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La produttività delle imprese italiane: andamento, determinanti e proposte per un rilancio

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Sommario

La produttività delle imprese italiane: andamento, determinanti e proposte per un rilancio

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Productivity growth and global value chain participation: empirical evidence and main measurement challenges

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Abstract

This paper provides an overview of the current productivity trends and their potential drivers exploring the impact of Global Value Chain (*GVC*) participation in the European economies and in the US in 2000-2014. More specifically, we investigate whether the reorganisation of the production activity and the adoption of new business models as captured by the extent of *GVC* participation contributes to gain fresh insights about the factors affecting the productivity slowdown in the advanced economies (12 European countries and the US). Then we test the linkages between productivity growth

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and *GVC* participation in an augmented production function framework and we find a positive and statistically significant impact of forward and backward participation on productivity growth. We also address the main challenges in measuring *GVC* participation and check the robustness of our econometric results using an Instrumental Variable (IV) approach. Data are gathered from WIOD and EUKLEMS.

Sintesi - Crescita della produttività e partecipazione alle catene globali del valore: evidenza empirica e principali problemi di misurazione

Questo lavoro fornisce una panoramica sulle recenti dinamiche della crescita della produttività e delle sue potenziali determinanti con riferimento all'impatto della partecipazione alle catene globali del valore (CGV) nelle economie europee e negli Stati Uniti nel periodo 2000-2014. In particolare, si analizza l'ipotesi che la riorganizzazione dell'attività produttiva e l'adozione di nuovi modelli di business, approssimati dall'intensità della partecipazione alle CGV, possano offrire nuove indicazioni sui fattori alla base del rallentamento della produttività nelle economie avanzate. L'analisi propone una valutazione della relazione tra crescita della produttività e partecipazione alle CGV nel quadro di una funzione di produzione che incorpori la partecipazione alle CGV. I risultati empirici evidenziamo un effetto positivo e statisticamente significativo della partecipazione sulla crescita della produttività. Nel lavoro, si esplorano anche le principali problematiche legate alle misure di partecipazione alle CGV. I dati utilizzati sono di fonte WIOD e EUKLEMS.

JEL Classification: O30; F23.

Parole chiave: *Crescita della Produttività; Catene Globali del Valore*.

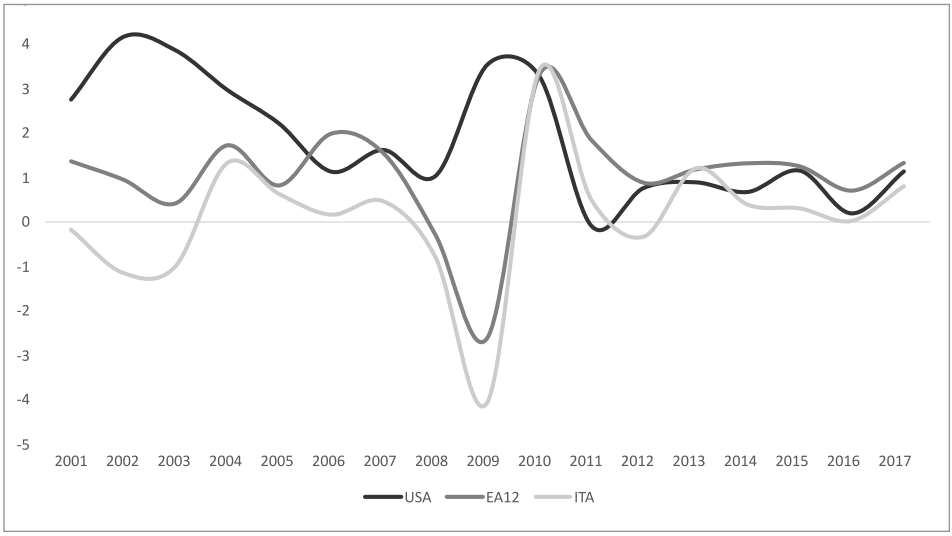
Keywords: Productivity Growth; Global Value Chains.

1. Introduction

Labor productivity growth has been declining in advanced economies since the beginning of the seventies (Bergeaud et al., 2016) experiencing a pronounced deceleration after the Great Recession (Figure 1). Many different explanations about the underlying causes of this so-called secular stagnation have been proposed so far but there is no consensus among researchers yet. Explanations vary from the view that the slowdown reflects cyclical factors related to the financial crisis to the belief that the decline is driven by longer-standing structural factors: measurement errors, misallocation of production inputs, changes in sectoral composition, reduction in the rate of technical progress and diffusion, the increasing necessity to adopt new business models to compete in the global market (ECB, 2017; Jona-Lasinio et al., 2019).

Figure 1 **Labor productivity growth in the Euro Area, the US and Italy**

(% changes)



Note: The figure shows annual growth in gross value added per hour worked in Italy and EA-12 (Market Economy aggregate), and in the US (Business Sector).

Source: authors' calculations based on Eurostat and BEA data.

The empirical evidence suggests that after the 2008-09 financial crisis, the slowdown of labor productivity in the United States and Europe has been driven primarily by a fall in Multi Factor Productivity (MFP) associated with a marked reduction of capital per worker (capital deepening). In this respect, recent studies indicate that the decline of capital accumulation has been determined mainly by an accelerator response of investment to the prolonged demand weakness that contributed to reduce capital deepening (Ollivaud et al., 2018), thus negatively influencing MFP growth also via spillover effects (Jona-Lasinio et al., 2019). But the analysis of the drivers of the slowdown across countries remains complex as there are relevant heterogeneities to be taken into account: some economies may require more emphasis on demand-side, as opposite to supply-side, driving factors. Additionally, the slowdown is becoming more puzzling because some countries are also actively participating to the globalization of the production activity assumed to generate productivity gains (Criscuolo and Timmis, 2017). The aim of this paper is to provide fresh empirical evidence on the drivers of the slowdown by exploring the linkages between productivity growth and Global Value Chain (*GVC*) in a production function framework. In particular, we consider two modes of *GVC* participation: 1) Forward (i.e. domestic value added embodied in foreign exports), capturing the domestic value added content of gross exports and including the value added generated by the exporting industry during its production processes as well as any value added created from upstream domestic suppliers that is embodied in exports. This measure is likely to be higher for countries (and sectors) involved in upstream production, with output and exports of that country feeding into the production and exports of downstream producers (i.e. forward integration); 2) Backward (i.e. foreign value added embodied in domestic exports), measuring the value of imported intermediate goods and services that are embodied in a domestic industry's exports. The value added can be generated from any foreign industry upstream in the production chain. The index of backward participation is used to evaluate to what extent the exports of a country are dependent on

imported content, the so-called backward integration. It is therefore likely to be higher if a country (or sector) is involved in downstream production.

