU, where the low-tech subsystem suffered the largest contraction both in the EU15 and in the EU12, being greatly affected by strong deindustrialization.

Although these claims about outsourcing have become more important, there are no studies that address to quantify economic structures convergence by using subsystem approach. This paper is the first contribution that adopts the subsystem approach to investigate inter-country structural convergence.

In order to deepen the analysis we apply the specialisation index to the subsystem approach with the aim of identifying whether the degree of specialisation increases when using a subsystem approach instead of horizontal based approach. The above picture offers the ground over which several original research questions can be planted. At first we can try to provide evidence for the under-researched issue structural convergence in the EMU countries. Looking at the manufacturing sector we then pose the following question:

Q1. Are the disparities in the composition of manufacturing productive structures among 19 EMU countries growing?

Subsequently, as stated above, we revise the usual approach of analysis based on economic sectors by applying the Krugman specialization index to the input-output subsystem approach. In doing so we are able to capture the change in the extent of vertical integration between the manufacturing sector and the KIBS looking at the changes of the productive structure though the lens of the subsystems. Hence, we can answer the following questions:

Q2. The changes in productive structures are more evident when a subsystem approach is applied than when the traditional sector-based approach is used?

2.3 The relationship between manufacturing subsystem and Knowledge intensive business services

Many authors show that inter-sectoral interaction tends to be more intense between manufacturing and knowledge-intensive sectors (e.g. Kox, 2004; Francois *et al*., 2015; Ciriaci and Palma, 2016). Furthermore, it has been argued that many manufacturing activities are required by the service sector to improve efficiency and innovation through the optimization or the substitution of some employment functions. For instance, Ciriaci and Palma (2016), using oecd data for some European countries for the period 1995-2005, demonstrate the existence of a strategic relationship between knowledge-intensive business services (KIBS) and manufacturing subsystems, dominated by technologically advanced subsystems. Therefore, the studies on technological change have identified the services as the key to capture structural transformations (Montresor and Vittucci Marzetti 2011; Di Berardino and Onesti, 2018).

These services are important, because they assume a central role in terms of production, information processing, knowledge diffusion, and innovation (Miozzo and Miles, 2002). Indeed, as Mas-Verdú, Alba, and Garcia Alvarez-Coque (2011) highlight, the activities come from their own diverse perspectives. Thus, manufacturing demonstrates a strong tendency to absorb innovative capacity, whereas services are more likely to spread innovation. As mentioned, the integration of these services is one way for manufacturing to gain knowledge and skills (Barney, 1991) as well as advantages in exports, value added, product innovation, employment, and productivity growth (Baker, 2007; Castaldi, 2009; Castellacci, 2010 ; Dachs *et al.*, 2014).

It is worth to noting the need for a careful assessment of the importance of intersectoral chains, because industrial development may depend on the quality of the services that they adopt (Gallouj, 2002). However, the empirical literature on the effects of the transition to a service-based economy has not always relied on an accurate measure of the phenomenon. For instance, the traditional approach does not allow researchers to distinguish producer services from consumer services. It is based on an arbitrary classification of service categories that does not accurately reflect the impact of producer services on the economy, which hinders reliable analysis (Cheng and Daniels, 2014). The subsystem approach to Input–Output analysis is helpful in answering these questions because it has several advantages. In particular, it allows researchers to measure the amount of increased employment in services that feeds either final demand or intermediate demand, avoiding the inaccuracies related to imputation based on their prevailing destination adopted by the traditional approach.

In the following, we explore two important issues: the contribution of KIBS to the manufacturing and industrial composition by technological intensity. Actually, these issues need not be considered individually but, rather, can be observed jointly in a strategic framework.

Looking at the manufacturing subsystem and their industries subsystems we then pose the following question:

Q3. What does it happen when we consider the role of KIBS and we control for manufacturing technological intensity?

3. Data and Methodological framework

In Pasinetti's approach, an important distinction is made between «sector or industry » and «subsystem». Pasinetti's subsystem feature a generalization of the concept of subsystem elaborated by Sraffa. As Sraffa stressed (1960; p.89): «the commodities forming the gross product can be unambiguously distinguished as those which go to replace the means of production and those which together form the net product of the system». The economy can be decomposed into as many parts as there are goods that contribute to the net product, «in such a way that each part is in a self-replacing state with a net product of one commodity only» (Harcourt, Massaro 1964; p. 717). These

parts can be called «subsystems». The traditional analysis of sectoral interdependence is by definition a static approach, but Pasinetti offers a way of looking at the same economy

from a dynamic point of view. Indeed, «the differences consist only in how economic relations are classified, but it is possible to switch from one to the other by means of linear algebraic transformations: the production coefficients of a vertically integrated sectorial model are a linear combination of the production coefficients of the corresponding input-output model» (Pomini, 2012; p. 55).

