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Global value chains and productivity gains: a cross-country analysis[4]

Summary
The main aim of this article is to assess the implications of involvement in global value chains (GVC) on sectoral productivity growth from the international perspective. Our panel data analysis covers 40 countries, 20 industries (13 manufacturing and 7 services sectors) in the period 1995–2011. Estimation results suggest that there is a positive link between TFP growth and the involvement of sectors in global value chains (measured as a share of foreign value added in exports). In particular, positive impact of foreign value added on TFP growth takes place mainly in manufacturing sectors. The results are robust to changes in productivity growth measurement.
Keywords: global value chains, foreign value added, productivity, panel data analysis

1. Introduction

The main aim of this article is to assess the implications of involvement in global value chains (GVC) on sectoral productivity growth from the international perspective. Our panel data analysis covers 40 countries, 20 industries (13 manufacturing and 7 services sectors) in the period 1995–2011.

In the first part of the article (Section 2), we present theoretical motivations which describe why the division of tasks across countries (i.e. global production

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sharing and the participation in GVC[5]) can result in productivity gains. We also describe related empirical findings. It is expected that an increase in internationalization and movement of some of the activities abroad should translate into productivity gains[6]. The basic argument considering this positive linkage is related to the firm's relocation of least efficient production stage in order to concentrate on more productive core activities. Further, firms can take advantage directly or indirectly (through their suppliers) of cheaper, better quality or more variable intermediate inputs and components. Still, there are studies questioning general productivity enhancing effect of cross-border production sharing and suggesting significant differences between the effects of materials and business services relocation[7].

In the empirical part of the paper we focus on the relationship between the involvement of particular sectors in GVC and their total factor productivity. In Section 3 we briefly discuss the measurement of a sector's position in GVC through the decomposition of gross exports. Specifically, we follow the methodology of Wang et al.[8] which can be used to measure a sector's position in an international production chain that varies by sector and country. It takes into account both domestic and foreign components of value added, as well as double counted terms in official trade statistics. We apply Wang et al.[9] decomposition to global input-output tables (World Input Output Database – WIOD) and focus on the information on foreign value added (FVA) content of exports.

Section 4 is dedicated to the econometric analysis in which we relate GVC indicators to sectoral total factor productivity growth. We estimate an augmented production function in which FVA indicators are treated as potential technology shifters, i.e. serve as determinants of the technological change term. Alternatively, we perform two step analysis: first calculating TFP growth as Solow residual and then regressing it on its potential determinants. The results suggest

[5] P. Antras, *Global Production: Firms, Contracts, and Trade Structure*, Princeton University Press, Princeton 2016.

[6] See e.g. M. Amiti, S.-J. Wei, *Service Outsourcing, Productivity: Evidence from the US*, "The World Economy" 2009, vol. 32, pp. 203–220; C. Cheung, J. Rossiter, Y. Zheng, *Offshoring and Its Effects on the Labour Market and Productivity: A Survey of Recent Literature*, "Bank of Canada Review" 2008, Autumn, pp. 15–28.

[7] B. Michel, F. Rycx, *Productivity Gains and Spillovers from Offshoring*, "Review of International Economics" 2014, vol. 22(1), pp. 73–85.

[8] Z. Wang, S.J. Wei, K. Zhu, *Quantifying international production sharing at the bilateral and sector levels*, National Bureau of Economic Research Working Paper no. 19677, 2013.

[9] Ibidem.

that FVA is positively associated with TFP productivity growth, but only in manufacturing sectors.

The main novelty of our study is based on the analysis performed for a wide set of countries and sectors in a panel setting and utilization FVA indicators obtained through Wang et al.[10] decomposition.

2. Theoretical background and related literature

Traditionally, production sharing across countries and offshoring has been considered from the trade perspective and measured with the use of disaggregated statistics on imports[11] or, recently, on exports[12]. As such the impact of production fragmentation on productivity can be explained either through trade-focused endogenous growth models or through recent trade theories.

The basis is the understanding of trade openness effect on productivity growth. For example, Aghion and Howitt[13] in their theoretical model distinguish three channels. First, growth is promoted by enhancing the domestic firms/sectors to innovate in order to escape foreign competitors (*the escape competition effect*). Less productive domestic producers are pushed out of the market and those who survive have the new possibility of buying intermediate goods from the most efficient producers. However, this mechanism depends on the firm's distance to the leader (technological frontier): those further away from the frontier might have weaker incentives to innovate as they are not able to catch up. On the contrary, the second effect (*the knowledge spillover)* in which trade generates positive externalities e.g. in the form of knowledge transfer can be more pronounced for the more backward firms/sectors/countries. The final channel (*the market size effect*) generates growth through economies of scale and the possibility to access larger markets.