In what follows, the analysis is structured into two steps: first, we offer an overview of the current productivity trends and their potential drivers in the Euro area and in the US, then we investigate whether the participation to *GVC* (both forward and backward) contributed to productivity growth over the last 15 years. The paper is organized as follows. Section 2 provides an summary of the literature while section 3 illustrates the measurement challenges and the data used in the analysis. Section 4 offers some descriptive evidence about the drivers of the slowdown and the extent of countries'participation in *GVC* and its correlation with productivity growth. Section 5 presents the empirical strategy and discusses the econometric results. Section 6 concludes.

2. Background Literature on GVC participation and productivity growth

The rising relevance of global value chains in modern economies stimulated new research efforts investigating the linkages between industries and countries participation in *GVC*s and productivity gains (Jona-Lasinio and Meliciani, 2019; Criscuolo and Timmis, 2017). There are potentially several channels through which *GVC*s can foster productivity growth, Criscuolo and Timmis (2017) highlight some of them. First, there is the classical argument of gains from specialization: in a value chain, firms can specialize in the activities in which they are relatively more efficient and outsource the others (the analogous of product specialization in the classical literature on trade liberalization). Second, *GVC*s participation can affect productivity by allowing firms to have access to a larger variety of cheaper and/or higher quality and/or higher technology imported inputs. Third, *GVC*s facilitate knowledge spillovers stimulating the interaction between domestic firms and multinationals. Finally, similarly to the case of international trade, *GVC*s can give firms access to larger markets and increase competition, thus favoring the development

of the most productive firms and inducing the exit of the least productive. However, taking a different perspective, the relationship between *GVC* participation and productivity growth can be also explored following the literature dating back to Coase (1937), focused on the identification of the forces driving the "make or buy" decision of a firm and evaluating the pros and cons of both market transactions and vertical integration. In theory, *GVC* participation puts the firm in the position of escaping from this dichotomy, as *GVC* involvement allows to choose between a wide array of market-based governance arrangements. The organization of the production process along a global value chain increases the extent of modularization, given the current level of technology, thus generating productivity gains. But Hortacsu and Syverson (2007) find that value chain integration increases firms' productivity, but the cause is not vertical integration per se. The productivity improvement is connected to the ability of operating in multiple ready-mix plants and to logistical advancements.

More recently, Grossman and Rossi-Hansberg (2008) suggested that offshoring and *GVC*s generate productivity gains as a result of the implied finer international division of labor acting as factor-augmenting technical change. Also Li and Liu (2014) and Baldwin and Robert-Nicoud (2014) underscore a positive productivity effect from *GVC* participation generated by increased competition, greater diversity in input varieties, learning externalities and technology spillovers. More up to date efforts instead investigate the influence of vertical specialization on economic performance of countries participating in *GVC*s (Kummritz, 2016; Constantinescu et al., 2017). In particular, Kummritz (2016), considering 54 countries and 20 industries over 5 years, finds that an increase in *GVC* participation leads to higher domestic value added and productivity independently of countries' income levels. Using an instrumental variable approach, he shows that a one percent increase in backward *GVC* participation stimulates an increase of 0.11% of domestic value added but there is no direct effect on labor productivity. On the other hand, a one percent increase in forward *GVC* participation leads to 0.60% higher dome-

stic value added and to 0.33% higher labor productivity. Constantinescu et al. (2017), using data on trade in value added from the World Input-Output Database, covering 13 sectors in 40 countries over 15 years find that participation in global value chains is a significant driver of labor productivity.

3. Measures of GVC participation and data description

In this paper, we measure Global Value Chain (*GVC*) participation from WIOD data that track both the origin and destination of value added embodied in gross exports and final demand, by country and sector.

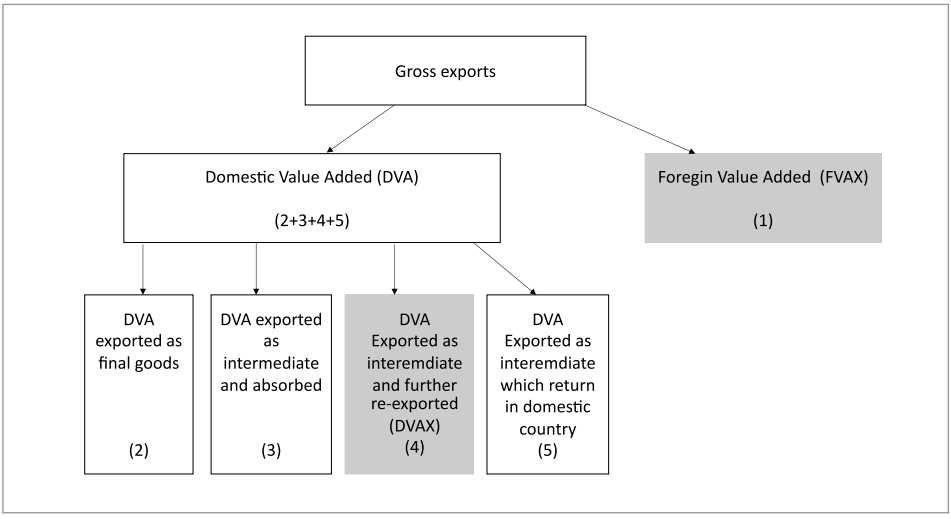
The indicators are based on the work of Koopman et al. (2010, 2014) extending the work of Hummels et al. (2001) and Johnson and Noguera (2012). Hummels et al. (2001) compute an index of vertical specialization accounting for the use of imported inputs in producing goods that are then exported. However, this indicator does not take into account country exports intermediates that are afterwards used to produce final goods abroad absorbed at home. By using input–output data for source and destination countries simultaneously, Johnson and Noguera (2012) overcome this limitation defining value-added exports as income generated in a given source country that is embodied in final goods absorbed in a particular destination and compute the ratio to gross export as a measure of the intensity of production sharing. Finally, Koopman et al. (2010, 2014) provide an unified framework that integrates the existing measures in block matrix formulation. They fully decompose gross exports into value added components and connect official gross statistics to value-added measures of trade.

Following this approach, gross export of a country, can be fully decomposed into two broad components (Figure 2): foreign value-added embedded in gross exports (1) (backward linkages) and domestic value-added in exports (2+3+4+5) . According to the type of goods domestic value added in export can be further decomposed into domestic value added embedded in export

of final goods (2) and domestic value added embedded in export of intermediates (3+4+5). Finally, considering the final destination of absorption, domestic value added in export of intermediates can be break in: domestic value added in export in intermediates directly absorbed in the first destination domestic market (3); domestic value added in export in intermediates further used as intermediate inputs for exports by third countries (4 forward linkages) and domestic value added export in intermediates that is initially exported but ultimately returned home embedded in imports from another country (5).

By means of this decomposition we can generate the two standard indicators for measuring *GVC* participation: a) "Forward" (DVAX), assessing the extent to which domestic exports are used by foreign firms as inputs to produce their own exports. This is the "seller-related" measure or supply side in *GVC*s; b) "Backward"(FVAX), measuring the extent to which domestic firms use foreign intermediate value added for exporting activities. This is the "Buyer" perspective or sourcing side in *GVC*s.