The I–O tables that present the direct needs of domestic production are a suitable methodology in analysing the intensity of this phenomenon. Following a method illustrated by Pasinetti (1973) these tables can be reworked to define an "operator" which is independent from the relative prices, and able to decompose a vector that expresses an entity classified for sector (based on a classification compatible with that of the I–O matrix) in a square matrix in which the same entity is remapped from the "sector" or "branch" to a "sub-system" (or "vertically integrated sector" or "block"). The subsystem is an aggregation that analytically represents all the activities used (directly or indirectly) to satisfy the final demand for a specific good or service, given the stock of fixed capital. By classifying each sector according to the final product, the subsystem identifies the contribution of every single sector or industry within each process of production.

The operator for the conversion from branch (sector or industry) to subsystems is obtained as follows:

$$L_D = (\hat{v})\,(I - A)^{-1}\,\hat{e} \qquad [1]$$

In the above equation, A is the coefficient matrix derived from the domestic I–O table; $(I-A)^{-1}$ represents the Leontief's inverse, the generic element of which, w_{ij} , measures the value of the output of branch i that is directly or indirectly needed to obtain a unitary value of the output of branch j available for final uses; v is a vector, the generic element of which, vi, represents the labour coefficients, obtained from the ratio between hours worked and total output at the current prices of branch i; e is a vector, the generic element of which, e_i, represents the output at the current prices of branch i destined for final demand. The latter includes the domestic consumptions and the total exports. The symbol "^" indicates that the underlying vector is transformed in a diagonal matrix which has the components of the vector on the principal diagonal and 0 elsewhere. The columns of L_D operator will represent the number of hours worked in each branch contributing directly or indirectly to the production of the subsystems.

The data used in the paper were obtained from the Word Input–Output Database (WIOD, 2016). The WIOD is a time-series of national symmetric input–output tables (industry x industry) that cover 40 countries and a time span from 2000 onwards (Dietzenbacher *et al.*, 2013; Los *et al.*, 2015; Timmer *et al.*, 2015). The availability of specific socio-economic accounts (SEAs) in the WIOD database, which are entirely complementary with the sectoral classification of national input–output tables, are perfectly suitable for the analysis of the changes in the production structure because that contain data for number of employment, hours worked and value added for each sector of the economies.

4. Divergence and convergence of national productive structures in the Eurozone

4.1 Production structure of EU19 countries

We start the analysis with an evaluation of the characteristics of the production structure and of the changes that have taken place since 2000. We break down the production structure of the overall Euro zone into seven industry groups: agriculture, manufacturing, public utilities, construction, market services (and KIBS inside it) and non-market services. Table 1 presents some interesting facts in this respect and highlights many differences in the productive composition obtained with a sectoral and a subsystem approach using data on number of employees, hours worked or value added (Montresor and Vittucci Marzetti, 2011; Ciriaci and Palma, 2016, Di Berardino and Onesti, 2018). This because the subsystem approach enables a deeper evaluation of the contribution of several activities to the economy as a result of intersectoral flows. We can outline two general tendencies with regard to manufacturing and services.

The sectoral approach reveals an 'underestimation', when compared to the subsystem approach, in the ability to generate employment, hours worked and value added in manufacturing. Indeed, if we use a subsystem approach, the weight of manufacturing becomes higher and exceeds 20 percent in all aggregates considered. This evidence is to be considered at the light of the renewed interest in industrial policies aimed at the renaissance of manufacturing in Europe and supports the idea that a strong and modern industrial structure is fundamental for boosting economic growth and strengthening Europe's global competitiveness. In fact, following the subsystem approach the aim of Horizon 2020 program about the weight of value added in manufacturing in the European countries would be already reached (EU Commission, 2014). The large outsourcing of manufacturing and the general reorganization of production are associated with a "minor deindustrialization process" if we compare it to the sectoral traditional approach. In fact, the employment shares of manufacturing sectors decrease from 17.4 percent to 13.9 percent (vs. a decrease from 24.6 percent to 20.5 percent observed if a subsystem approach is used); that of the hours worked from 20.5 percent to 16.3 percent (vs. 25.7 percent to 21.7 percent); and that of the valued added from 17.2 percent to 16.4 percent (vs. 24.5 percent to 22.5 percent). This suggests that policies should overcome traditional sectoral boundaries that are becoming more blurred, while it should be taken into account the processes of integration between the different production activities.