[10] Ibidem.

[11] E.g. as share of imported intermediates in domestic value added – R.C. Feenstra, G.H. Hanson, *The impact of outsourcing and high-technology capital on wages: Estimates for the United States, 1979–1990*, "Quarterly Journal of Economics" 1999, vol. 114, pp. 907–941.

[12] A. Mattoo, Z. Wang, S.J. Wei, *Trade in Value Added: Developing New Measures of Cross-Border Trade*, World Bank Publications, London 2013.

[13] P. Aghion, P. Howitt, *The Economics of Growth*, MIT Press, Cambridge 2009, pp. 267–286.

New-new trade theory[14] provides the explanation for sectoral productivity gains as a result of trade activity in a framework accounting for firms' heterogeneity. In the basic model of Melitz[15] a firm which enters the export market must first make an initial investment – fixed entry costs exist due to the need to collect information on foreign markets or to set up new distribution channels. Export decision occurs after the productivity is known. Only firms with suffiecintly high productivity enter the export market while the least productive are forced to exit. This market selection relocates market shares towards more efficient firms and contribute to an aggregate productivity gains observed at the sectoral level. According to this model, "trade – even though is costly – always generates a welfare gain"[16].

Recent evolution of trade theory has focused on the phenomenon of globally observed increase in production sharing and the division of tasks across countries due to offshoring[17]. In particular, in GRH framework the effect of offshoring depends on the interplay between different effects, one of them being the productivity effect[18]. Trade in tasks induces productivity gains connected with cost saving (falling costs of offshored tasks). This mechanism is similar to Jones and Kierzkowski[19] reasoning, where the effects of production fragmentation through technology improvements affects the industry and employed factors of production.

In their papers Amiti and Wei[20] and Schwörer[21] list many channels through which relocation of some of the parts of production can enhance productivity.

[14] Thoroughly described in: M.J. Melitz, S.J. Redding, *Heterogeneous Firms and Trade*, in: *Handbook of International Economics*, vol. 4, eds G. Gopinath, E. Helpman, K. Rogoff, Elsevier, Amsterdam 2015, pp. 1–54.

[15] M. Melitz, *The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity*, "Econometrica" 2003, vol. 71, no. 6, pp. 1695–1725.

[16] Ibidem, p. 1713.

[17] G.M. Grossman, E. Rossi-Hansberg, *Trading tasks: A simple theory of offshoring*, "American Economic Review" 2008, vol. 98, pp. 1978–1997 – GRH here after; R. Baldwin, F. Robert-Nicoud, *Trade-in-goods and trade-in-tasks: An integrating framework*, "Journal of International Economics" 2014, vol. 92(1), pp. 51–62.

[18] The other two are: the relative price effect and the labour supply effect. Relative price effect is connected with the falling prices of goods produced by firms engaged in offshoring, while labour supply effect refers to the displacement of workers whose tasks have been offshored.

[19] R.W. Jones, H. Kierzkowski, *Globalization and the Consequences of International Fragmentation*, in: *Money, Capital Mobility, and Trade: Essays in Honor of Robert A. Mmundell*, eds A.C. Guillermo, R. Dornbusch, M. Obstfeld, MIT Press, Cambridge 2001, pp. 365–383.

[20] M. Amiti, S.-J. Wei, op.cit.

[21] T. Schwörer, *Offshoring, Domestic Outsourcing and Productivity: Evidence for a Number of European Countries*, "Review of World Economics" 2013, vol. 149, pp. 131–149.

The basic argument on such a positive linkage is related to firm's relocation of least efficient production stages in order to concentrate on more productive core activities. Furthermore, through offshoring firms take advantage of cheaper, better quality inputs; it may also provoke efficiency upgrading through the reorganization of firm's activity or induce technology transfer from foreign suppliers. Finally, as cost saving phenomenon, offshoring should increase profits which in turn can be transferred into innovation activities. However, Michel and Rycx[22] suggest that production fragmentation requires time consuming reconstruction of company's activity and productivity gains might be materialized only in the long run (while short-term effects can be limited due to the additional costs of coordinating spatially distributed stages of production).