Figure 2 **Decomposition of gross export in value added trade**



Source: Author's elaboration based on Koopman(2010)

Backward participation is therefore likely to be higher if a sector is involved in downstream production as opposed to Forward, which is likely to be higher for sectors performing mainly upstream productions. As a consequence, the mechanisms through which *GVC* participation may potentially affect productivity growth can differ depending on the position of the firm along the chain. In principle, backward activities favor the exploitation of complementarities between domestic and foreign capabilities and the access to more advanced foreign technology is potentially beneficial for growth. Forward activities instead, increase exposure to new ideas and incentives to upgrade the production process, thus facilitating gains from specialization.

Measurement method

To compute the above measures of *GVC* participation assume a G-country, N-sector production and trade system where matrix X represents gross output that can be used either as intermediate or final good. Using the harmonised input-output tables we derive A the matrix of input-output coefficients, describing the units of intermediate goods needed for the production of one unit of gross output. Multiplying A and X we obtain the matrix of goods for intermediate use. The relationship between gross output, intermediate goods, and final demand goods can then be expressed as:

$$X = AX + Y \tag{1}$$

With Y being the matrix of goods for final use. Then rearranging the previous equation as $X = BY$ with:

$$B = (I - A)^{-1} \tag{2}$$

where B is the Leontief inverse matrix. To obtain the *GVC* indicators in gross export it is necessary to determine the value-added share matrix V and the matrix of gross export E. Finally, multiplying V by B and E, we get the ma-

trix vae. For the general G-country N-sector case, this is as follows:

$$vae = \begin{bmatrix} v_1 & 0 & \cdots & 0 \\ 0 & v_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & v_{gn} \end{bmatrix} \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1g} \\ b_{21} & b_{22} & \cdots & b_{2g} \\ \vdots & \vdots & \ddots & \vdots \\ b_{g1} & b_{g2} & \cdots & b_{gg} \end{bmatrix} \begin{bmatrix} e_1 & 0 & \cdots & 0 \\ 0 & e_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & e_{gn} \end{bmatrix}$$

In a simple example with two countries (i and j) and industries (k and l) we can zoom in to see the exact matrices content:

$$\begin{bmatrix} v_{ik} & 0 & 0 & 0 \\ 0 & v_{il} & 0 & 0 \\ 0 & 0 & v_{jk} & 0 \\ 0 & 0 & 0 & v_{jl} \end{bmatrix} \begin{bmatrix} b_{ikik} & b_{ikil} & b_{ikjk} & b_{ikjl} \\ b_{ilik} & b_{ilil} & b_{iljk} & b_{il}l \\ b_{jkik} & b_{jkil} & b_{jkjk} & b_{jkjl} \\ b_{jlik} & b_{jlil} & b_{jljk} & b_{jljl} \end{bmatrix} \begin{bmatrix} e_{jk} & 0 & 0 & 0 \\ 0 & e_{il} & 0 & 0 \\ 0 & 0 & e_{jk} & 0 \\ 0 & 0 & 0 & e_{jl} \end{bmatrix}$$
$$= \begin{bmatrix} vae_{ikik} & vae_{ikil} & vae_{ikjk} & vae_{ikjl} \\ vae_{ilik} & vae_{ilil} & vae_{iljk} & vae_{il}l \\ vae_{jkik} & vae_{jkil} & vae_{jkjk} & vae_{jkjl} \\ vae_{jlik} & vae_{jlil} & vae_{jljk} & vae_{jljl} \end{bmatrix}$$

From the vae matrix it is possible to decompose gross exports into value added along four dimensions: source country, source industry, using country, and using industry. For instance, vae_{ikjl} is the value added of industry k from country i in the exports of industry k from country j. Defining ik as the domestic country i industry k and jl as the foreign country j industry l, $DVAX$ of ik, the forward linkage indicator is obtained as:

$$DVAX_{ik} = \sum_l \sum_j vae_{ikjl} \tag{3}$$

with $i \neq l$. It represents the row sum of the elements of the vae matrix of country i sector k and is equal to the sum of value added from the domestic industry k of country i in the exports of all industries l in all foreign countries j.

FVAX of *ik*, the backward linkage indicator is obtained as:

$$\Phi_2 = \Phi_{S2}\omega_{S2} + \Phi_{E2}\omega_{E2} \tag{4}$$

with $i \neq l$. It represents the column sum of the elements of the vae matrix of country i sector k and is equal to the sum of value added from all industries l of all foreign countries l in the exports of industry k in country i.

Similarly, it is also possible to decompose value added according to final demand (Timmer et al. 2013) in fact, the the directly importing country often differs from the ultimate destination where the good is absorbed by final demand. Those indicators differently from those based on export tracks not only the value added traded in the production of exports, but also value added embedded in domestic and international final demand, consumed as a final goods. If we assume to have the same a *G-country*, *N-sector* production and trade system as before, to compute the indicator in final demand is necessary to apply the same decomposition used for the ones in gross export therefore we have to multiply the Leontief inverse B for the value added matrix V to obtain the value added share matrix BV but, differently from the indicators in gross export we multiplay BV by the matrix of final demand F, the $(G \times N) \times (N)$ diagonal matrix with country i's demand for final goods produced in country j sector k along the principal diagonal. The final BVF matrix is the decomposition of global value added by combinations of county-sector of origin and country-sector of final destination. Also in this case we can derive two different indicators: the row sum of the elements of the BVF matrix of country i sector k is the domestic value added embodied in foreign final demand $(DVAFD)$ in formula:

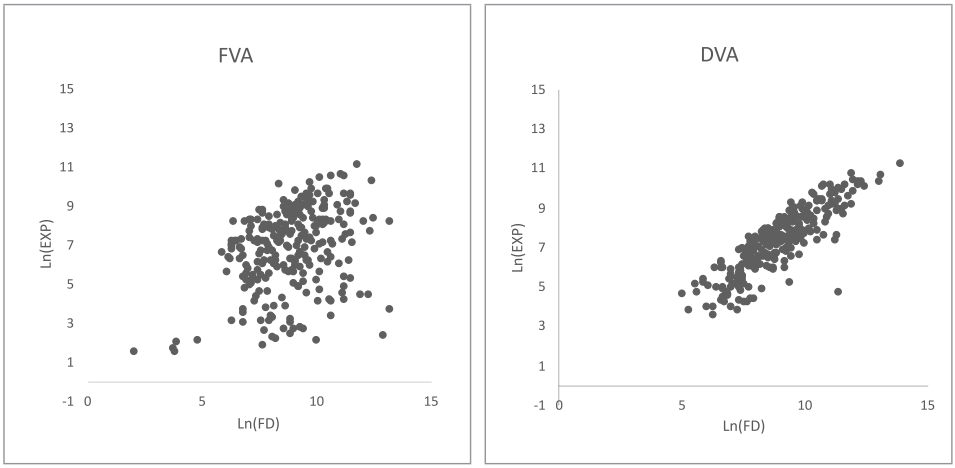
$$DVAFD_{ik} = \sum_{l} \sum_{j} vaf_{ikjl}$$

and the column sum of the elements of the BVF matrix of country i sector k is foreign value added embodied in domestic final demand $FVADD$ in formula:

$$FVADD_{ik} = \sum_{l} \sum_{j} vaf_{jlik}$$

Figure 3 shows the average values of domestic value added and foreign value added in export versus final demand for the countries and sectors included in our analysis. The two indicators are correlated both in domestic and in foreign value added, however they are not perfectly correlated confirmig the fact that they measure different mode of participation in the global production network and the relation is different for domestic and foreign value added. In particular the domestic value added measures in export and final demand are more correlated compared to the foreign ones and, for all the observations the indicator in final demand is higher than the one in export, which is not surprising considering that advanced countries (as the ones included in our sample) tend to participate more in final goods with respect to intermediates therefore they will show high indicator in domestic value added in final demand.