In contrast, in the market services we observe a substantial 'overestimation' using the sectoral composition, because its weights in all the aggregates obtained through a subsystem approach are lower. This trend seems mainly prominent for KIBS, corroborating the hypothesis that their indirect role to satisfying the

final demand of other activities inside the production system is commonly rather underestimated. In fact, the employment shares of KIBS sectors in 2014 is 10.6 percent (vs. a value of 20.5 percent observed if a subsystem approach is used); that of the hours worked is 13.5 percent (vs. 6.8 percent); and that of the valued added is 12.9 percent (vs. 7.2 percent). The other economic sectors and industries that compose the production system are less involved in inter-sectoral linkages in comparison to manufacturing and services; hence, we focus on these latter our analysis.

The above mentioned differences in measuring the composition of the economic activities for manufacturing and services point out that the subsystem should be preferred to the sectoral approach, which does not suitably take into account for those employment, hours worked or value added formally active in services but which are used to satisfy the final demand for manufacturing. The strong intensity of inter-sectoral linkages demonstrates that the evolution of services, KIBS in particular, and manufacturing is actually symbiotic, and thus, if the growth in services depends on manufacturing, then, at the same time, structural changes in services affect manufacturing.

To conclude, the economic transition to services is accompanying the deindustrialization process, but in this trend it should be considered the increasing vertical integration between services and manufacturing that can be attributed to the greater complexity of managerial functions, on the one hand, and to strong vertical decentralization by manufacturing firms, on the other.

Table 1. Productive structure composition by sectors and sub-systems (EU19)

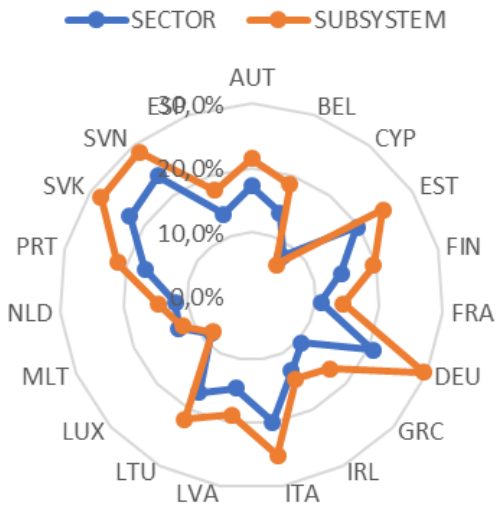
	Sector					
	Employment		Hours Worked		Value Added	
	2000	2014	2000	2014	2000	2014
A	4.9	3.5	2.4	2.0	2.4	2.0
M	17.4	13.9	20.5	16.3	17.2	16.4
PU	1.2	1.1	1.5	1.5	2.8	2.7
C	7.4	6.0	7.8	5.9	6.6	4.9
MS	40.3	44.2	38.5	42.9	48.7	51.0
KIBS	*11.0*	*10.6*	*9.9*	*13.5*	*11.5*	*12.9*
NMS	28.9	31.2	29.3	31.4	22.3	23.0
	Subsystem					
	Employment		Hours Worked		Value Added	
	2000	2014	2000	2014	2000	2014
A	3.0	2.2	1.7	1.5	1.8	1.6
M	24.6	20.5	25.7	21.7	24.4	22.5
PU	1.2	1.3	1.4	1.5	2.0	2.0
C	9.6	7.4	10.1	7.4	9.0	6.7
MS	30.4	35.0	29.5	34.2	37.4	41.2
KIBS	*4.3*	*5.8*	*4.1*	*6.8*	*4.6*	*7.2*
NMS	31.2	33.6	31.7	33.8	25.3	26.0

In the following analyses we provide evidence on the hours worked, neglecting both employment and value added. The reasons supporting this choice are manifold. As seen in table 1 the trends are very similar for all the aggregates (hours worked, employment and value added); moreover, considering the hours worked has several advantages as stressed by Portella-Carbó (2016), as they are directly comparable over time and among countries and are not related to institutional arrangements, social conventions, or the length of the working day (i.e. part-time work).

Now we focus specifically on the manufacturing system only. Figure 1 shows each of the EU19 countries by manufacturing share in the economy, in order to capture the differences between the weights of

manufacturing in the sector and subsystem approaches. As we expected, the sub-system approach gives almost everywhere a higher weight for manufacturing than the sector approach, and in the largest countries and manufacturing-oriented economies this gap is even more evident. This is likely due by a tendency, in large manufacturing countries (e.g. Germany, France, Italy), to move toward 'advanced manufacturing systems' that reinforce competitiveness through a deep integration between manufacturing and services, especially knowledge intensive ones. This process is shared also by some small countries (for example in Slovenia and Slovakia), for which the manufacturing/services integration clearly emerges from figure 1 as well.