Given the recent development in trade theory and the interest in firm heterogeneity, productivity effects of global production sharing have been commonly analysed from the perspective of firms[23]. Due to the nature of our data, we shall concentrate on industry level evidence of productivity effects of global production sharing. Starting from country-specific studies, Egger et al.[24] analysed the case of 20 manufacturing industries in Austria and showed that material offshoring (mainly to Eastern Europe) had a positive significant impact on their TFP growth. Amiti and Wei[25] dealt with 96 US manufacturing industries (observed between 1992–2000). They concluded that service offshoring had a significant positive effect on productivity, while positive effect of material offshoring was not robust and its magnitude was much lower than service offshoring. This finding is in line with what Michel and Rycx[26] confirmed for Belgium (studied over the period 1995–2004): they found that materials offshoring had no effect on productivity, while business services offshoring lead to productivity gains in manufacturing. However, cross-country differences are evident as Daveri and

[22] B. Michel, F. Rycx, op.cit.

[23] Among others H. Görg, A. Hanley, E. Strobl, *Productivity effects of international outsourcing: evidence from plant-level data*, "Canadian Journal of Economics/Revue canadienne d'économique" 2008, vol. 41(2), pp. 670–688 on Irish plants; A. Hijzen, T. Inui, Y. Todo, *Does Offshoring Pay? Firm-Level Evidence from Japan*, "Economic Inquiry" 2010, vol. 48(4), pp. 880–895 on Japanese firms. The review of the first wave of the studies on the impact of offshoring on productivity is presented in: K.B. Olsen, *Productivity Impacts of Offshoring and Outsourcing: A Review*, OECD Science, Technology and Industry Working Paper no. 1, 2006.

[24] P. Egger, M. Pfaffermayr, Y. Wolfmayr-Schnitzer, *The international fragmentation of Austrian manufacturing: The effects of outsourcing on productivity and wages*, "The North American Journal of Economics and Finance" 2001, vol. 12(3), pp. 257–272.

[25] M. Amiti, S.-J. Wei, op.cit.

[26] B. Michel, F. Rycx, op.cit.

Jona-Lasinio[27] found that offshoring of intermediates within the same industry ("narrow offshoring") was beneficial for productivity growth in 21 Italian industries (1995–2001), while the offshoring of services was not.

Cross-country analyses are generally very scarce. Egger and Egger[28] addressed the effect of offshoring on productivity of low skilled labour employed in 21 manufacturing industries in 12 EU member countries (1993–1997). They found that, contrary to the short-run effects, in the long run international outsourcing exhibited a positive effect on labour productivity of low-skilled workers. Falk[29] investigated the impact of international outsourcing on TFP growth based on manufacturing industry data for 14 OECD countries for the period 1995–2000. The results reveal that while material outsourcing was not a significant dirver of productivity, international outsourcing of service inputs raised the rate of TFP growth by 2.4 p.p. over the sample period. In the more recent study, Schwörer[30] linked manufacturing firm-level data from Amadeus with industry measures of offshoring for nine European countries observed between 1996 and 2008. He finds that service offshoring and offshoring of non-core manufacturing activities (broad offshoring) are associated with TFP increase.

In all of the above mentioned studies offshoring indices were conventionally calculated on the basis of trade statistics on imported intermediate inputs. Recent developments in the field of production sharing measurement, accounting for the division of value added across countries[31] matched with international input-output data (WIOD[32]), propose a new direction of research. Still, there are not yet many multicountry productivity-focused studies using GVC approach. In the recent paper Hagemejer[33] combined firm-level information with international statistics on sectors' participation in GVC for nine new EU member states. He shows that increased foreign content of exports brings additional productivity

[27] F. Daveri, C. Jona-Lasinio, *Offshoring and productivity growth in the Italian manufacturing industries*, "CESifo Economic Studies" 2008, vol. 54(3), pp. 414–450.

[28] P. Egger, H. Egger, *International Outsourcing and the Productivity of Low-skilled Labor in the EU*, "Economic Inquiry" 2006, vol. 44(1), pp. 98–108.

[29] M. Falk, *International Outsourcing and Productivity Growth*, "Review of Economics and Institutions" 2012, vol. 3(1), pp. 1–19.

[30] T. Schwörer, op.cit.

[31] A. Mattoo, Z. Wang, S.J. Wei, op.cit.; Z. Wang, S.J. Wei, K. Zhu, op.cit.

