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Macroeconomic effects of EU value chain participation *

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Abstract

In this paper we analyze some macroeconomic effects derived from the participation of EU countries in global and regional value chains over the period 1990-2018. By employing local projections, we show that the impact of value chain participation on economic performance depends crucially on the country's position in the production chain. While backward participation is linked to better economic performance, forward participation leads to declining domestic output and a rise in unemployment. Moreover, we find evidence of important heterogeneity among EU countries, with peripheral and CEE countries being more sensitive to shocks in the participation indicators. Our results are robust to different controls.

JEL Classification: F14; F15; F62; C32
Keywords: Global Value Chains, EU; local projections, VAR.

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1 Motivation

The most important feature of modern globalization has probably been the organization of production processes broken in many stages through value chains and involving firms located in several countries, the so-called "global value chains"(GVCs). Moving in lockstep with trade and investment liberalization, product fragmentation has resulted in large increases in trade in intermediates that rendered the gross trade flows measured by trade statistics less informative than in the past.[1] In spite that after the Great Recession both trade and the pace of GVCs development dipped, they remain a key defining feature of the global economy (Haugh et al., 2016; Timmer et al., 2016).

Although the macroeconomic consequences of international trade have been largely studied in both the theoretical and empirical literature, effects of participation in GVCs remain less-explored. Indeed, at the aggregate level, the costs and benefits of GVCs are complex, as they increase the interconnections between countries and thereby the uncertainty. In other words, the impact of GVCs on economies and societies is more diffuse and less controllable than that from the initial phase of globalisation (Baldwin, 2016).

On the one side, the literature has detected several "benefits"to the growing participation in GVC. In general, the idea is that trade liberalisation, within the framework of multilateral cooperation, has been a key factor driving global economic prosperity. In particular, it is suggested that GVCs trends have important implications for productivity, with potential gains through firms and countries specialising in their most productive tasks and utilising new varieties and higher quality foreign goods, services and intangible inputs. The theoretical literature supports these views (e.g., Grossman and Rossi-Hansberg (2008), Halpern et al. (2015); Li and Liu (2014); Kee (2015)). While some of these gains are associated with conventional trade, welfare gains can theoretically be larger in a multiple-sector framework and considering the input-output linkages (Caliendo and Parro, 2012; Ossa, 2015).

On the other side, there is a growing belief that rising trade integration can lead to unemployment, income losses, inequalities and polarisation of politics (Autor et al., 2020). In addition, the higher connectivity brought about by GVCs has made economies more interdependent, increasing the likelihood that a local disruption will lead to a system-wide failure. Moreover, disruptions in GVCs can seriously damage national economies, and governments will benefit from more systematic insights on the position of their country in GVCs. (e.g. OECD (2013)).

[1]The traditional view of international trade is that each country produces goods and offers services that are exported as final products to consumers abroad. However, in today's global economy, this type of trade only represents around 30% of all trade in goods and services. In reality, about 70% of international trade today involves GVCs, as services, raw materials, parts, and components cross borders (see OECD (2013)).

Empirical investigations of the aforementioned effects of GVC participation have been limited, mainly due to unavailability of data. The evidence about the macroeconomic consequences of this type of globalization are far from being conclusive and deserve further empirical investigation. One important exception is Kummritz (2016), who shows that an increase in GVC participation leads to higher domestic value added but the effect is only significant for middle and high income countries. The results also highlight that both upstream suppliers of intermediates and downstream users of foreign inputs benefit from production networks equally.

This paper asks whether involvement in GVCs improves economic performance, as measured by the behavior of output, productivity, unemployment and the current account. To this end, we estimate impulse response functions from local projections for the 28 EMU Member States over the period 1990-2019[2]. This straightforward methodology, proposed by Jordà (2005), allows us to focus attention on results rather than the estimation technique.

We make several novel contributions to the scarce existing literature. First, we focus on countries belonging to the European Union (EU). An analysis at the European level is interesting since the EU is the region with the greatest degree of participation in GVCs. Overall, the participation of the EU in GVCs is significantly higher than in the United States and China. Moreover, despite the global GVC slowdown since 2012, in the EU countries this process has been much less pronounced (ECB, 2019a).

Second, we adopt both a global and a regional approach to value chain participation in order to provide a richer analysis. Indeed, in contrast to the bulk of the literature, we split international value chains into global and regional value chains. Whereas the first one involves all partner countries, in the second case trade entails only EU intra-regional trade. The importance of distinguishing between GVCs and RVCs becomes evident given that the international organisation of production is predominantly regional in scope (Baldwin and Lopez-Gonzalez, 2015). As such, most supply-chain trade takes place within "Factory Asia", "Factory Europe", and "Factory North America". Among them, European industry is particularly regionalised: in contrast to Asia, where more than half of total trade is extra-regional, or North America, where the figure is approximately 50% - in Europe three-quarters of all trade is intra-regional.[3] It is also important to note that, after 2011, the integration of EU countries into RVC has declined to a lesser extent than its GVC participation with other countries (ECB, 2019a).

[2]Although at the moment of writing the paper the UK is no longer an EU member, it was for the sample period.

[3]According to data from the UNCTAD-Eora database, in 2018, the EU-28 average participation in GVCs was about 67.7 percent, compared to 44.6 in China, 46.8 in the United States and about 50 percent in Asian economies excluding China.

Third, this paper compares alternative ways of measuring participation in Global Value Chains. Other than the overall participation score, we provide a deeper analysis by distinguishing forward linkages (i.e., domestic value-added exports of a country which goes into exports of other countries) and backward linkages (foreign value added in gross exports of a country). Whereas the first component accounts for an economy's capacity to generate income through trade integration, the second captures an economy's reliance on imports for its exporting activities. An idea about relative "upstreamness"of an economy, i.e. a higher share of domestic content that returns to a country after processing abroad within GVCs, is given by the ratio between forward and backward participation. Upstreamness is usually associated with technologically enhanced products and thus with more beneficial engagement in GVCs as compared to participation through assembly stages of production chain.[4] Compared with the world average, EU countries are moderately downstream, meaning that the foreign content of EU production is larger compared with the inputs supplied by the EU to other countries. Within the EU, larger economies are located more upstream compared with small countries, highlighting the presence of pan-European production chains in which intermediate goods and services are produced by the former and then fed into the assembling processes taking place in small EU countries (ECB, 2019a).

Fourth, unlike most of the literature on GVCs that focuses on trade and micro or firm-level data[5], our research, instead, tries to ascertain how participation in GVCs affects the main macroeconomic variables.