Figure 1. Share of manufacturing in each EU19 countries: sector and subsystem approaches. Hours worked. 2014 (percentage values).



Note: see Appendix for the legend of countries.

4.2 Specialization in the EU19 countries

The renewed interest in industrial policies that aim at the renaissance of manufacturing in Europe need to take some cross-country differences into account for the effectiveness of the industrial policy. To this end the present section examines the cross-country differences in manufacturing specialization between the EU19 countries through the implementation of specialization and concentration indices to the subsystem approach.

In so doing we overcome a shortcoming of the current empirical literature (see among others Palan and Schmiedeberg, 2010), which usually neglect inter-sectoral linkages. Due to the availability of consistent input-output data over a long time horizon 2000-2014, we can overcome this restriction through the first time adoption of the subsystem approach to the KSI (Krugman Specialization Index), in order to understanding how much of the specialization process is explained by interlinkages among different activities. The KSI is one of most diffused measures of specialization. It can be seen as a relative specialization that compare one country to a reference group, EU19 in our analysis. We can define the Subsystem Krugman Specialization Index (SKSI) as follows:

$$\textbf{SKSI} \quad = \quad K_k(t) = \sum_i \left| V_k^i(t) - \overline{V}^i(t) \right| \qquad [2]$$

where $V^{i}_{k}(t)$ is the share of ***subsystem*** *i* in country *k* at time *t* based on hours worked and $\bar{V}^{i}(t)$ is the share of ***subsystem*** *i* in the European union less country *i*[5]. The higher the index, the more the economic structure of one country deviates from the EU19 area and the more a country is considered to be specialized.

Specialization is a growing force in the manufacturing among EU19 countries, as shown in Table 2. Indeed, the results by applying the KSI show an increasing trend in specialization over time, which potentially implies a diverging trend among the EU19 economies. The specialization process over time seems to be even more evident when we abandon the sector approach in favour of the subsystem one, as shown in tab.2. We have a confirmation of this trend, also applying the coefficient of variation - the so-called sigma convergence - (calculated as the ratio between standard deviation and arithmetic mean in the share of manufacturing among the EU19 countries). This evidence highlights the fact that the subsystem approach seems to be a good alternative for the investigation of specialization, because it allows to capture more information about production structure than the traditional sector approach.

Table 2. KSI (Krugman Specialization Index), SKSI (Subsystem Krugman Specialization Index) and CV (coefficient of variation) in EMU 19 countries by sector and sub-system manufacturing (2000-2014). Hours worked.

Manufacturing	2000	2014	deviation 2000-2014 2000=100
KSI	0,730	0,800	109,6
SKSI	0,884	1,122	126,9
Sector CV	0,232	0,292	125,9
Subsystem CV	0,229	0,335	146,3

Regarding the subsystem approach, in table 3 we present a disaggregated country ranking to capture the contribution of each country to the composition of the total SKSI. At the top ranking position, with a plus sign, there are the most specialized countries with respect to the Eurozone manufacturing average. Instead, the countries with the minus sign have a lower specialization in manufacturing in comparison to the eurozone average. Table 3 shows that the changes in the period 2000-2014 have altered the specialization in different directions. On the one hand, the ranking enables us to appreciate the reduction in the number of countries with KSI above average from ten countries in 2000 to six countries in 2014 (higher territorial concentration of manufacturing in few countries). On the other hand, there is a general decrease in the specialization of manufacturing in all the countries except Germany, which shows an increase in specialization (from 0.048 to 0.106). Thus, the consolidation of the German leadership in manufacturing is evident also looking at the SKSI. This seems to happen at the expenses of other traditional manufacturing countries, such as Italy, and contextually in favour of eastern European countries like Slovakia. The well-known Germanisation of the Eurozone manufacturing triggers the specialization of a country like Slovakia, which is a strong German supplier, but depress the manufacturing system of other countries, as Italy (Cirillo and Guarascio, 2015; Simonazzi *et al*., 2016; Stollinger *et al*., 2013). This framework does not seem to be consistent with the path of reorganization of manufacturing included in the proposal of European Commission (EU Commission, 2013; 2014) with the so-called "industrial leadership," a pillar of the Horizon 2020.

[5] The same index can be calculated, more traditionally, by sectors, as also reported in table 2, in which KSI is the traditional Krugman Specialization Index calculated by sectors.

Table 3. Decomposition of SKSI of EU19 for each country in manufacturing subsystems. Hours worked. No absolute value presented.