Figure 3 **Domestic value added and Foreign value added in export and final demand**



Source: Author's calcolation based on WIOD.

Along with *GVC* indicators the database employed in this paper includes data on tangible and *ICT* capital as well as standard growth accounting variables such as output and labor input. The source for *GVC* measures of participation is the World Input Output Database (WIOD) while the main source for output, labor, tangible and *ICT* capital is the EU KLEMS database (see O'Mahony and Timmer 2009, for details). A set of control variables for the econometric analysis are gathered from the World Bank database. The analysis covers the years 2000-2014[1]for 12 European countries (AT, BE, DE, DK, ES, FI, FR, IT, NL, PR, SE, UK) plus US and 30 Nace Rev 2 industries.

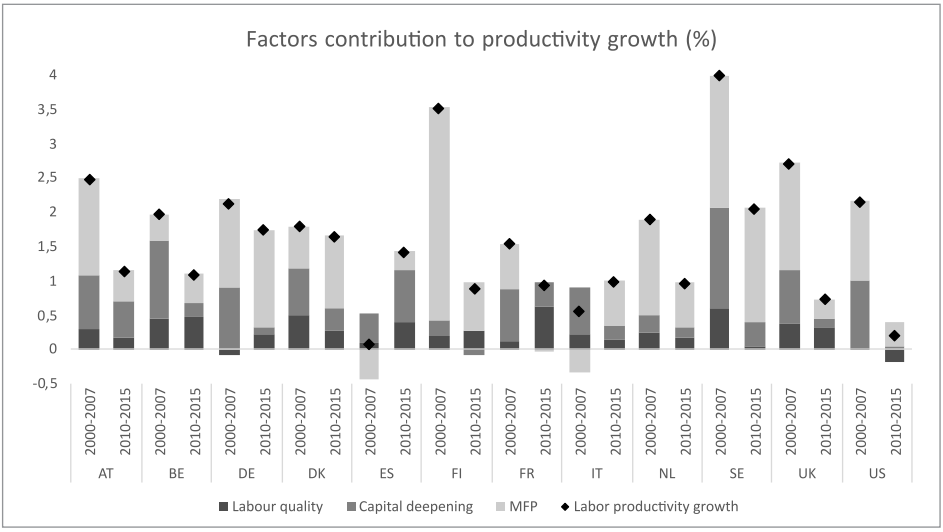
1 The time coverage of our analysis is determined by the availability of WIOD data that are up to 2014.

4. Descriptive evidence

4.1 Sources of productivity growth

We provide descriptive evidence on the sources of the slowdown adopting a standard growth accounting approach (GA)[2] for 12 EU economies and the US over the years 2000-2015.

Figure 4 **Contributions to labor productivity growth (%)**



Note: The figure compares average factors contribution to annual growth in gross value added per hour worked in selected advanced economies over the periods 2000-2007 and 2010-2015. For the post-crisis years, data refer to 2010-2014 for Italy and Sweden.

Source: authors' calculations based on EUKLEMS data.

As a first step, we look at the traditional decomposition of the sources of growth and then we consider individual sectoral contributions to aggregate labor productivity growth.

Figure 4 presents the standard sources of growth results before (2000-2007)

2 1942 [Tinbergen, 1942], 1957 [Solow, 1957], and Griliches, 1967 [Jorgenson and Griliches, 1967] and 1976 [Diewert, 1976].

and after (2010-2015) the financial crisis for the sample economies. The early 2000s were characterized by heterogeneous performances among advanced economies, with some European countries (UK, Finland, Sweden) outpacing the performance of the US, while others (Spain, Italy and, to a lesser extent, France) lagging behind. Since 2007, however, productivity growth recorded a widespread decline converging towards historically low average growth rates across countries. In 2000-2007, labor productivity growth has been driven by capital deepening in Belgium, France, Italy, Spain and Denmark (ranging from 0.4 pp in Spain to 1.1 pp in Belgium), whereas MFP accounted for a major share of labor productivity growth (from 1.2 pp in the US to 3.1 pp in Finland) in the remaining economies. In the post-crisis period, the contribution of capital deepening dropped significantly in most of the European countries (-0.1 pp in Finland, 0.5 pp in Austria but 0.8 pp in Spain).

Over the same period of time, the MFP slowdown was even more pronounced and widespread: the average growth rate was almost zero in the US and negative in the European economies[3]. In the pre-crisis years, MFP accounted for a large portion of the productivity growth rate differentials between the Mediterranean economies (Italy and Spain) and the other countries, providing a negative contribution (on average by 0.32 pp and 0.45 pp respectively) to labor productivity growth. After 2008-09, the contribution of MFP increased in Denmark, Germany, Italy and Spain, remained stable in Belgium, and decreased in the remaining economies. In Finland, France, Germany and Spain, the slowdown in capital deepening and MFP growth was partly counterbalanced by an increase in the contribution from labor quality.

When we move to individual sectors' contribution to productivity growth (tables A1 and A2 in the appendix), we find that Professional services have been the main drag on labor productivity growth in most countries, providing a positive contribution over the whole period only in Sweden, UK and the US. Then Wholesale and retail services boosted aggregate productivity growth

3 However, excluding the crisis years, 2008 and 2009, from the calculations we get a different and more varied picture

in all advanced economies, although with a declining contribution besides the Mediterranean economies (Italy moved from an average of 0.11 pp in 2000-2007 to 0.45 pp in 2010-2015, and Spain from -0.19pp to 0.57pp).

In 2000-07, labor productivity growth was mainly driven by services: Telecommunication services in France and Italy (contributing on average to 0.28 pp and 0.26 pp, respectively), Financial services in Spain and Denmark (0.6), Wholesale services in Germany and Sweden (0.7) and in the US (0.6). Swedish productivity growth was also largely affected by the manufacturing of Electrical and optical equipment (0.7 pp) growing at remarkably high rates over this period. Between 2000 and 2007, Telecommunications experienced highly differentiated yearly rates of growth across countries recording 6% in Germany, 10% in Spain, 11% in Italy and Sweden, and 12% in France. At the same time, productivity growth was particularly high in Electrical and optical equipment, increasing by 17% in the US, 15% in Sweden, 7% in France and Germany, and around 4% in Spain and 2% in Italy. The very same sectors acting as the largest contributors to labor productivity growth before the crisis account for most of the slowdown observed at the aggregate level since 2010. Although the slowdown has been widespread across countries and sectors, a few exceptions emerge. Among them, Professional services and Wholesale and retail trade in Spain (with contribution increasing to 0.2 and 0.6 pp, accordingly), IT services and Transport equipment in Germany (respectively from 0.11 to 0.2 pp, and from 0.25 to 0.48pp), the whole manufacturing sectors in Spain and Italy.