Our results show that the impact of GVC participation on economic performance depends crucially on a country's position in the production process. Indeed, whereas global backward participation is linked to better economic performance in terms of GDP growth and unemployment, the effect on the current account, however, is ambiguous: even if exports are increasing, imports would also rise with higher participation. As for global forward participation, it leads to economically and statistically significant declines in domestic output and a rise in unemployment, which tends to generate improvements on the current account position. The effects of both backward and forward participation on output tend to be magnified for the peripheral euro countries as well as for CEE countries, becoming to some extent negligible for the core euro area countries. Surprisingly, at the country level, the transmission mechanism between GVC participation and the macroeconomy is not productivity. These results persist after several robustness checks.

[4]Returned value added is typically associated with upstream activities such as design, marketing, R&D.

[5]See Antràs and Chor (2021) for a survey of the theoretical base of GVCs as well as of the main empirical approaches to their measurement.

This paper is organized as follows. Section 2 relates the present research with previous literature. In Section 3 we describe the data and in Section 4 we present the methodology and the empirical results. Next, we do robustness analysis in Section 5. Section 6 concludes.

2 Related literature

In a world where both internal and external imbalances have been large for extensive periods, the role of GVCs –that have predominated in trade since the 90's– deserves special attention. The rise in importance of the value-added concept, as opposed to conventional gross trade, and the increase in intermediate trade have brought about some challenges with regard to the way macroeconomic indices are computed and interpreted. Firms' and sectors' participation in global value chains also creates or strengthens cross-country linkages via trade in intermediate inputs. This has important consequences for macroeconomic analysis. In this section we will revise not only previous empirical findings but also what the theory on GVCs predicts concerning their effects on output, productivity, the current account and employment.

The emergence of GVCs challenges some views on the economic impacts of globalisation but confirms others. Among the most important impacts of GVCs is their role in raising growth and productivity. The economic literature has long provided strong evidence that openness to international trade and investment can be an important driver of growth and productivity, although the impacts are often dependent on domestic economic conditions and policies. As with conventional trade, the theoretical effects of GVCs on productivity are due to the efficiency-enhancing impacts of international competition, to access to foreign knowledge and technology, and to the scope for specialisation and economies of scale. Foreign inputs, embodying more productive technology and resources, are reallocated more efficiently as the intermediate goods may spur innovation in the final goods by enhancing access to foreign knowledge. GVCs participation, which involves a multiple-sector framework and considers the input-output linkages, promotes development more than countries would achieve through standard trade. According to a recent publication by the World-Bank (2020), GVCs are related to productivity gains and income growth due to their two defining characteristics: long-term firm-to-firm relationships and hyper-specialization in specific tasks.

At the empirical level, the micro literature suggests that GVC participation has a positive effect on productivity. For instance, productivity may be enhanced by the relocation of some of the parts of production within a GVC through various channels (Amiti and Wei, 2009; Schwörer, 2013). The basic argument is related to a firm's relocation of the least efficient production stages to concentrate on more productive core activities. Then, productivity gains rely on the interdependence of

domestic firms with foreign ones, that share know-how and technology with their buyers and suppliers. Criscuolo and Timmis (2017) point that participating in GVCs can stimulate productivity growth through the potential for firm specialization in core tasks, access to imported inputs, knowledge spillovers from foreign firms, and pro-competitive effects of foreign competition.[6] For this reason, firms in developing countries can become more productive –as it has been the case in Vietnam, Cambodia and Bangladesh. Furthermore, firms take advantage of cheaper, better quality inputs through offshoring; it may also provoke efficiency upgrading through the reorganization of a firm's activity or induce technology transfer from foreign suppliers.

For richer countries, the micro evidence concerning the GVCc total effects on productivity is not as conclusive. Using propensity-score matching and difference-in-difference methods, Yan and Baldwin (2014) examine whether the integration of Canadian manufacturing firms into a GVC improves their productivity. They find that more productive firms tend to self-select into joining GVCs. ECB (2019b) examines the role of openness and GVC participation for technology diffusion across EU countries finding that the main channel of technology diffusion is the technology embedded in imported inputs, rather than the upgraded quality standards when exporting intermediates to parent firms. Karpowicz and Suphaphiphat (2020) study the specific case of four EU countries (Austria, Denmark, Germany and the Netherlands) that are strong GVCs participants. Although GVC (backward) participation may have benefited productivity both directly (through specialisation) and indirectly, thanks to technological improvement, the positive effect is small.[7] Linking more firms to GVCs can help spread productivity gains to the whole economy but it also means that more firms, and therefore more workers, are exposed to the impacts, positive and negative, of GVCs on employment and wages.[8]

In addition to income and productivity gains, GVCs are supposed to deliver more and better jobs, as production is more capital-intensive (World-Bank, 2020).[9] Although this may reduce employment, the overall effect is mostly positive, due to the increase in exports. Participation in GVCs may affect employment, through both job destruction and job creation. Therefore, GVCs present both opportunities and challenges for countries. Indeed, GVCs give workers the opportunity to apply their skills all around the world without moving countries. At the same time, the demand for some skills drops as activities are offshored, exposing workers to wage reductions

[6]By specializing in those core tasks, firms can reap productivity gains (Grossman and Rossi-Hansberg, 2008).

[7]GVCs participation is not enough to maintain productivity. They explain the stagnation in labor productivity during the last 10 years to the necessity of combining GVCs with better credit conditions and a larger share of intangibles in the firms.

[8]However, productivity gains will not spread to the whole economy if small firms do not have the capacity to absorb new technology and production modes (Fernandez-stark et al., 2010).

[9]More empirical evidence confirming these results can be found, among others, in Shepherd and Stone (2012).

or job losses in the short term. In the long term, however, offshoring enables firms to reorganise and achieve productivity gains that can lead to job creation. Despite such complexity, an increasing number of studies have tried to measure the effects of GVCs on employment (Jiang and Milberg, 2013; ILO, 2015). Empirical evidence shows that, in general, participation in GVCs has a positive impact on employment, especially in developing countries, since it facilitates either structural transformation or generates new linkages in and around the value chain. Nonetheless, it is still not clear if increasing participation in GVCs helps to reduce the share of disadvantaged employees such as informal employees in the labour force (Artuc et al., 2019). Furthermore, the effects of trade liberalisation and participation in GVCs on labour market outcomes has been shown to be highly country-specific (Shingal, 2015). This suggests the necessity for additional studies on this issue. Moreover, as there are multiple channels that explain how GVCs may affect labour markets [10], the implications of participation in GVCs for employment remain to be fully understood and can be diverse. While recent studies show that import competition from low-cost countries such as China has led to a fall in employment, especially in the manufacturing sector (Autor et al., 2015), competition from low-cost countries is only one aspect of GVCs. OECD countries import intermediates from high-tech manufacturing industries and business services but also export these products to other countries, which creates new employment opportunities. Evidence for Europe also shows employment shares of both high-skilled and low-skilled workers increasing at the expense of medium-skilled workers. According to Shepherd (2013), the available empirical evidence suggests that labour market outcomes are influenced by the type of activities undertaken by GVC participants.[11] GVCs clearly contribute to the shifting demand for skills, but it is difficult to know how much is due to trade and how much to technology.[12] This change can now be measured with the availability of world input–output tables.[13]

[10]Taglioni and Winkler (2016) argue that GVCs can benefit labour markets through three channels: first, a demand effect, as multinationals (and other GVC participants) have a high demand for skilled labour; second, a training effect, as local firms participating in GVCs may receive training from either multinationals or their foreign buyers; third, a labour turnover effect, as knowledge embodied in the workforce of participating firms moves to other local companies. Moreover, according to OECD (2013) or ECB (2019b), participation in GVCs can change the composition of the labour force. Low-skilled jobs would be affected, with a downward pressure on wages.