	2000		**2014**
SVN	0,087814	DEU	0,105994
ITA	0,055712	SVN	0,069054
DEU	0,048125	SVK	0,065046
SVK	0,044638	ITA	0,040956
IRL	0,032027	EST	0,028983
BEL	0,026642	LTU	0,001842
FIN	0,012248	PRT	-0,00064
MLT	0,010502	AUT	-0,00138
LTU	0,008639	FIN	-0,02073
EST	0,007162	LVA	-0,02902
PRT	-0,0128	BEL	-0,03401
LVA	-0,02522	ESP	-0,04867
AUT	-0,02831	GRC	-0,05167
NLD	-0,03615	IRL	-0,07137
ESP	-0,03621	NLD	-0,0741
FRA	-0,05817	FRA	-0,0885
GRC	-0,10043	MLT	-0,09982
LUX	-0,11099	LUX	-0,13579
CYP	-0,14173	CYP	-0,15443
TOTAL SKSI	**0,883519**	**TOTAL SKSI**	**1,121996**

a) Note: the Total SKSI is give by the sum of the countries SKSI in absolute value

Many authors (Ciriaci and Palma, 2016; Sarra *et al.*, 2018) show that inter-sectoral interaction tends to be more intense in the medium/high-tech and high-tech manufacturing subsystems than in the remaining manufacturing ones. Indeed, the technological progress has expanded the diffusion of inter-industry linkages in the economic system, and the intermediate stages of the value chains have become increasingly important in final production (Silva and Texeira, 2008). We use the well-known classification adopted by the Organisation for Economic Cooperation and Development (OECD 2003) to distinguish our manufacturing subsystems in Low-Tech (LT), MediumLow-Tech (MLT), MediumHigh-Tech (MHT) and High-Tech (HT) industries.

For our aim we then aggregate the four groups in two, LT-MLT and HT-MHT, since it is suffice to point out the main differences in the SKSI, which is reported in Table 4 by country for the HT-MHT[6] manufacturing subsystems. Table 4 shows a value of SKSI for HT-MHT industries more than double that of the overall manufacturing SKSI: 2.588 and 1.122 respectively. Germany, unlike other countries, increases the SKSI also for the HT-MHT industries, from 0.177 to 0.187, confirming again its leadership in the eurozone manufacturing activities. We can identify at a first glance different models of specialization among the production systems. These differences are the foundation of the real divergence between the economic systems that we are experimenting in the Eurozone, with its corollary of asymmetric reaction of countries against exogenous shocks, supporting the Krugman hypothesis (Krugman, 1993).

[6] We do not report the results for Low-Tech and Medium Low-Tech since they are symmetrical.

Table 4. Decomposition of SKSI of EU19 for each country in Medium High-Tech and High-Tech manufacturing subsystems. Hours worked. No absolute value presented.

	2000		2014
DEU	0,176774	DEU	0,186927
IRL	0,05362	SVK	0,027295
FRA	0,036287	IRL	0,013244
FIN	0,031998	SVN	-0,00966
MLT	0,006196	FIN	-0,01847
BEL	-0,00599	AUT	-0,01949
AUT	-0,04101	FRA	-0,02361
ESP	-0,04658	BEL	-0,03631
NLD	-0,04991	ITA	-0,03881
ITA	-0,05931	NLD	-0,04602
SVN	-0,08224	ESP	-0,08861
SVK	-0,1219	MLT	-0,13865
PRT	-0,23894	LUX	-0,23011
LUX	-0,24178	EST	-0,24071
GRC	-0,28127	PRT	-0,26029
CYP	-0,32184	CYP	-0,26483
EST	-0,32608	LVA	-0,29256
LVA	-0,3377	GRC	-0,31044
LTU	-0,36739	LTU	-0,34182
TOTAL KSI	**2,8268**	**TOTAL KSI**	**2,587864**

4.3 KIBS integration in the manufacturing subsystem

A further advantage of the input-output subsystem approach is that it allows us to focus on manufacturing/KIBS integration with the aim to point out the different models of manufacturing specialization emerging in the EMU countries. Integration between manufacturing and KIBS can be seen as a process that overcomes the traditional boundaries among the factors of production and adjusts the contribution of activities in the economy of each country. The degree of integration of KIBS into manufacturing can be assessed through the share of direct and indirect inputs of KIBS in the production of final goods.

The following figures report the degree of KIBS vertical integration in the manufacturing subsystem in the nineteen EMU countries in 2000 (left graph) and 2014 (right graph): considering respectively the manufacturing subsystem as a whole (figure 2), the low-tech manufacturing subsystem (figure 3) and the high-tech manufacturing subsystem (figure 4). The axes defining the four panels in the middle of the graph represent the average values of the EU19, by considering manufacturing subsystem in a "pseudo-EMU area" consisting of the sum of 19 countries (Montresor and Vittucci Marzetti, 2011).