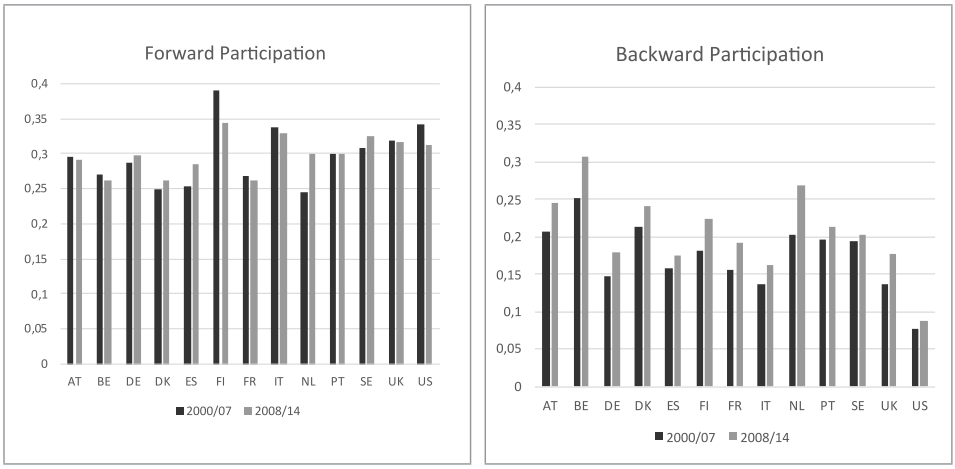
5. Global Value Chain participation and productivity growth

In this section we merge the evidence on *GVC* participation and productivity growth.

Figure 5 shows the average intensity of forward and backward participation over the years 2000-2014 distinguishing between the extent of participation

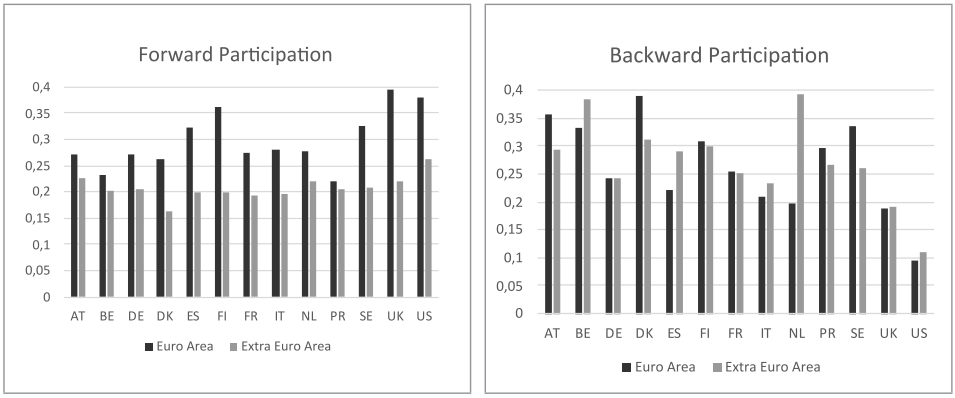
in two time periods: 2000-2007 and 2008-2014. The sample countries display higher forward than backward participation but the scope of *GVC* participation varies significantly across countries and sectors. Small open economies such as Belgium, Denmark and Netherlands import a larger amount of input from abroad (backward participation) while bigger countries such as the US and UK are relatively more involved in the *GVC*s as suppliers of value added. Italian forward participation is higher than the average of the sample, decreasing slightly in the second period, while backward participation is lower with an increasing trend after 2008. Overall, the degree of forward participation is relatively homogeneous across countries, while backward participation appears more heterogeneous. Backward participation has increased for all the countries in our sample after 2008 as opposed to forward participation showing mixed trends.

Figure 5 – Forward and Backward Participation 2000-07 and 2008-14



Source: authors' calculations based on WIOD data.

Figure 6 - Forward and Backward Participation intra and extra EURO area

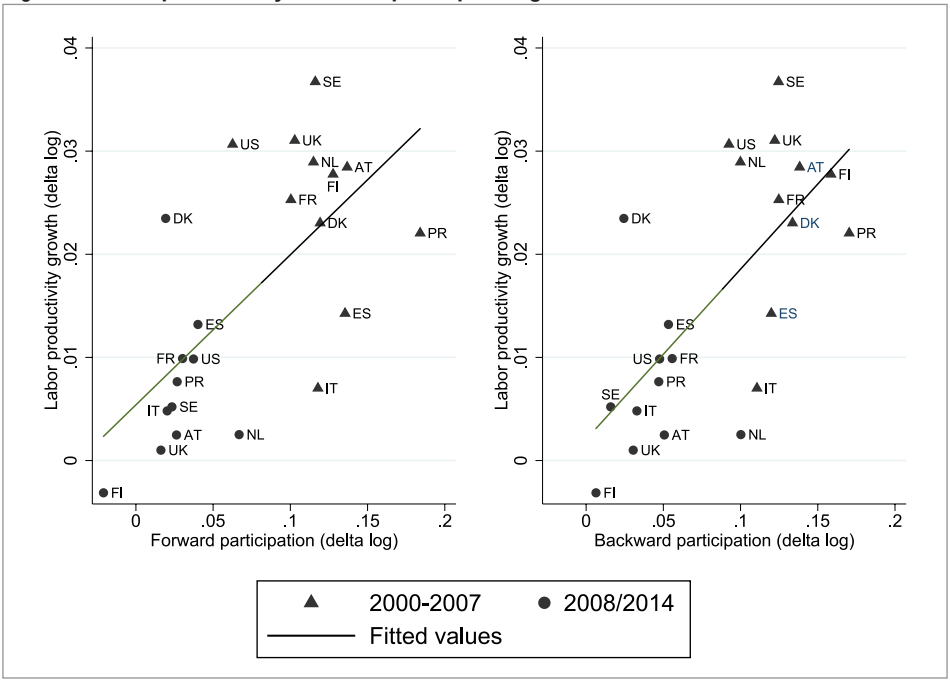


Source: authors' calculations based on WIOD data.

Figure 6 shows the average rate of participation distinguishing the partner economies those intra or extra euro area. Accounting for the currency area between dimension provides additional insights about a possible *integrated market* effect on the different modes of participation. Economic integration might favor *GVC* participation simply eliminating currency risk and tariffs. When production processes encompass multiple border crossings, as in *GVC* production, the trade costs are amplified, and can affect the competitiveness of the entire value chain. Moreover, euro area countries present a shared business climate potentially boosting participation via a reduction of intra-firms monitoring costs. Our sample economies show stronger forward linkages intra euro area compared to the extra euro area. The difference is larger for UK, Spain and Finland and is mainly driven by the services sector . Backward linkages are instead more differentiated between countries. For half of the sample countries backward participation intra and extra euro area are comparable. However, Netherlands and Belgium show larger participation with extra euro area, mainly for manufacturing while Austria, Denmark and Sweden have stronger linkages within euro area. Italy has stronger forward participation linkages intra euro area mainly in manufacturing but larger backward participation extra euro area.