[11]What is clear is that workers that perform manual or cognitive tasks that lend themselves to automation or codification (e.g. book-keeping, monitoring processes, processing information) are most likely to be affected by GVCs; many of these tasks can be offshored as services. However, such tasks may be complementary to those that cannot easily be digitised or offshored due to high transaction costs or the need for contact with customers.

[12]High-skilled workers are less likely to be affected, as they tend to perform non-routine cognitive tasks that complement information technology; demand for such workers often increases with greater investment in information technology. Low-skilled workers engage in non-routine tasks such as operating vehicles and assisting and caring for others, which may also be less affected by trade or technology.

[13]While a significant gap continues to exist between the theoretical and empirical literature related to GVCs, more focus has been placed on labor in research on GVC (Barrientos et al., 2010).

The evidence on the effects of GVCs in the current account is more scarce. López-Villavicencio and Mignon (2021) argue that the main mechanism described in the literature is that higher participation in GVC implies a larger share of a country's exports that represents value-added to its imported intermediates. This channel, however, is limited to backward participation in GVCs (importing intermediate goods and services that are then used to assemble the final product). The effect, however, is ambiguous: even if exports are increasing, imports would also rise with higher participation.

For the euro area countries, ECB (2019a) looks at the role that changes in GVCs of the vulnerable countries have played in recent years in correcting external imbalances.[14] Their results suggest that the role of GVCs in the adjustment of vulnerable countries' trade balances was limited, uneven across countries and in most cases not clearly positive. Overall, the results of the two analyses suggest that Spain and Greece may have experienced beneficial effects from their GVC involvement, while for Slovenia and Cyprus the adjustment in the trade balance may have been higher without GVC involvement. In the same vein, Brumm et al. (2019) adopt the International Monetary Fund approach to external imbalances (EBA) and find positive effects on the current account balances for a group of both deficit and surplus countries. López-Villavicencio and Mignon (2021) extend the analysis by including more countries, a sectoral breakdown in backward linkages and a dynamic approach. In contrast to Brumm et al. (2019) they find that backward GVCs participation tends to deteriorate the current account position, stronger for services than for manufacturing. Moreover, the risk of GVC bottlenecks became clear during the pandemic. Thus, some countries could use reshoring as a means to transfer production back home. The success of any reshoring strategy relies on the exporting country's capacity to substitute for its reduction of imported intermediate goods and outsourced production. The reshoring of supply chain networks to domestic economies, while only partial, could significantly reduce international trade.[15]. According to Asian Develoment Bank (2021) when the supply chains are reshored by $10\% - 20\%$, global exports, imports, and total trade are estimated to decrease by $13\% - 22\%$. This can be especially relevant for the EU countries, reinforcing the current RVC.

[14] See Section 2.3 of the Occasional Paper.

[15] Post–pandemic, economies may consider diversifying upstream production–economies decrease their dependency on their primary source of intermediate goods, acquiring them from other sources. Similarly, they may also diversify downstream production by decreasing dependency on demand from their top importer and export intermediate products to other economies. This strategy could involve different scenarios, such as regionalizing or nearshoring supply chains.

3 Data and descriptive statistics

3.1 Data and definitions

We collected data for the 28 EU members from the period 1990-2018. Within the EU, we consider not only the total area, but also different groups: "Core"(Austria, Belgium, Denmark,Germany, France, Luxembourg, the Netherlands, Sweden and the UK), "Periphery "(Finland, Cyprus, Greece, Ireland, Italy, Malta, Portugal and Spain), Euro (countries in the Euro zone) and Central European Economies or CEE (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Slovak Republic and Slovenia).

We use the UNTACD-Eora GVC database (2019) to obtain our measures of GVCs, given its larger geographical coverage (189 countries) as well as relatively recent input-output data. Measuring GVCs is far from being a simple task due to the fragmentation of production across several countries. While trade data have been widely used to measure GVCs, this raises important concerns.[16] The most obvious drawback is that trade data are expressed in gross terms, meaning that the value of intermediate inputs traded along the supply chain is accounted for several times distorting the measure. The key progress in terms of GVC measurement has come from the construction of multi-country input-output tables linking national input-output tables using bilateral trade flows (De Backer et al., 2018). Those tables allow to quantify the contributions of the various production stages withing the global supply chain in the final product value. Eora global supply chain database (UNCTAD) is particularly well suited for this purpose, as it consists of a multi-region input-output table covering a large set of economies, as mentioned above.

Based on this data and following Koopman et al. (2010), country i's participation in GVC is defined as follows:

$$GVC_i = \frac{DVX_i + FVA_i}{VAX_i} \tag{1}$$

where DVX_i denotes domestic value added; FVA stands for foreign value added; and VAX_i is country i's value added exports.

A country i's backward participation in GVC is defined as follows:

$$Backward_i = \frac{FVA_i}{VAX_i} \tag{2}$$

As seen, backward participation looks upward the value chain at the imports which are used in the production of exports, such as raw materials or intangibles involved at the beginning of the production process (e.g. research, design). *Backward*

[16] See, for instance, Feenstra and Hanson (1996), as well as Amador and Cabral (2016) and Haltmaier (2015) for a survey.

then captures the "import to export"dimension and indicates that a country is positioned at a higher stage of the production process. Backward participation is supposed to be linked to better economic performance through productivity gains due to the increasing access to the highest-quality inputs to production process. Note, however, that taken to the extreme, backward integration may crowd out local production and limit domestic value addition (Farole, 2016).

Forward participation, in turn, corresponds to domestic value added that is further exported by third countries:

$$Forward_i = \frac{DVX_i}{VAX_i} \tag{3}$$

That is, forward linkages imply producing and exporting intermediates, to which importing countries will then add further value and export as finished products or further stage intermediates. Productivity spillovers from forward linkages in value chains are expected to come from the requirements to meet demanding standards and technical regulations imposed by buyers with subsequent demands diffusing down through the domestic value chain (Farole, 2016).

Note that the GVC previous indicator involves global trade, i.e. intra and extra-regional partner countries. However, looking at the question of whether value chain trade is rather regional in scope, we further define regional value chain (RVC). Following the same calculation, the RVC approach focuses on imports and exports of intermediate goods within a specified region. Therefore, RVC zooms in on a country's integration with the production network of a region, rather than that of the entire world, namely, the sum of FVA from rest of the region and DVX to the rest of the region over the total value added export. For our purposes, the region consists of the 28 countries in the EU.