[32] M.P. Timmer, E. Dietzenbacher, B. Los, R. Stehrer, G.J. de Vries, *An Illustrated User Guide to the World Input – Output Database: the Case of Global Automotive Production*, "Review of International Economics" 2015, vol. 23, pp. 575–605.

[33] J. Hagemejer, *Productivity spillovers in the GVC. The case of Poland and the New EU Member States*, WNE Working Paper University of Warsaw, Faculty of Economic Sciences no. 42(2015)/190, 2015.

gains on top of those which can be attributed to exporting, and that in selected cases participation in the GVC leads to a smaller productivity gap between foreign and domestic firms.

3. Data and foreign value added (FVA) measurement

Our panel is composed of 40 countries[34], 20 industries (13 manufacturing and 7 services sectors)[35] observed in the period 1995–2011 (unbalanced panel). The main data source is World Input Output Database – WIOD[36]. We employ the *decompr* package in R[37] to perform the decomposition of sectoral gross exports with the use of algorithm proposed by Wang et al.[38] Their framework is an extension of work of Koopman et al.[39] and provides the detailed information about various components of total exports – domestic, foreign and pure double counting as well. This approach allows to track the structure of value added in every sector and to show how value added is used in domestic sectors.

In particular, we use the information on foreign value added (*FVA*) as a measure of involvement of particular sectors in global value chains and dependency on tasks performed abroad. According to Wang et al.[40] FVA reflects this part of total country's export, both of final and intermediate goods (*FVA_FIN* and *FVA_INT*, respectively), which is created by using intermediates imported from direct partner or via third countries (Figure 1). The two main components of *FVA* can be interpreted as follows[41]. A large share of foreign value added (*FVA*)

34 Australia, Austria, Belgium, Bulgaria, Brazil, Canada, China, Cyprus, the Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, the United Kingdom, Greece, Hungary, India, Indonesia, Ireland, Italy, Japan, Korea, Lithuania, Luxembourg, Latvia, Mexico, Malta, Netherlands, Poland, Portugal, Romania, Russia, Sloviaka, Slovenia, Sweden, Turkey, Taiwan, The United States of America.

35 Manufacturing sectors – all NACE 1.1 sectors except for sector 23 – Coke, Refined Petroleum and Nuclear Fuel. Services sectors – Inland Transport, Water Transport, Air Transport, Other Transport Activities, Post and Telecommunications, Financial Intermediation, Renting of M&Eq and Other Business Activities.

36 M.P. Timmer, E. Dietzenbacher, B. Los, R. Stehrer, G.J. de Vries, op.cit.

37 B. Quast, V. Kummritz, *Decompr: global value chain decomposition in R*, Centre for Trade and Economic Integration (CTEI) Working Papers no. 01, 2015.

38 Z. Wang, S.J. Wei, K. Zhu, op.cit.

39 R. Koopman, Z. Wang, S.J. Wei, *Tracing Value-Added and Double Counting in Gross Exports*, "American Economic Review" 2014, vol. 104(2), pp. 459–494.

40 Z. Wang, S.J. Wei, K. Zhu, op.cit.

41 Ibidem, p. 34.

in a country's final goods exports (*FVA_FIN*) is a sign that that the country is mainly involved in final assembling activities based on imported components. Hence, it just participates in cross-country production sharing on the low end of GVC. An increasing foreign value-added share in a country's intermediate exports (*FVA_INT*) implies that the country is upgrading its industry to start producing intermediate goods for other countries, especially when more and more of these goods are exported to third countries for final goods production. The latter is a sign that the country is no longer at the bottom of GVC. The movement from the bottom to the top of GVC can be a sign of industrial upgrading. Table 1 reports a rise in *FVA*, *FVA_FIN* and *FVA_INT* (as percentage of exports).