Figure 2 illustrates the degree of KIBS vertical integration in the manufacturing subsystem as a whole. The extent of this integration and the weight of manufacturing subsystem differ significantly among countries. The main considerations we can draw from the comparison of left and right panel concern the distribution of the countries relatively to the axis defining the EMU averages of KIBS integration and the averages of manufacturing subsystem weights on the economy. In the left panel (2000) the countries are closer in terms of manufacturing subsystem weights, especially the largest countries in the EMU area and, consequently, their distribution was more vertically oriented, showing that the main differences in the productive systems were to search in the integration of KIBS into the manufacturing subsystems. In 2014 (right panel), on the contrary, the dispersion of the countries over the horizontal line indicates that while the gaps in terms of KIBS integration are closing over time, there is a divergence in the weights of the manufacturing subsystems: with a block of manufacturing countries, led by Germany and Italy, followed by

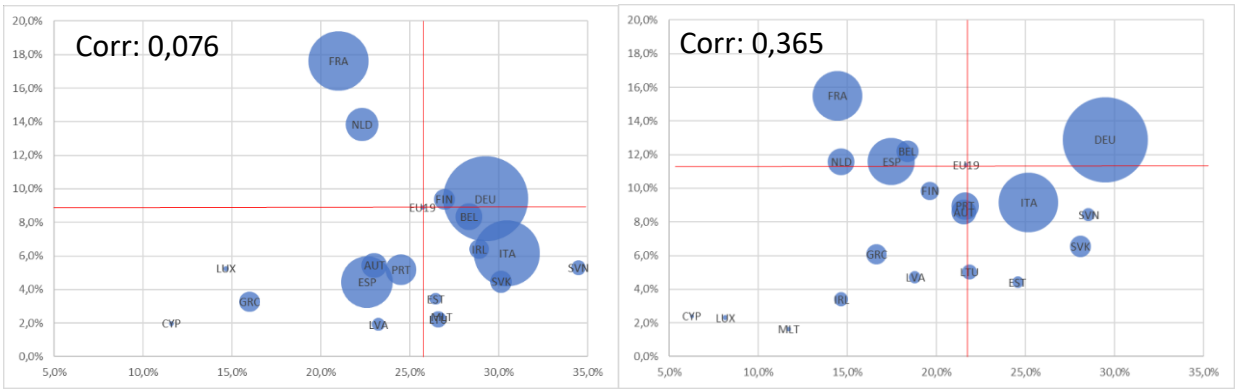
Slovenia, Slovakia, Estonia and Lithuania, with evident differences in the level of KIBS integration, and a second block of more 'de-industrialized' countries, which is led by France and Spain, with an higher level of KIBS integration.

There is a general evidence of a diverging process among the EU19 countries. We can observe different trends with reference to the role of manufacturing among the four largest countries that are also pointed out by the literature debate between real de-industrialization and tertiarization of manufacturing processes. France and Spain are characterized by a strong tertiarization process accompanied by a strong decrease in the weight of manufacturing subsystem. Indeed, in France the weight of manufacturing from 2000 to 2014 dropped down, while maintaining the highest level KIBS integration in comparison to the EU19 countries. It should be noted the jump of Spain in KIBS integration and the contextual loss of a not negligible share of manufacturing. Despite a reduction of manufacturing production in Italy, the latter remains with Germany a leading manufacturing country in EMU, but only Germany conjugates high manufacturing weight and high level of KIBS integration (top-right panel) reaching a sustainable equilibrium between a high level of growth in KIBS integrated to manufacturing and the simultaneous reinforcement of manufacturing.

A further lesson we can infer from the countries movement over time is that the gap among big and small countries is increasing. Indeed, the smallest countries are located at the bottom of the chart attesting the low degree of KIBS integration in the manufacturing system. For example, the case of the Greek manufacturing system shows that despite it has the same weight of the French one, the integration of KIBS is less than half.

Finally, the correlation between the KIBS integration and the weight of manufacturing systems reinforces over time confirming that the business services play a leading role in the development of the manufacturing sector, as shown in different studies (Ciriaci and Palma, 2016), and they could contribute to improve the competitiveness of the manufacturing sector and of the overall production system.