Since we are interested on the macroeconomic consequences of GVC participation, in addition to the previously mentioned GVC indicators, the macroeconomic variables entering the empirical model are annual GDP, labor productivity (defined as the ratio of GDP to employment), the unemployment rate and the current account balance (period average, deflated by GDP). These previously mentioned variables correspond then to our key variables of interest. Some further control variables used in for robustness purposes are the most common determinants of economic activity: real effective exchange rate (period average, deflated by the CPI), foreign direct investment to GDP, the dependency ratio, CPI inflation and the terms of trade. All the variables are taken from IMF WEO and World Bank WDI databases.

3.2 Descriptive statistics and some stylized facts

In this section we describe the position and participation of the EU countries both in Global and Regional Value Chains as defined above. In addition, we also assess

Table 1: Global and regional value chain in % participation, 1990 and 2018

	1990			2018		
	GVC	RVC	RVC/GVC	GVC	RVC	RVC/GVC
LUXEMBOURG	79.81	67.76	84.90	84.94	48.21	56.76
SLOVAKIA	73.97	57.54	77.79	80.68	56.33	69.82
BELGIUM	71.51	52.91	73.99	78.38	44.16	56.34
LITHUANIA	69.16	40.73	58.89	78.08	42.99	55.06
NETHERLANDS	67.36	45.58	67.67	77.62	50.88	65.55
ESTONIA	67.23	47.03	69.95	74.9	42.33	56.52
SLOVENIA	62.21	51.47	82.74	74.26	55.98	75.38
IRELAND	61.39	36.85	60.03	73.13	59.21	80.97
LATVIA	59.8	42.13	70.45	72.99	50.09	68.63
AUSTRIA	59.8	47.48	79.40	70.1	32.56	46.45
MALTA	58.85	35.67	60.61	69.83	38.68	55.39
HUNGARY	56.67	44.59	78.68	68.41	46.38	67.80
DENMARK	56.17	43.04	76.62	68.01	28.11	41.33
FINLAND	54.37	38.56	70.92	67.8	49.82	73.48
SWEDEN	54.36	39.7	73.03	67.67	46.3	68.42
FRANCE	53.55	38.14	71.22	67.12	39.06	58.19
PORTUGAL	53.21	43.33	81.43	64.27	41.81	65.05
CZECH	53.21	43.69	82.11	63.78	36.7	57.54
UK	52.54	34.48	65.63	63.68	42.11	66.13
GERMANY	51.16	34.57	67.57	62.83	35.78	56.95
CROATIA	51.14	42.64	83.38	62.17	41.22	66.30
GREECE	49.93	35.79	71.68	61.97	47.46	76.59
POLAND	49.04	41.1	83.81	60.37	41.44	68.64
ROMANIA	48.93	37.5	76.64	59.66	37.2	62.35
SPAIN	48.13	36.43	75.69	58.8	42.13	71.65
CYPRUS	42.2	27.66	65.55	57.86	36.03	62.27
ITALY	41.59	30.45	73.21	54.33	31.8	58.53
BULGARIA	40.13	30.23	75.33	51.5	33.25	64.56
MEAN EU-28	56.69	41.68	73.53	67.68	42.79	63.31

Notes: GVC and RVC correspond to global and regional value chain, respectively.

the four groups (core, periphery, Eurozone and CEE countries) of EU members that we distinguish later in the analysis.

Table 1 and Figure 1 describe the evolution of the variables comparing the position of the countries at the beginning of the sample (1990) and at the end (2018). Some patterns can be inferred from them. First, the smaller EU countries need to source a greater share of inputs from abroad, so their participation in GVCs is higher than that of the bigger economies. In addition, as shown in Table 1, EU

countries are more involved in regional than in non EU supply chains. Indeed, as seen in the table, most of the total overall participation is regional in nature and, even though the regional component has decreased over time, in 2018 two thirds of the intermediate inputs imported or exported to incorporate into final products that are latter shipped to consumers all over the world, were originated in other EU countries.[17] Second, Cyprus and Greece may have obtained their positions due to their specific domestic export structure: both countries are rather specialised in the tourism sector which is located at the end of the supply chain and relatively less vertically fragmented. Also an exporter of services, but in the opposite extreme, Luxembourg appears to be involved in much supply chain trade, which is most probably due to its strong financial services sector that provides inputs to many other firms. Third, a couple of smaller economies, Denmark and Lithuania, specialise in production stages which are placed at the very end of the supply chain compared to other larger countries such as Italy, Spain and the UK. Finally, Germany, having the largest market size in the EU and taking up a central position in Europe's supply chains, shows a middle position in which it performs rather average on both scales. As in the case of the other large EU countries, its size and diversification determines its position.

If we asses how the participation in both regional and global chains has evolved over time, all countries, with the exception of Ireland, have increased their participation in extra-EU chains in the last thirty years. Denmark, Austria and Luxembourg stand out as they have more than tripled their position. However, in some other cases, their position reverses when we look at RVCs, namely, Ireland, Belgium, Estonia and the Czech Republic decrease their regional participation during the period.

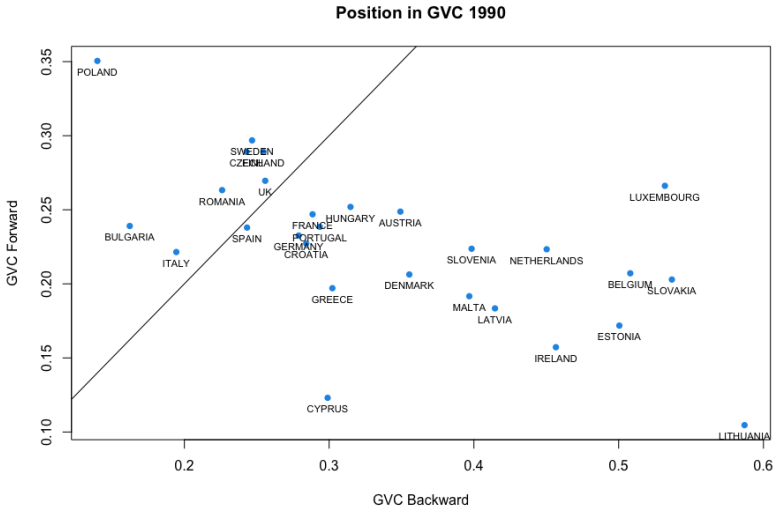
In Figure 1 we compare EU countries' forward and backward participation in 1990 (left-hand side graphs) with that in 2019, both in global (upper row) and regional (lower row) value chains. Concerning GVCs, most EU countries were both at the beginning and at the end of the sample, tilted towards backward participation. Exceptions were, in 1990, CEE countries such as Poland, Romania, Bulgaria and the Czech Republic, as well as Sweden, Finland and the UK. Average backward participation would be very heterogeneous in 1990, with steady forward positions of around 20%. At the end of the sample, three of the previous countries remain with a higher proportion of forward participation (Romania, the Czech Republic and Finland) with the addition of Greece. The large EU countries (Germany, France, Italy, UK and Spain) were in 2018 in an intermediate position (32% backward, 30% forward in the case of Germany) and smaller very open economies have around 50% backward participation and just 20% forward.