As the main goal of our analysis is to investigate if and to what extent global value chain participation is related to labour productivity growth, Figure 7 shows the relationship between the average rates of growth of labour productivity and *GVC* participation (both for forward and backward) across the sample economies.

Figure 7 **Labor productivity and GVC participation growth**



Source: authors' calculations based on WIOD and EUKLEMS data.

We split our time span comparing average rates of growth before (2000/2007) and after the crisis (2008/2014). Productivity growth and *GVC* participation are positively and strongly related with slightly higher correlation for forward compared to backward participation. On average forward and backward participation as well as productivity growth were relatively higher before the financial crisis.

6. Empirical strategy

6.1 Econometric approach

We further explore the relationship between *GVC* participation and productivity growth estimating a standard production function augmented with measures of backward and forward participation. Our benchmark equation is as follows:

$$\triangle \ln\left(\frac{Y}{L}\right)_{i,c,t} = \beta_0 + \beta_1 \triangle \ln\left(\frac{K^j}{L}\right)_{i,c,t} + \beta_2 \triangle \ln(GVC^z)_{i,c,t} + \delta_i + \varepsilon_{i,c,t} \qquad (5)$$

where c is country, i industry and t time; Y is total value added, L are hours worked, K^j is capital stock with j=total, tangible, R&D and software capital assets; GVC refers to the mode of global value chain participation with $z = dvax$ (forward) and $fvax$ (backward), and δ_i and γ_t are industry and time dummies.

As it is well known in the empirical literature, the estimation of a production function as equation (5) might be biased as it can violate the assumption of strict exogeneity of factor inputs, and might be affected by structural identification problems related to measurement errors and multicollinearity. Moreover, equation (5) may suffer from reverse causality because more productive sectors might be in the position of participating more intensively in *GVC*s, reversing the direction of the relation we test. Thus, we estimate equation (5) resorting also to Instrumental Variables (IV) as suggested by Ackerberg et al (2015), and we follow Kummritz (2016) to identify the proper instruments for participation. Specific instruments are generated summing the predicted bilateral value added flows obtained combining a measure of trade and industry distance over countries and sector[4]. In the following section we

4 The detailed description of the construction of the instruments for *GVC* participation is described in the appendix.

illustrate our main empirical findings.

6.2 Econometric results

Table 1 shows the first set of results for equation (5). All regressions contain industry and time fixed effects and are estimated both by Generalized Least Squares (GLS) (odd cols) and IV (even cols). Columns 1 to 4 present results for the productivity impact of forward participation while columns 5 to 8 refer to backward participation. As expected, total capital stock has a positive and statistically significant coefficient across all specifications with bigger IV coefficients, thus suggesting an underestimation bias in the GLS estimates. Then, as shown by Corrado et al. (2017) intangible assets are likely to generate larger productivity returns compared to traditional capital assets so that we also check for differential effects of tangible and intangible assets types in equation (5). Cols 3,4 and 7,8 distinguish capital assets between tangible, R&D and Software. Both GLS and IV estimated coefficients for the three asset types are statistically significant, thus corroborating the evidence of a positive productivity impact from intangibles also in a framework accounting for *GVC* participation. This results is consistent with the argument provided by Durand and Miller (2018) claiming that intangible assets such as standards, specifications, R&D achievements, as well as software and organizational know-how are typically scalable assets, imposing negligible marginal costs following the initial investment made to create them and resulting in infinite returns to scale. The difference in scale economies between tangible and intangible assets implies that the firms controlling intangible-intensive parts of the chain will be in the position of experiencing a relatively larger productivity improvement from network participation as output expands (Haskel and Westlake, 2017). This is why intangible capital is an essential element for productivity growth along the chain (Jona-Lasinio and Meliciani, 2019).

Both modes of *GVC* participation positively and significantly affect pro-

ductivity growth, with forward linkages exerting a stronger impact compared to backward participation. As empirical research in support of the theoretical predictions linking *GVC*s to productivity is limited and because most of the empirical analysis focused mainly on the impact of backward participation, we do not have a comparable benchmark for our empirical results on forward linkages. But to get the sense of the size of the effects generated by both participation modes we quantify the contribution of participation to labor productivity growth using columns 4 and 8 in Table 1. Forward participation accounts for 0.008 percentage points per year for a growth rate of productivity equal to 0.015 percent per year. That is a rather large contribution compared to backward participation which accounts for 0.002 percentage points.

Table 1 **Productivity growth and GVC participation: benchmark specification**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Forward participation				Backward participation			
VARIABLES	xtgls	IV	xtgls	IV	xtgls	IV	xtgls	IV
$\triangle\ln(K^{tot}/L)$	0.300***	0.503***			0.289***	0.802***		
	(0.017)	(0.106)			(0.017)	(0.217)		
$\triangle\ln(dvax)$	0.079***	0.144***	0.049***	0.114***				
	(0.006)	(0.022)	(0.005)	(0.018)				
$\triangle\ln(K^{tang}/L)$			0.086***	0.168**			0.088***	0.165**
			(0.014)	(0.077)			(0.014)	(0.077)
$\triangle\ln(K^{R\&D}/L)$			0.027***	0.035*			0.026***	0.031*
			(0.006)	(0.018)			(0.006)	(0.018)
$\triangle\ln(K^{Sw}/L)$			0.062***	0.089**			0.055***	0.096**
			(0.010)	(0.041)			(0.009)	(0.042)
$\triangle\ln(fvax)$					0.015***	0.042***	0.012***	0.027***
					(0.003)	(0.010)	(0.002)	(0.007)
Observations	3,486	2,699	2,839	2,431	3,494	2,795	2,844	2,433
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Sector FE	YES	YES	YES	YES	YES	YES	YES	YES

Table 2 **Productivity growth and GVC participation: controls**

	Forward	Backward
$\triangle \ln(K^{tang}/L)$	0.095***	0.0918***
$\triangle \ln(K^{RkD}/L)$	0.0279***	0.0273***
$\triangle \ln(K^{Sw}/L)$	0.0563***	0.0517***
$\triangle \ln(dvax)$	0.0467***	
$\triangle \ln(fvax)$	-0.107*	-0.119*
$\triangle \ln(pop)$	-0.0103	-0.0149
$\triangle \ln(tax)$	-0.0231**	-0.0149
$\triangle \ln(reg)$		
Observations	2,435	2,439
year FE	YES	YES
sector FE	YES	YES

Finally, to check the robustness of our results, in Table 2 we test equation (5) including controls for country size (population), the degree of market regulation (reg) and fiscal pressure, measured as corporate tax rate (tax). The results are broadly unaffected. Indeed, market regulation has a small impact on productivity growth, country size is barely significant while fiscal pressure has no effect. However, our findings suggest that besides the existence of a strong positive link between *GVC* and productivity growth, further investigation of the multiple channels through which this relation operates is warranted.