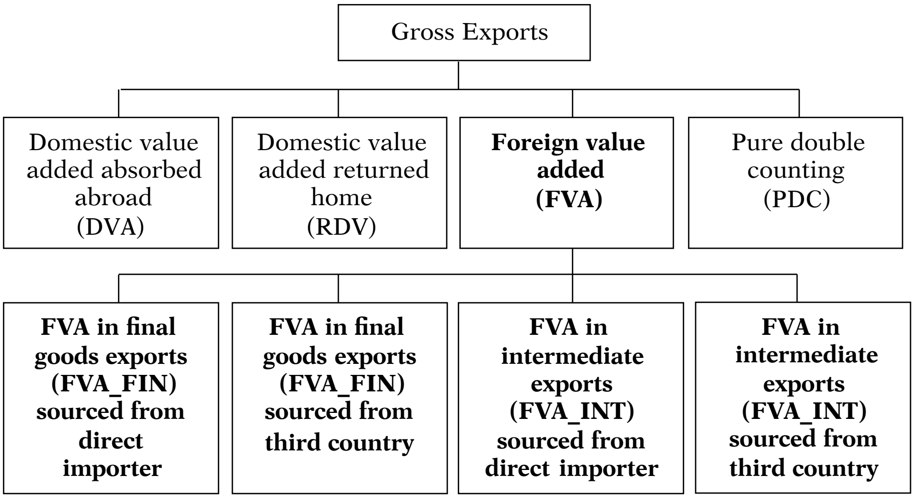

Figure 1. Gross exports decomposition – foreign value added components

Source: own elaboration based on: Z. Wang, S.J. Wei, K. Zhu, *Quantifying international production sharing at the bilateral and sector levels*, National Bureau of Economic Research Working Paper no. 19677, 2013, pp. 25–26.

Table 1. Change in *FVA*, *FVA_FIN* and *FVA_INT* (40 countries, 1995–2011)

	FVA			*FVA_FIN*			*FVA_INT*		
	All	Manuf	Service	All	Manuf	Service	All	Manuf	Service
1995	6.1	12.3	5.9	2.9	7.3	2.4	3.2	5.0	3.5
2011	8.2	16.0	7.8	4.0	9.8	3.1	4.1	6.2	4.4

Notes: weighted avareges across countries and sectors (weighted by sectoral employment); *FVA*, *FVA_FIN* and *FVA_INT* as % of gross export.

Source: own calculations with data from WIOD, using Wang et al. methodology – Z. Wang, S.J. Wei, K. Zhu, *Quantifying international production sharing at the bilateral and sector levels*, National Bureau of Economic Research Working Paper no. 19677, 2013.

4. Estimation results

In our empirical setting, we start from the standard production function specification in which GVC indicators are treated as potential technology shifters, i.e. as determinants of the technological change term. The formula is as follows (time subscripts are omitted for simplification):

$$Y_{ij} = A_{ij}(FVA_{ij}, X_{ij})F(L_{ij}, K_{ij}), \tag{1}$$

where: Y_{ij} *is* the value added of sector *j* in country *i*, produced with two main inputs: labour (L_{ij}) and physical capital (K_{ij}); A_{ij} is an index of technical efficiency which in turn is determined by involvement in GVC, measured by foreign value-added (FVA_{ij}) and other sector-specific control variables (X_{ij}). Such an approach has been adopted in the related literature[42] and this method is called "econometric approach to productivity measurement"[43].

Taking natural logarithms and first differences of equation (1) we obtain the following specification which will be the basis of our empirical analysis:

$$\Delta \ln Y_{ijt} = \alpha_{ij} + \beta_1 \Delta \ln K_{ijt} + \beta_2 \Delta \ln L_{ijt} + \beta_3 \ln FVA_{ijt-1} + \beta X_{ijt-1} + \upsilon_t + \eta_i + e_{ijt} \tag{2}$$

where: multi factor productivity growth (change in the production, *Y*, once changes in labor and capital inputs, *K* and *L*, have been taken into account) is determined by *FVA*. Among additional control variables *X*, we include the degree of domestic competition. It is proxied by price-cost margin (*PCM*) calculated as the difference between value added (VA_{ijt}) and labour compensation ($COMP_{ijt}$) as a proportion of gross output (GO_{ijt}): $PCM_{ijt} = (VA_{ijt} - COMP_{ijt})/GO_{ijt}$[44]. Additionally, we include a set of dummies: υ_t is the time-specific effect reflecting

[42] Among others: M. Amiti, S.-J. Wei, op.cit.; B. Michel, F. Rycx, op.cit.

[43] For the discussion of methods dedicated to productivity measurement see: *Measuring Productivity: Measurement of Aggregate and Industry-level Productivity Growth, OECD Manual*, OECD, Paris 2001; *OECD Compendium of Productivity Indicators 2015*, OECD Publishing, Paris 2015.