As for regional backward-forward participation, the lower row of Figure 1 shows

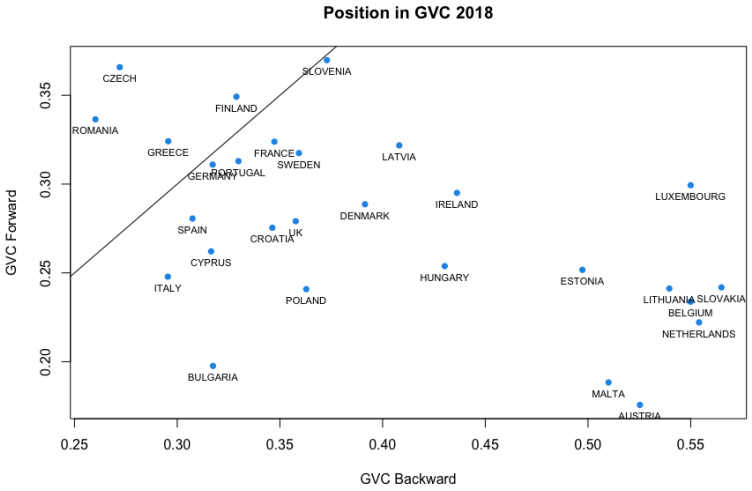
[17]Note that the difference between the GVC and RVC participation index corresponds to the percentage of participation of the EU countries vis-à-vis non EU countries.

a change in the pattern of intra-EU value chains. In 1990, 11 countries, including the larger economies, were more involved in backward participation as compared to forward. Smaller countries were placed above the 45 degree line. The situation has reversed in 2018, with a stronger presence in the backward stages of production not only for the large EU countries but also for smaller peripheral and CEE countries.

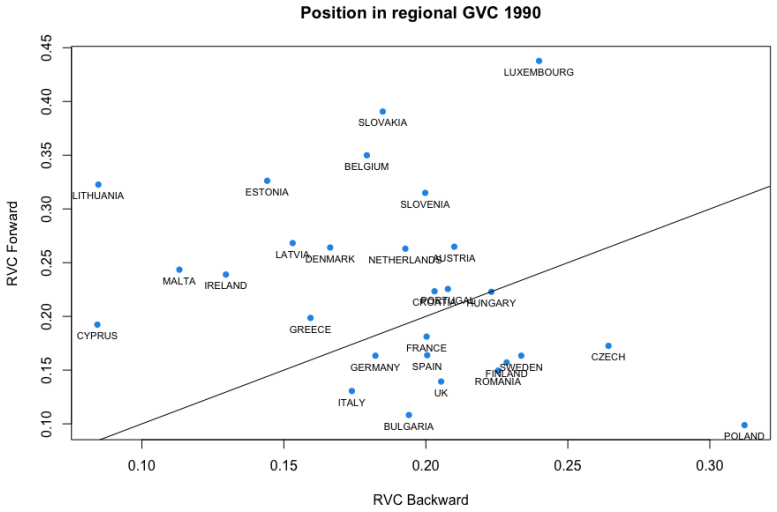
The picture that emerges from the data is that the EU countries are very active participants in both extra and intra-EU value chains, which reflects the high level of openness and economic integration of the EU economies. Moreover, there is quite a balanced relation in participation both in backward and forward stages of production, probably due to the high level of diversification, from manufactures to services, of EU countries.



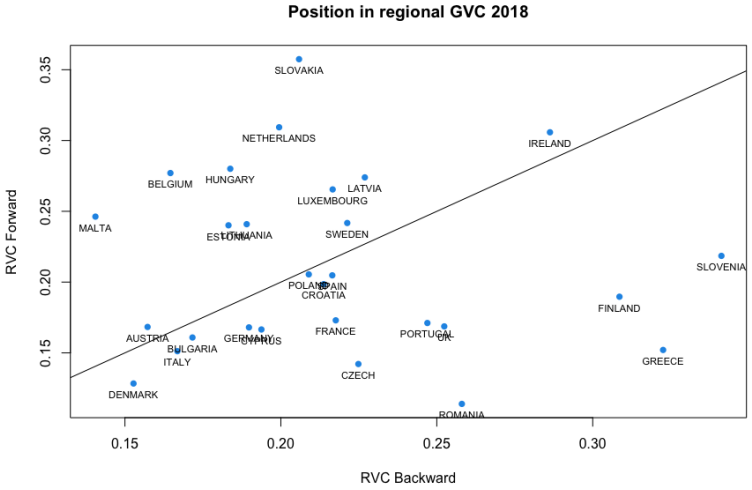
(a) GVC. Backward-forward participation 1990.



(b) GVC. Backward-forward participation 2018.



(c) RVC. Backward-forward participation 1990.



(d) RVC. Backward-forward participation 2018.

Figure 1: Backward and forward participation in Global and Regional Value Chains. EU countries

4 Empirical strategy and benchmark results

4.1 Methodology

In order to quantify the macroeconomic effects of GVC participation, our strategy is based on the local projection method (LPM henceforth) proposed by Jordà (2005) to flexibly document the dynamic response of macroeconomic outcomes to GVC participation. A local projection is a statistical framework that accounts for the relationship between an exogenous and an endogenous variable, measured at different time points. Local projections are often applied in impulse response analyses. The local projections method, similar to a classical VAR model, allows to recover the dynamics of the dependent variable after a shock. Local projections, however, are becoming increasingly popular because of their robustness to misspecification and their flexibility. More specifically, they have a number of advantages over the VAR models typically used in the literature. First, the local projections method generates estimates that are less vulnerable to misspecification of the data generating process because the impulse response is estimated separately for each horizon. Second, it allows controlling for a relatively large set of variables, which would be impractical in a regular VAR setting. Third, it allows for inference directly on the estimated impulse responses. Finally, they can easily accommodate non-linear specifications, which we use to uncover regional patterns.