Figure 2. KIBS integration in the manufacturing sub-system(% of hours worked)



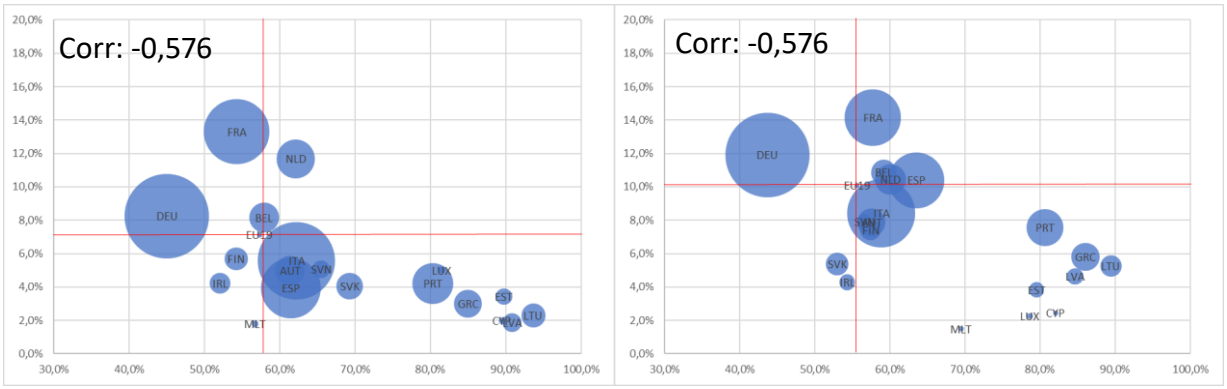
2000 2014

b) Note: x = Share of Manufacturing subsystem; y = Integration of KIBS in Manufacturing subsystem; size of circles: represents the size of each country's manufacturing subsystem in the total manufacturing subsystem in EU19 in 2014, calculated in terms of total hours worked; Corr is the correlation between KIBS integration and manufacturing systems weights.

When we turn our attention to the subsystems disaggregated in LT-MLT and HT-MHT we notice several differences accompanying the development over time of the integration of KIBS in the manufacturing systems. Figure 3 reports the KIBS integration if we consider only the LT-MLT manufacturing subsystems. As we can see there is a negative relation between the weight of the LT-MLT subsystems on the total manufacturing subsystems and KIBS integration: the higher the LT-MLT share, the lower the KIBS integration. Low tech industries do not develop over time a sensibly higher KIBS integration and the picture of the 2000 is quite similar to that of 2014, except for some small reallocation of countries: the largest countries seem to reduce their disparities both in terms of LT-MLT shares and of KIBS integration; some

small countries like Portugal and Greece increase their divide with respect to other countries in terms of LT-MLT shares.

Figure 3. KIBS integration in the manufacturing sub-system for LT and MLT industries (% of hours worked)



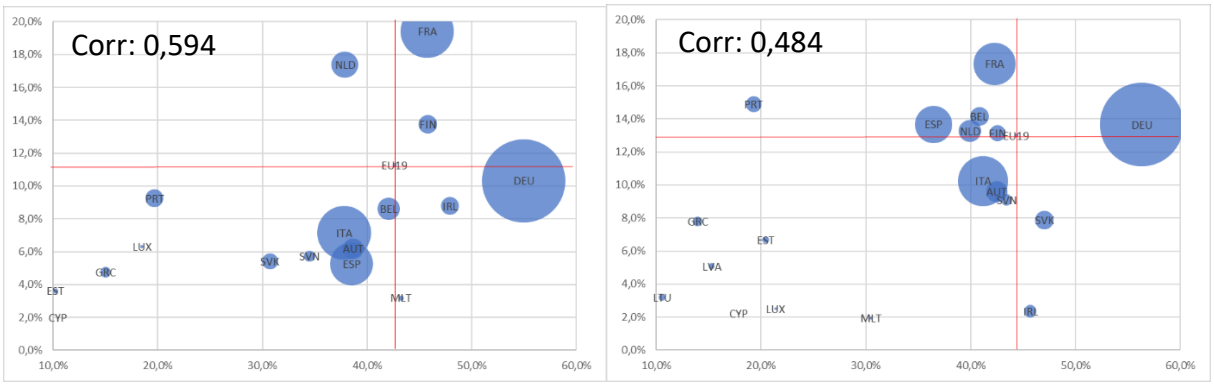
2000 2014

c) Note: x = Share of LT-MLT manufacturing subsystem on total manufacturing subsystem; y = Integration of KIBS in LT-MLT Manufacturing subsystem; size of circles: represents the size of each country's manufacturing subsystem in the total manufacturing subsystem in EU19 in 2014, calculated in terms of total hours worked; Corr is the correlation between KIBS integration and manufacturing systems weights.