[44] The *PCM* is in the range between zero and one. The higher the index, the lower the competition on the domestic market. See J. Wolszczak-Derlacz, *The impact of domestic and foreign competition on sectoral growth: a cross-country analysis*, "Bulletin of Economic Research" 2014, vol. 66, issue S1, pp. S110–S131 for the discussion of the index construction and the empirical analysis of its impact on productivity in 21 manufacturing industries in 18 OECD countries over the period 1990–2006.

a common technology shock or business cycle fluctuations while η_i is an unobserved country specific effect. The time-invariant industry-level fixed effects are eliminated through first differencing. We use country-industry fixed effect as the specification of our panel (α_{ij}). We assume that all factors except *K* and *L* that influence productivity growth are lagged. *L* is measured in terms of hours worked in a sector.

Alternatively, the second approach to productivity measurement is based on standard calculation of total factor productivity (TFP) growth as the Solow residual through growth accounting exercise. TFP is then regressed it on its potential determinants (including *FVA*). This method is composed of two steps: estimating TFP growth (not directly observable) and then using it as depended variable in the second step[45]. Since we have only sectoral data (as opposed to firm-level ones), we rather concentrate here on the econometric approach to productivity measurement, while TFP-based results will be considererd as a robustness check.

In the first instance we checked for the unit roots of our variables[46]. Another important issue is linked to potential endogenity between *FVA* and productivity. We thus adopt instrumental variables (IV) method of estimation where sector-level instrument for *FVA* is obtained through gravity-type regression[47].

The estimation results are presented in Tables 2, 3 and 4. Table 2 reports the results with overall *FVA* (as percentage of gross exports in the sector), while Table 3 and Table 4 refer to the effect of *FVA_FIN* and *FVA_INT*, respectively. The first three columns are dedicated to the basic model (without *PCM*), while columns 4, 5 and 6 show the results when the augmented specification is estimated.

45 The Solow residual was calculated as $TFPgrowth_{ijt} = \Delta \ln Y_{ijt} - (\hat{a}_{ij} + \hat{b}_1 \Delta \ln K_{ijt} + \hat{b}_2 \Delta \ln L_{ijt})$ taking into account time and industry specific effects, and whithout imposing any restrictions on capital and labour growth elasiticities. The second step involved estimating the following regression: $TFPgrowth_{ijt} = \alpha_{ij} + \beta_1 \ln FVA_{ijt-1} + \beta X_{ijt-1} + u_t + n_i + e_{ijt}$. The results are presented in Table 5.

46 The results are obtainable upon request.

47 The results of estimation of eq. (2) with the use of FE effects are obtainable from the authors upon request. In order to build an instrument we follow the methodology based on Di Giovanni and Levchenko approach (J.D. Giovanni, A. Levchenko, *Trade openness and volatility*, "The Review of Economics and Statistics" 2009, vol. 91(3), pp. 558–585) and described in detail in Parteka and Wolszczak-Derlacz (A. Parteka, J. Wolszczak-Derlacz, *The Impact of Trade Integration with the European Union on Productivity in a Posttransition Economy: The Case of Polish Manufacturing Sectors*, "Emerging Markets Finance and Trade" 2013, vol. 49(2), p. 101). Here, in the gravity equation as left hand side variable we consider *FVA* while right hand side variables reflect domestic and foreign sector's size, distance and additional controls, such as: common currency, participation in regional trade agreement, common official language and colonial relationship. The data for control variables used in gravity model come from CEPII database (available at www.cepii.fr), updated by the authors.

We perform the estimation first for the whole sample – all sectors (columns 1 and 4), then for manufacturing sectors only (columns 2 and 5) and, finally, for services sectors only (columns 3 and 6).

In all the specifications shown in Table 2 the growth of inputs, *K* and *L*, is positively associated with the growth of value added. Then, the higher the *PCM* (hence, the lower the domestic competition), the lower the multi factor productivity growth. The parameter in front of *FVA* is of our main interest. When we consider overall *FVA* (foreign value added embodied both in final and intermediate exports), the coefficient is positive and statistically significant when all industries are considered together (remember that we have country-sector fixed effects) but it looses its statistical significance when we add *PCM* to the regression. *FVA* however results to be a significant positive determinant of productivity growth in manufacturing sectors (as shown in column 2 and in column 5 of Table 2). In case of services (columns 3 and 6) productivity change does not result to be linked to foreign value added content.