Moreover, in a recent paper, Plagborg-Møller and Wolf (2021) show that, quoting the title of the paper, "local projections and VARs estimate the same impulse responses". They argue that the only requirement needed for this result is unrestricted lag structure. This represents a very important outcome, as it supports the use of local projections as a very suitable method for many empirical applications due to the advantages above reported

The local projection technique generates new estimates for each forecast horizon $h = 0, 1, ..., H$, regressing the dependent variable at $t+h$ on the available information set at time t. Impulse response functions (IRFs) are obtained as a subset of the estimated slope coefficients of the projections. The baseline specification for the panel model is the following:

$$\Delta y_{i,t+h} = \alpha_i + \gamma_t + \beta_h \Delta GVC_{i,t} + \nu X_{i,t} + \epsilon_{i,t+h} \tag{4}$$

where $y_{i,t}$ is the outcome variable of interest (log GDP, unemployment rate, log productivity or current account balance as a percentage of GDP) for country i at time t, α_i are country fixed effects to control for unobserved cross-country heterogeneity, γ_t are time fixed effects to control for global shocks, $\Delta GVC_{i,t}$ is the change in the GVC participation (overall, backward or forward), ν is a vector of nuisance coefficients, $X_{i,t}$ is a vector that contains two lags of each of: a) changes in the dependent variable, b) the GVC, c) GDP growth. Finally, $\epsilon_{i,t}$ is the error term.

The coefficients on the variations of participation, β_h, trace out the effect of an increase in participation at time t on macroeconomic outcomes at time $t+h$, i.e. the impulse response of the outcome variable. Given that GVC is measured as a fraction of gross exports, and the GDP is measured in logarithms, the estimated coefficients on GVC measures the percentage change in the GDP at time $t+h$ in response to a one percentage point of gross exports increase in participation at time t. We portray productivity to be the key transmission mechanisms for GVC participation.

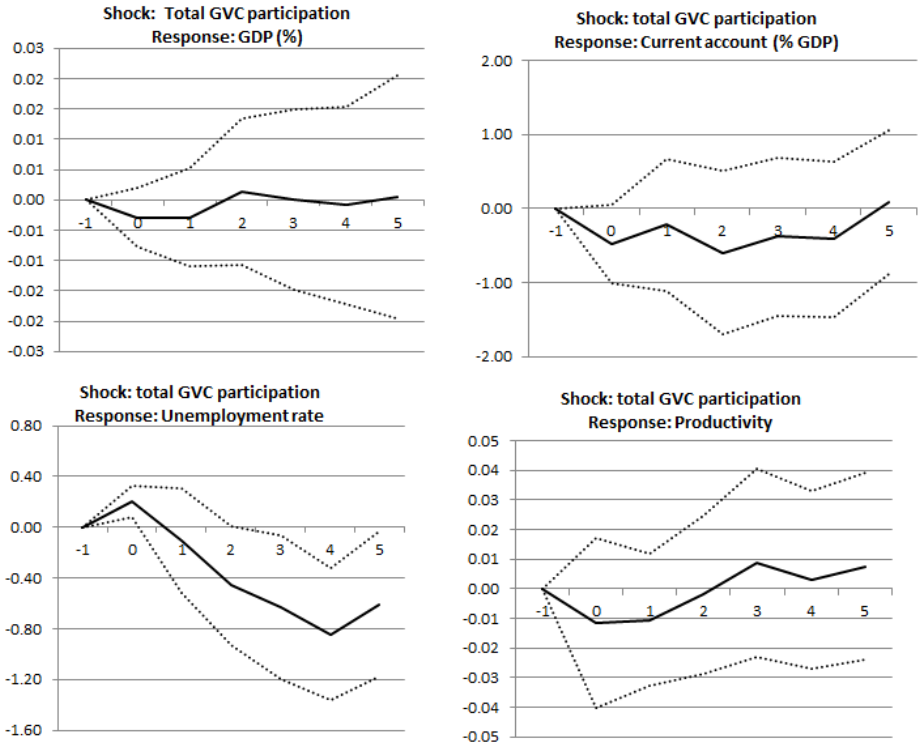
4.2 Results

The aggregated results are presented in Figure 2. The shock consists of one-standard deviation rise in the participation, which corresponds to an increase of about 1.66 percentage points, well within the standard range of the data. The effect of the shock on GDP and productivity is clearly non-significant. In the case of the current account, an increase in GVC participation would have a contemporaneous negative effect, but in the limit of significance. The most affected variable is unemployment: the contemporaneous effect is positive, i.e., higher GVC participation increases unemployment, that is compensated after some periods, with a total negative effect.

In Figure 3 we further decompose the overall participation into backward and forward participation and find significant effects, probably hidden before behind the aggregation. The response of the variables is the opposite depending on whether the shock affects backward (left-hand side of the figure) or forward participation. In particular, an increase in backward participation has a positive and significant effect on GDP after two periods, a clear negative effect on unemployment and a negative effect on the current account. In contrast, a shock on forward participation provokes a negative response on GDP (more long-lasting than in the case of backward participation), an increase in the unemployment rate and an improvement in the current account. The response of productivity is not significant in the case of backward participation but it is slightly negative (contemporaneously) after a shock in forward participation.

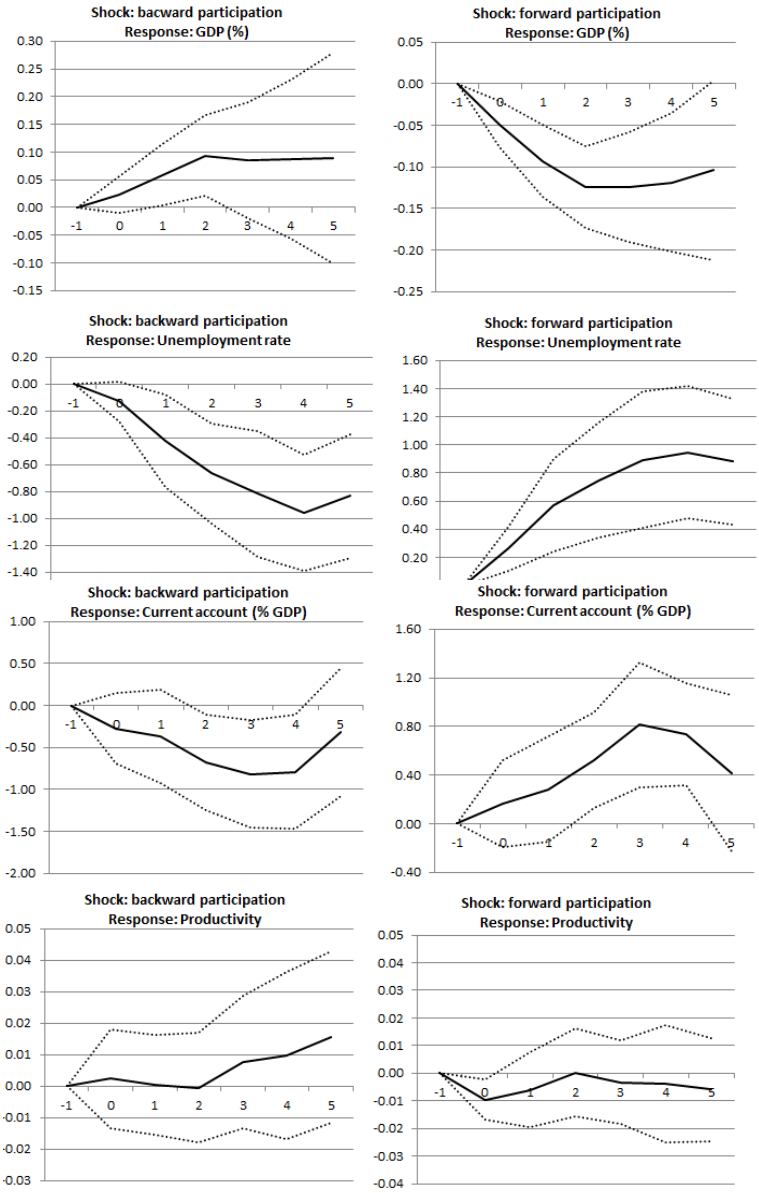
Surprisingly, at the country level, the transmission mechanism between GVC participation and the macroeconomy is not productivity. This aggregate evidence seems to oppose what is usually found at the micro level, i.e. at the firm level. Still, it is important to examine the generality and robustness of our findings and see how sensitive they are to the assumptions that we have implicitly made in our analysis.