The evidence is substantially different when we concentrate on HT-MHT subsystems (Figure 4), which show a positive relation with KIBS integration: the higher the HT-MHT subsystems share in the overall manufacturing, the higher the KIBS integration. From 2000 to 2014 we observe some 'radicalisation' in the manufacturing subsystems development in the EMU area. In 2014 is quite evident the hegemonic role of Germany: it is the leading manufacturing country, as a whole and especially in the HT-MHT industries, and it is the only country that is able to locate in the top-right panel, given the high level of KIBS integration in HT-MHT industries. This dominant German model contrasts with other two 'models' which are led by the following large countries respectively; Italy, on the one hand, and France with Spain, on the other. Italy is located in the bottom-left panel, showing a lower than average share of HT-MHT industries coupled with a lower than average KIBS integration. Traditional manufacturing industries, largely LT-MLT, are the core of the Italian manufacturing as well known, requiring low levels of KIBS integration. France and Spain on the contrary are able to locate in the top-left panel, showing a higher than average KIBS integration, while maintaining a lower than average share of HT-MHT. These two countries are experiencing over time a rather evident de-industrialisation process which is compensated by the development of a strong integration of the KIBS into manufacturing subsystems.

Finally we can also notice a diverging path between big and small countries, in terms of manufacturing weight, as the gap between the top-right block of countries and the bottom-left one widens from 2000 to 2014.

Figure 4. KIBS integration in the manufacturing sub-system for MHT and HT industries (% of hours worked)



2000 2014

d) Note: x = Share of HT-MHT manufacturing subsystem on total manufacturing subsystem; y = Integration of KIBS in HT-MHT Manufacturing subsystem; size of circles: represents the size of each country's manufacturing subsystem in the total manufacturing subsystem in EU19 in 2014, calculated in terms of total hours worked; Corr is the correlation between KIBS integration and manufacturing systems weights.

5. Preliminary remarks

This study has focused on structural divergence/convergence among EMU countries through the analysis of the integration between manufacturing and KIBS in terms of hours worked. The paper is based on the last release of WIOD database and covers a long period (2000-2014) by adopting a vertical perspective (subsystem approach) of the production structure. We measure all the activities that need to be integrated to create final production in a specific branch. By classifying each sector/industry according to final goods, the subsystem identifies the contribution of every single sector/industry within each production process and illustrates the extent to which the organization of the economy influences final production.

Preliminary results show that disparities are growing in the composition of productive structure and they are even more pronounced when we consider intersectoral dynamics, by confirming the Krugman position about the increasing specialisation among EMU countries. The increasing heterogeneity in productive structures likely triggers a divergence process and increases the probability of asymmetric shocks, calling for a (no longer postponable) fiscal union. Looking at the sub-systems seems to be crucial in understanding how the productive structures move and develop, since it is possible to capture inter-industries linkages (one of the pillar of smart-factory) and to inform policy makers about the important role of value chains traditionally neglected if compared to the role of sectors.

Our results are of particular relevance for national and European policy makers, since they show that contrary to the expectations of the European Commission (1991), the EMU endogenous forces did not push the member states toward a process of less specialization and structural and real convergences. On the contrary, the Krugman hypothesis (Krugman, 1993) seems to hold: specialization of EMU countries tends to increase in the last decades. If this is the case, as our results seem to imply, the EMU is likely to experience low degrees of business cycle synchronisation, with the fierce negative consequences already experienced during the Sovereign Debt crisis for some EMU countries given the incomplete nature of the monetary union (De Grauwe, 2016).

Appendix:

AUT	Austria
BEL	Belgium
CYP	Cyprus
DEU	Germany
ESP	Spain
EST	Estonia
FIN	Finland
FRA	France
GRC	Greece
IRL	Ireland
ITA	Italy
LTU	Lithuania
LUX	Luxembourg
LVA	Latvia
MLT	Malta
NLD	Netherlands
PRT	Portugal
SVK	Slovakia
SVN	Slovenia

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ABSTRACT

The imbalances among countries belonging to the European Monetary Union (EMU) have been analysed under several angles in recent years, (i.e. productivity growth, institutional characteristics, labor market policies, external trade balance, etc…), but often neglecting the evolution of economic and productive structures. In this work we aim to fill this gap analyzing the countries specialization through the differences in the inter-industrial linkages that affect economic systems competitiveness and production processes. The integration of specialization indexes in the input-output subsystem approach applied to the most recent released of the WIOD data (2018). Results show that disparities are growing in the composition of productive structure and they are even more pronounced when we consider intersectoral dynamics; in particular, when Knowledge intensive business services are addressed to satisfy the manufacturing final demand and when we control for manufacturing subsystem technological intensity.