Table 2. The impact of *FVA* on productivity growth ($\Delta \ln Y_{ijt}$) – IV estimates

Sample (sectors):	All	Manuf	Service	All	Manuf	Service
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln K_{ijt}$	0.521***	0.432***	0.554***	0.584***	0.442***	0.661***
	[0.123]	[0.047]	[0.170]	[0.037]	[0.045]	[0.055]
$\Delta \ln L_{ijt}$	0.443***	0.375***	0.518***	0.392***	0.335***	0.461***
	[0.066]	[0.051]	[0.116]	[0.065]	[0.041]	[0.125]
$\ln FVA_{ijt-1}$	0.155**	0.241***	0.05	0.052	0.169***	–0.097
	[0.076]	[0.034]	[0.171]	[0.068]	[0.036]	[0.170]
PCM_{ijt-1}				–0.727***	–0.663***	–0.932**
				[0.180]	[0.087]	[0.422]
Observations	9223	6323	2900	9076	6265	2811
Under-identification	0.000	0.000	0.000	0.000	0.000	0.000
Weak identification	120.2	22.7	458.0	98.8	414.7	13.6
Hansen J	0.47	0.49	0.64	0.67	0.85	0.38

Notes: Robust standard errors in parentheses. Statistically significant at *** 1, ** 5, * 10 percent level. In all specifications, year dummies and country dummies included. Panel specified by country-industry pair. $\ln FVA_{ijt-1}$ treated as endogenous variable and instrumented on the basis of the gravity equation as explained in the main text. The figures reported for the under-identification test are the p-values and refer to the Kleibergen-Paap rk LM test statistic, where a rejection of the null indicates that the instruments are not under-identified. The weak identification test refers to the Kleibergen-Paap Wald rk F statistic test for the presence of weak instruments. As a "rule of thumb" the statistic should be at least 10 for weak identification not to be considered a problem (D. Staiger, J. Stock, *Instrumental variables regression with weak instruments*, „Econometrica" 1997, vol. 65, pp. 557–586). Hansen J (p-values) refer to a test of overidentifying restrictions with the null hypothesis that the instruments are valid instruments.
Source: own calculations with data from WIOD.

Table 3. The impact of *FVA_FIN* on productivity growth ($\Delta \ln Y_{ij,t}$) – IV estimates

Sample (sectors):	All	Manuf	Service	All	Manuf	Service
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln K_{ijt}$	0.524***	0.430***	0.556***	0.583***	0.444***	0.663***
	[0.124]	[0.048]	[0.171]	[0.037]	[0.045]	[0.055]
$\Delta \ln L_{ijt}$	0.450***	0.390***	0.520***	0.395***	0.344***	0.458***
	[0.066]	[0.052]	[0.116]	[0.064]	[0.041]	[0.125]
$\ln FVA_{ijt-1}$	0.078	0.127***	0.01	0.029	0.082***	–0.05
	[0.063]	[0.022]	[0.148]	[0.047]	[0.022]	[0.122]
PCM_{ijt-1}				–0.758***	–0.753***	–0.851**
				[0.157]	[0.081]	[0.353]
Observations	9221	6323	2898	9074	6265	2809
Under-identification	0.000	0.000	0.000	0.000	0.000	0.000
Weak identification	400.5	341.5	131.7	382.0	292.7	130.7
Hansen J	0.15	0.01	0.46	0.98	0.02	0.30

Notes: as under Table 2
Source: own calculations with data from WIOD.

Table 4. The impact of *FVA_INT* on productivity growth ($\Delta \ln Y_{ij,t}$) – IV estimates

Sample (sectors):	All	Manuf	Service	All	Manuf	Service
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln K_{ijt}$	0.524***	0.435***	0.556***	0.585***	0.447***	0.664***
	[0.124]	[0.047]	[0.171]	[0.037]	[0.045]	[0.054]
$\Delta \ln L_{ijt}$	0.445***	0.376***	0.521***	0.392***	0.338***	0.460***
	[0.066]	[0.050]	[0.116]	[0.064]	[0.041]	[0.125]
$\ln FVA_{ijt-1}$	0.115	0.199***	0.006	0.047	0.136***	–0.07
	[0.081]	[0.029]	[0.183]	[0.062]	[0.030]	[0.153]
PCM_{ijt-1}				–0.739***	–0.715***	–0.878**
				[0.167]	[0.083]	[0.385]
Observations	9221	6323	2898	9074	6265	2809
Under-identification	0.000	0.000	0.000	0.000	0.000	0.000
Weak identification	344.8	325.8	100.2	359.3	286.2	115.0
Hansen J	0.35	0.18	0.44	0.63	0.35	0.32

Notes: as under Table 2
Source: own calculations with data from WIOD.