7. Conclusions

In this paper, we explored the linkages between *GVC* participation and productivity growth in a sample of 12 European economies and the US in 2000-2014. Our findings support the existence of a positive linkage between different modes of *GVC* participation and productivity growth, which is

stronger for forward linkages. The analysis developed so far reinforces the idea that the increasing relevance of *GVC* participation and the consequent reorganization of the production processes might significantly affect productivity growth and that a deeper investigation of the multiple mechanisms through which different modes of *GVC* participation affect productivity in the economies is warranted.

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Appendix

A1 - Instrumenting GVC participation

The estimation of our benchmark equation may violate the assumption of strict exogeneity therefore we choose to follow the Kummritz(2016) approach instrumenting for GVC participation .

Both the GVCs indicators we use are calculated summing up for each country and sector combination, bilateral value added flows,therefore to built our IV we need at first to predict the bilateral value added flows then used as instruments in a 2SLS. To predict the vae_{ijkl} flows we need to take in account two dimensions: the distance between countries i and j and the distance between industries k and j. We could estimate country distance using the bilateral trade costs and the industrial distance as the number of intermediate stages between them: the interaction of this two components will be use in a "zero" stage to instrument the vae bilateral flows.

The gravity model augmented to consider GVCs Noguera(2012) shows how the vae_{ij} flow depends not only on the bilateral trade costs τ_{ij} but also on the trade costs τ_{ic} of all the countries which sent indirectly value added to j through i mediation. If we exclude τ_{ij}, namely the trade cost between the two countries we are considering, we can use the normalised sum of the bilateral trade costs to predict the country distance component of the vae_{ij} flow. Given the exclusion of τ_{ij}, the indirect bilateral cost has the advantage to be exogenous respect to the vae_{ij} flow we try to instrument.

Thus, the first part of the instrument will be the average trade cost weighted by the trade partner export share:

$$\tau_{ijt} = \sum_c \tau_{ict} * \frac{e_{ict}}{\sum_c e_{ict}} \tag{6}$$

where $c \neq i,j$

Considered the country level we need to address the industry one. To instrument *GVC* participation we need to take into account also industrial distance since, the value added between sectors could flow directly if the sectors are close or it can flow indirectly via other sectors if they are involved in different stages of production Thus, the larger the industrial distance, the larger the probability that third sector affects the trade relation.

The industrial distance is calculated using upstreamness and downstreamness developed byAntras and Chor(2013)

$$upstreamness_k = \sum_j \sum_l \frac{a_{ikjl} * y_{ik}}{y_{lj}} * upstreamness_l \tag{7}$$

$$downstreamness_k = \sum_j \sum_l a_{ikjl} * downstreamness_l \tag{8}$$

where y is total output and a the share of inputs in outputs obtained from the matrix of input-output coefficients. The indicator of industrial distance used is calculated as:

$$inddistance_{kl} = \frac{1}{upstreamness_k * downstreamness_l} \tag{9}$$

where upstreamness represents how far is a sector as a seller of value added from the final demand and downstreamness represents how far is a sector as a buyer of value added from primary inputs.

Eventually, to implement the IV strategy, we need to combine this two elements to predict an instrument of the flows which can be used in a 2SLS strategy.

We predict the bilateral value added flows as:

$$\ln vae_{ikjlt} = \beta_0 + \beta_1 \ln(\tau_{ij} * indistance_{kl}) + \gamma_{ik} + \gamma_{ky} + \gamma_{iy} \tag{10}$$

And we obtain our instruments for fvax and dvax aggregating the flows as:

$$fvax_{ikt} = \sum_l \sum_j vae_{jlikt} \tag{11}$$

$$dvax_{ikt} = \sum_l \sum_j vae_{ikjlt} \tag{12}$$

We estimate 4 different instrumental variables as in Kummritz(2016):the first is the same as the one in Kummritz (2016) with bilateral gross export trade costs and industrial distance aggregated for all the years in the sample, the second is estimated using bilateral gross export trade costs and industrial distance computed for every year, the third is generated using bilateral value added trade costs and industrial distance aggregated over time in our the sample and finally the fourth is obtained using bilateral value added trade costs and industrial distance calculated for every year.

Table A1 - **Sectoral contribution to labor productivity growth by country (2000-2007)**

Sector / Country	AT	BE	DE	DK	ES	FI	FR	IT	NL	SE	UK	US
Food, beverages tob.	0.11	0.12	0.01	0.02	0.10	0.17	0.07	0.00	0.03	0.08	0.07	0.05
Textiles	0.06	0.07	0.04	0.02	0.10	0.04	0.09	0.06	0.02	0.02	0.09	0.06
Wood and paper	0.09	0.08	0.04	0.05	0.02	0.25	0.05	0.03	0.05	0.12	0.05	0.07
Chemicals	0.12	0.10	0.16	0.07	0.07	0.07	0.12	0.02	0.23		0.11	0.10
Rubber and plastics	0.05	0.08	0.09	0.07	0.02	0.08	0.10	0.04	0.04	0.07	0.08	0.02
Metals	0.09	0.10	0.10	0.02	0.01	0.20	0.06	0.08	0.09	0.13	0.11	0.05
Electrical and optical equip.	0.13	0.08	0.32	0.13	0.06	1.46	0.14	0.05	0.11	0.72	0.07	0.51
Machinery, equipment n.e.c.	0.19	0.06	0.14	0.18	0.04	0.18	0.07	0.08	0.13	0.23	0.07	0.06
Transport equipment	0.16	0.09	0.25	0.02	0.12	0.01	0.01	0.03	0.06	0.26	0.08	0.15
Other manufacturing	0.08	0.01	0.09	0.08	0.03	0.05	0.08	0.02	0.05	0.09	0.07	0.05
Electricity, gas, water	0.04	0.02	0.01	-0.03	0.11	0.09	0.06	0.01	0.07	0.04	0.05	-0.03
Construction	0.12	0.22	0.11	-0.14	-0.79	-0.13	-0.08	-0.17	0.12	0.12	0.01	-0.22
Wholesale, retail trade	0.27	0.45	0.66	0.45	-0.19	0.53	0.19	0.11	0.50	0.71	0.48	0.55
Transportation, storage	0.08	0.14	0.22	0.17	-0.08	0.03	0.05	0.15	0.23	0.19	0.18	0.08
Accomodation, food	0.05	0.10	0.00	-0.10	-0.34	0.04	-0.06	-0.18	-0.03	-0.02	-0.01	0.00
Publishing, audiovisual	0.03	0.00	0.00	0.09	-0.03	0.02	0.05	0.01	0.03	0.05	0.07	0.39
Telecommunications	0.11	0.21	0.13	0.30	0.25	0.28	0.28	0.26	0.29	0.23	0.31	
IT, information services	0.05	0.05	0.11	0.08	0.07	0.06	0.08	0.01	0.10	0.17	0.15	0.16
Finance and insurance	0.32	0.14	-0.25	0.57	0.56	-0.01	0.12	0.19	0.29	0.24	0.51	0.38
Professional services	-0.01	-0.26	-0.20	-0.27	-0.40	-0.18	-0.20	-0.25	-0.07	0.32	0.42	0.15
Arts, entert., recreation	0.00	-0.03	-0.03	-0.05		-0.02	0.10	-0.01	-0.01	-0.02	-0.02	0.01
Other service activities	0.02	0.03	-0.01	0.00		-0.03	0.02	-0.06	-0.03	0.07	-0.02	-0.06