Figure 2: Macroeconomic responses to GVC participation's shocks



Note: Time is portrayed on the x-axes; the solid lines represent the average estimated response, and we include its 90 percent confidence interval as dotted lines (computed using Driscoll-Kraay standard errors).

Figure 3: Macroeconomic effects of backward and forward participation



Note: Time is portrayed on the x-axes; the solid lines represent the average estimated response, and we include its 90 percent confidence interval as dotted lines (computed using Driscoll-Kraay standard errors).

5 Robustness Analysis

In this Section, we account for some issues that need to be addressed to ensure the robustness of our results. We begin by examining heterogeneity among EU countries. Second, we take into account the role of regional value chains. Third, we perform a VAR analysis, using a Cholesky decomposition. Finally, we add a list of relevant controls to guard against possible omitted variable bias. Given the relevance of accounting for the difference between backward and forward participation, we keep our analysis at this level, omitting the overall participation index.

5.1 Heterogeneity among countries

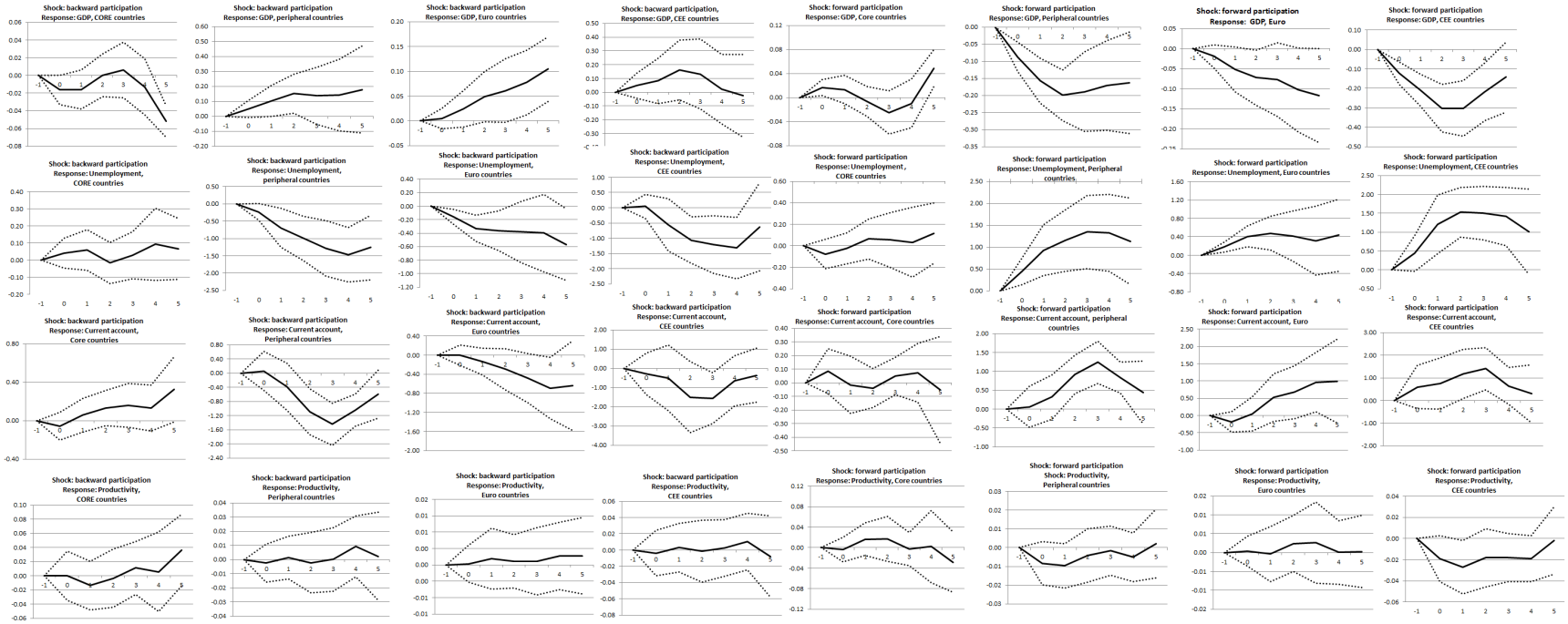
The organisation of value chains is strongly influenced by the source of final demand. It is clear that gains/losses associated with value chain trade do not accrue to countries in a uniform fashion.

In Figure 4 we represent the effects of a backward participation shock on the four groups of countries, namely, core, periphery, euro area and CEE countries. Concerning the effects on GDP, only after several periods there is a negative effect for the core countries and a positive one in the euro area. In the case of unemployment, no significant effect appears in the core countries, but in the other three groups, with different intensity (more pronounced in the CEE and periphery) the effect is negative. The current account's effect is only clearly significant (and negative) for the periphery and no significant effect is found in productivity.

A positive shock on forward participation has no significant effect on the core countries, with the exception of a mild contemporaneous increase in GDP. None of the country groups record any effect on productivity. However, the macroeconomic impact on the peripheral countries is significant in the cases of GDP (that decreases), unemployment (that grows) and, with some delay, it also provokes an improvement in the current account. The euro countries only experience an increase of unemployment, whereas the CEE countries' GDP decreases, unemployment grows and, as in the periphery, the current account improves after some time.

In sum, the results show substantial heterogeneity among countries: an increase in backward participation has positive macroeconomic effects on the peripheral and CEE countries, and the opposite happens when the shock occurs in forward participation. Core countries and those belonging to the Eurozone are less affected by shocks. This is strong evidence that the gains from GVC trade are being distributed unequally across countries, which far more reaching economic impact –both positive and negative– on less developed countries than to richer countries in the EU28.