Table 5. The impact of *FVA*, *FVA_FIN* and *FVA_INT* on the *TFP* growth – robustness check

FVA measure:	*FVA*			*FVA_FIN*			*FVA_INT*		
Sample:	All	Manuf	Service	All	Manuf	Service	All	Manuf	Service
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\ln FVA_{ijt-1}$	0.056	0.166***	–0.101	0.03	0.081***	–0.053	0.05	0.134***	–0.067
	[0.067]	[0.035]	[0.171]	[0.047]	[0.022]	[0.123]	[0.062]	[0.029]	[0.154]
PCM_{ijt-1}	–0.72***	–0.67***	–0.96**	–0.75***	–0.76***	–0.87**	–0.73***	–0.72***	–0.89**
	[0.178]	[0.085]	[0.424]	[0.157]	[0.080]	[0.354]	[0.166]	[0.082]	[0.386]
Obs.	9076	6265	2811	9074	6265	2809	9074	6265	2809
Under-ident.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Weak ident.	100.8	424.8	13.7	382.1	295.4	128.8	359.1	292.6	113.2
Hansen J	0.70	0.85	0.39	0.90	0.025	0.31	0.67	0.35	0.32

Notes: as under Table 2
Source: own calculations with data from WIOD.

The results obtained with *FVA_FIN* (Table 3) and *FVA_INT* (Table 4) are similar. In manufacturing sectors there is a positive and statistically significant association between multi factor productivity growth and foreign value added – either in the final good exports or in intermediate goods exports. However, as far as the magnitude of the parameters is considered, the effect is not strong. We shall stick to the augmented specifications. The elasticity between *FVA_FIN* measure and productivity growth is equal to 0.08 (column 5 in Table 3). In case of *FVA_INT*, the effect is slightly stronger (point estimate of 0.136 – column 5 in Table 4).

As a robustness check, in Table 5 we report the robustness check results obtained through regressing *TFP* growth on alternative *FVA* measures and *PCM*. *TFP* growth was obtained as a residual: after deducting the growth of labour and capital inputs from value added growth. Again we treat *FVA* as endogenous variable and employ the instrument obtained through gravity regression. The results confirm positive impact of foreign value added (*FVA*, *FVA_FIN* and *FVA_INT*) on *TFP* growth only in case of manufacturing sectors. The magnitude of the parameters is very similar to the previous ones obtained through econometric approach to multi factor productivity measurement.

5. Conclusions

In this paper we addressed the relationship between the participation in global value chains and productivity developments. To this aim, we performed a panel data analysis of sectoral productivity growth in a wide sample of 40 economies observed in the years 1995–2011. We employed a recent method of trade data decomposition[48] which allows us to trace back the source of value added embodied in exports of each of the sectors. Our econometric strategy takes into account potential endogeneity issues through the use of a gravity based instrument.

Estimation results suggest that there is a positive link between the involvement of sectors in global value chains (measured as a share of foreign value added in exports) and multi factor productivity growth. We took into account sector heterogeneity, splitting the sample into manufacturing and services. Indeed, our results show that the positive impact of foreign value added on productivity growth takes place mainly in manufacturing sectors. The results are robust

48 Z. Wang, S.J. Wei, K. Zhu, op.cit.

to changes in estimation strategy (econometric method vs. standard TFP measurement of productivity growth).

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Globalne łańcuchy wartości a wzrost produktywności – ujęcie międzynarodowe

Streszczenie
Przedmiotem artykułu jest analiza wpływu zaangażowania w globalne łańcuchy wartości (GŁW) na wzrost produktywności. Badanie obejmuje perspektywę międzynarodową – w tym celu są wykorzystane dane panelowe dotyczące 40 krajów, 20 sektorów (13 sektorów przemysłu przetwórczego oraz siedmiu sektorów usługowych) i lat 1995–2011. Wyniki estymacji sugerują występowanie pozytywnego wpływu pomiędzy wzrostem TFP a zaangażowaniem sektorów w GŁW (mierzonym jako udział zagranicznej wartości dodanej w eksporcie). W szczególności efekt ten jest widoczny w ramach przemysłu przetwórczego. Rezultaty są odporne na zmiany sposobu pomiaru wzrostu produktywności.
Słowa kluczowe: globalne łańcuchy wartości, zagraniczna wartość dodana, produktywność, analiza panelowa

Zgodnie z oświadczeniami autorów, udział każdego z nich w tworzeniu artykułu jest równy.