Source: authors' elaboration based on EUKLEMS data

Table A2 - **Sectoral contribution to labor productivity growth by country (2010-2015)**

Sector Country	AT	BE	DE	DK	ES	FI	FR	IT	NL	SE	UK	US
Food, beverages tob.	0.03	0.10	0.03	0.03	-0.05	-0.11	0.04	0.05	0.04	0.06	0.03	-0.07
Textiles	0.02	0.00	0.01	0.01	0.03	0.02	0.02	0.11	0.01	0.00	-0.01	0.01
Wood and paper	0.11	0.01	0.04	0.04	0.06	0.22	0.04	0.06	0.03	0.05	-0.01	0.00
Chemicals	0.09	0.14	0.08	0.38	0.05	0.09	0.07	0.08	0.00		-0.05	-0.02
Rubber and plastics	0.09	0.02	0.07	0.01	0.05	0.02	0.02	0.07	0.03	0.03	0.00	-0.01
Metals	0.16	0.28	0.15	0.04	0.23	0.11	0.04	0.16	0.03	0.24	0.04	0.01
Electrical and optical equip.	0.10	-0.03	0.18	0.08	0.02	-0.25	0.07	0.03	0.06	0.29	0.00	0.13
Machinery, equipment n.e.c.	0.09	0.01	0.12	0.19	0.04	0.00	0.04	0.09	0.09	0.18	0.00	0.01
Transport equipment	0.06	0.05	0.48	0.03	0.12	0.03	0.03	0.06	0.04	0.22	0.13	0.12
Other manufacturing	0.09	0.00	0.03	0.14	0.08	0.02	0.04	0.01	0.03	0.00	0.03	-0.01
Electricity, gas, water	-0.02	-0.04	-0.01	0.01	-0.06	0.07	0.04	-0.16	0.02	0.11	-0.03	0.02
Construction	-0.17	0.06	0.05	0.08	0.17	0.00	-0.13	0.11	0.09	-0.16	0.23	-0.07
Wholesale, retail trade	0.16	0.15	0.28	0.34	0.57	0.19	0.25	0.45	0.56	0.48	0.32	0.31
Transportation, storage	0.08	0.10	-0.07	0.32	0.21	0.31	0.13	-0.08	0.19	0.21	0.09	-0.07
Accomodation, food	0.07	-0.06	0.02	-0.07	-0.12	-0.09	0.00	-0.04	-0.11	-0.15	-0.11	-0.16
Publishing, audiovisual	0.00	0.01	0.01	0.09	-0.02	-0.03	0.02	-0.05	-0.02	0.08	0.07	0.21
Telecommunications	-0.07	0.01	0.05	0.25	0.22	0.12	0.14	0.02	-0.01	0.12	-0.01	
IT, information services	0.05	0.05	0.20	0.04	0.01	0.27	0.05	0.00	0.13	0.21	0.12	0.11
Finance and insurance	0.02	0.25	0.12	-0.12	-0.26	0.02	0.07	0.13	-0.06	0.28	-0.24	0.05
Professional services	-0.06	-0.25	-0.05	0.04	0.21	-0.10	-0.07	-0.26	0.01	0.28	0.31	0.14
Arts, entert., recreation	0.01	-0-01	0.01	0.00		-0.04	-0.01	-0.02	-0.03	-0.04	-0.06	0.02
Other service activities	-0.01	0.01	0.01	0.02		-0.09	-0.03	0.04	0.00	0.04	0.03	-0.01

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ECONOMIA ITALIANA 2020/2

La produttività delle imprese italiane: andamento, determinanti e proposte per un rilancio

La stagnazione della produttività accomuna la maggior parte dei paesi Ocse e appare come un tratto emergente della attuale fase del capitalismo contemporaneo. Tuttavia, il quadro italiano è ancora più preoccupante rispetto al contesto internazionale poiché il rallentamento della produttività ha origini più profonde e lontane nel tempo. Questo numero di Economia Italiana, Editors **Matteo Bugamelli, Marcello Messori e Roberto Monducci**, fornisce alcuni elementi interpretativi, approfondisce alcune delle cause della situazione nel nostro Paese e contribuisce al dibattito di *policy*.

A differenza di quanto accaduto in quasi tutti i paesi economicamente avanzati, l'insieme delle imprese italiane della manifattura e – soprattutto – dei servizi non ha saputo adattarsi, fra la fine degli anni Ottanta e i primi anni Novanta del secolo scorso, alle novità strutturali indotte dalle innovazioni nell'ICT e dalla tendenziale unificazione dei mercati internazionali.

In Italia la stagnazione della produttività e la scarsa crescita del PIL negli ultimi venticinque anni dipendono dall'**inadeguato numero di imprese dinamiche** cui corrisponde, sul fronte opposto**,** un eccesso di imprese che – soprattutto nelle dimensioni minori – risultano poco efficienti e la diffusa capacità da parte di aziende con poche prospettive di crescita a rimanere sul mercato.

I quattro saggi sul tema contenuti in questo numero offrono **prime e possibili spiegazioni di questo assetto strutturale del sistema delle imprese che caratterizza l'Italia nel confronto con gli altri sistemi economicamente avanzati,** contribuendo ad individuare i fattori che ostacolano lo sviluppo del sistema produttivo e le leve sulle quali agire per un pieno dispiegamento del suo potenziale di crescita. Si tratta, in particolare, di carenze organizzative e manageriali, di una scarsa propensione all'innovazione, di posizioni subordinate nelle catene internazionali del valore. Questo 'vuoto' riflette anche le difficoltà strutturali della nostra società: l'ambiente politico-istituzionale e burocratico accresce l'incertezza e premia i comportamenti passivi, rafforzando esternalità negative. Recuperare già nel breve termine parte del ritardo accumulato è un obiettivo difficile ma non velleitario.

ECONOMIA ITALIANA nasce nel 1979 per approfondire e allargare il dibattito sui nodi strutturali e i problemi dell'economia italiana, anche al fine di elaborare adeguate proposte strategiche e di *policy*. L'Editrice Minerva Bancaria si impegna a riprendere questa sfida e a fare di Economia Italiana il più vivace e aperto strumento di dialogo e riflessione tra accademici, *policy makers* ed esponenti di rilievo dei diversi settori produttivi del Paese.

EMB
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