Figure 4: Macroeconomic effects of backward and forward participation by group of countries



Notes: Time is portrayed on the x-axes; the solid lines portray the average estimated response, and we include its 90% confidence interval as dotted lines (computed using Driscoll-Kraay standard errors).

5.2 The role of Regional Value Chains

In the previous analysis we assessed the effects of the shocks on the overall GVCs. However, in the case of the EU countries, regional value chains (RVC) are relatively large. Thus, it seems relevant to ponder if shocks to regional –forward or backward– participation have the same effects on the macroeconomic aggregates as the overall shocks.

In Figure 5 we represent a regional shock from backward (left-hand side graphs) and forward (right-hand side) participation and its effects on GDP, unemployment and the current account.[18] The direction of the effects are similar to those obtained from the overall shocks. The response of GDP is positive but only significant after two periods in the case of backward participation. The opposite response (negative) occurs after three periods of a forward participation shock. Also with some delay there are significant effects on unemployment (negative and positive, respectively) and on the current account, that improves in the case of forward participation and worsens with an increase in backward participation. All in all, although the effects on the macro magnitudes analyzed are similar to the case of overall GVC shocks, regional participation changes seem to be less significant and of a smaller size.

5.3 VAR models and omitted variables

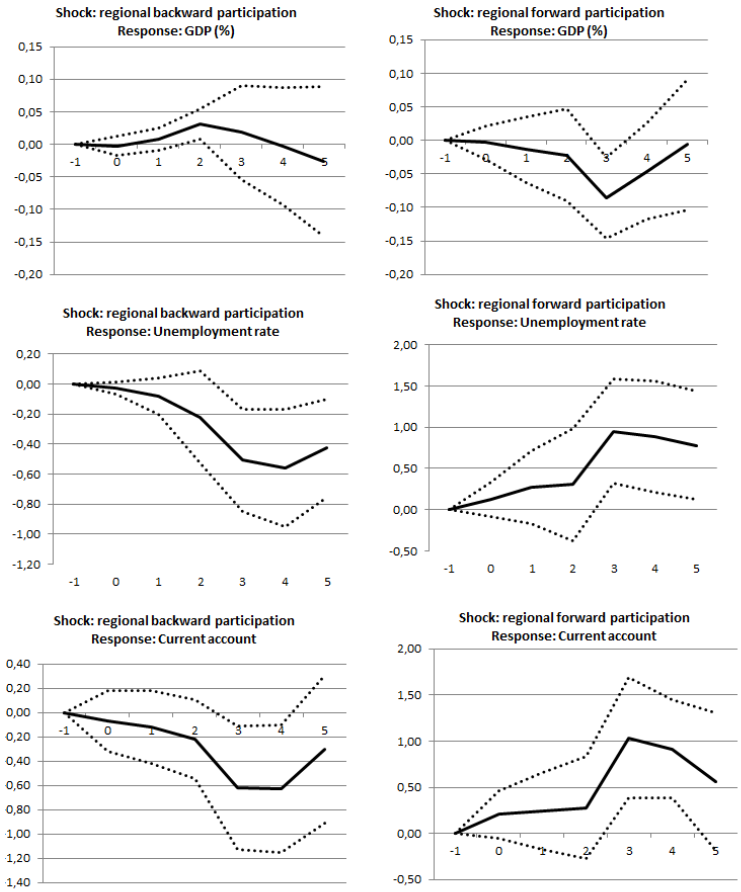
Our specification implicitly assumes that shocks to the participation do not respond to changes in the outcome variables within a year. To check whether the results are sensitive to this assumption, we perform a VAR analysis. We estimate a first system of stationary variables: $X_{it} = (\Delta GDP_{it}, \Delta U_{it}, \Delta GVC_{it}, \Delta Productivity_{it})$ with Δ being the first difference operator. We use use a Cholesky decomposition with the following order to recover orthogonal shocks: output, the unemployment rate, the GVC participation indicator, productivity and the trade balance. Having the measures of economic outcome (growth in real GDP and the change in the unemployment rate) before GVC implies that the economic response is restricted to zero upon impact. [19] Once all the coefficients of the panel VAR are estimated, we compute the impulse response functions (IRFs) to describe the response of the endogenous variables over time to a shock in the participation score.

The impulse response functions from the panel VAR models in Figure 6 show that GDP growth responds negatively and significantly to higher forward partici-

[18] We omit the results for productivity which are not significant.

[19] Note that the assumption behind the Cholesky decomposition is that series listed earlier in the VAR order impact the other variables contemporaneously, while series listed later impact those listed earlier only with lags. Consequently, variables listed earlier in the VAR order are considered to be more exogenous. However, since this implies a causal ordering on how the system works, which might be hard to justify, we changed the ordering of the variables. Results remain robust to all possible specifications (results are available upon request).

Figure 5: Effects of backward and forward regional participation



Notes: Time is portrayed on the x-axes; the solid lines portray the average estimated response, and we include its 90% percent confidence interval as dotted lines (computed using Driscoll-Kraay standard errors).

pation, while the unemployment rate responds positively and significantly to this shock. It is important to remark that the response of productivity is slightly negative and significant in this case. Figure 6 also shows that the responses to backward participation, though significant for GDP and unemployment, respond less. These results are in line with our previous findings derived from local projections and confirms the equivalence of the two approaches, as recently shown by Plagborg-Møller and Wolf (2021).

Finally, as another robustness check, we present in Table 2 the local projections depicted in Figure 3 applied to backward and forward participation controlling for the following varibles: real effective exchange rate, inflation rate, FDI, terms of trade and dependence ratio. The left-hand side of Table 2 includes the backward participation results. Compared to the left-hand side graphs of Figure 3, we also find that the effects are only clearly significant and negative for unemployment and the current account. Once we use controls, no significant effects are found for GDP and productivity. Without controls, only a very small significant and negative effect was found after two periods in GDP.

Similar results are found when we apply the controls to the forward participation (right-hand side of Table 2 and Figure 3). A shock to forward participation increases unemployment and improves the current account. Concerning GDP, there is also a significant negative effect, as in the previous analysis. The only difference we find is that there is a contemporaneous productivity negative effect that we did not find without control-variables.[20]

6 Summary and discussion

Participation in global value chains can lead to increased job creation and economic growth. However GVCs can also create vulnerabilities. The COVID-19 crisis is an example of amplified profound fault lines in the functioning of global value chains which exposed the fragility of a model characterized by high interdependencies.

This paper studies whether countries involvement in GVCs improve their economic performance, measured by how GVC participation affects output, productivity, unemployment and the current account. To this end, we estimate impulse response functions from local projections for the 28 EU Member States over the period 1990-2018.

We make several novel contributions to the scarce existing literature. First, we focus on European Union (EU) countries, the region that has the highest participation percentage in GVCs. Second, we adopt both a global and a regional approach to value chain participation. Third, this paper compares alternative ways of measuring participation in Global Value Chains distinguishing between forward and backward linkages.

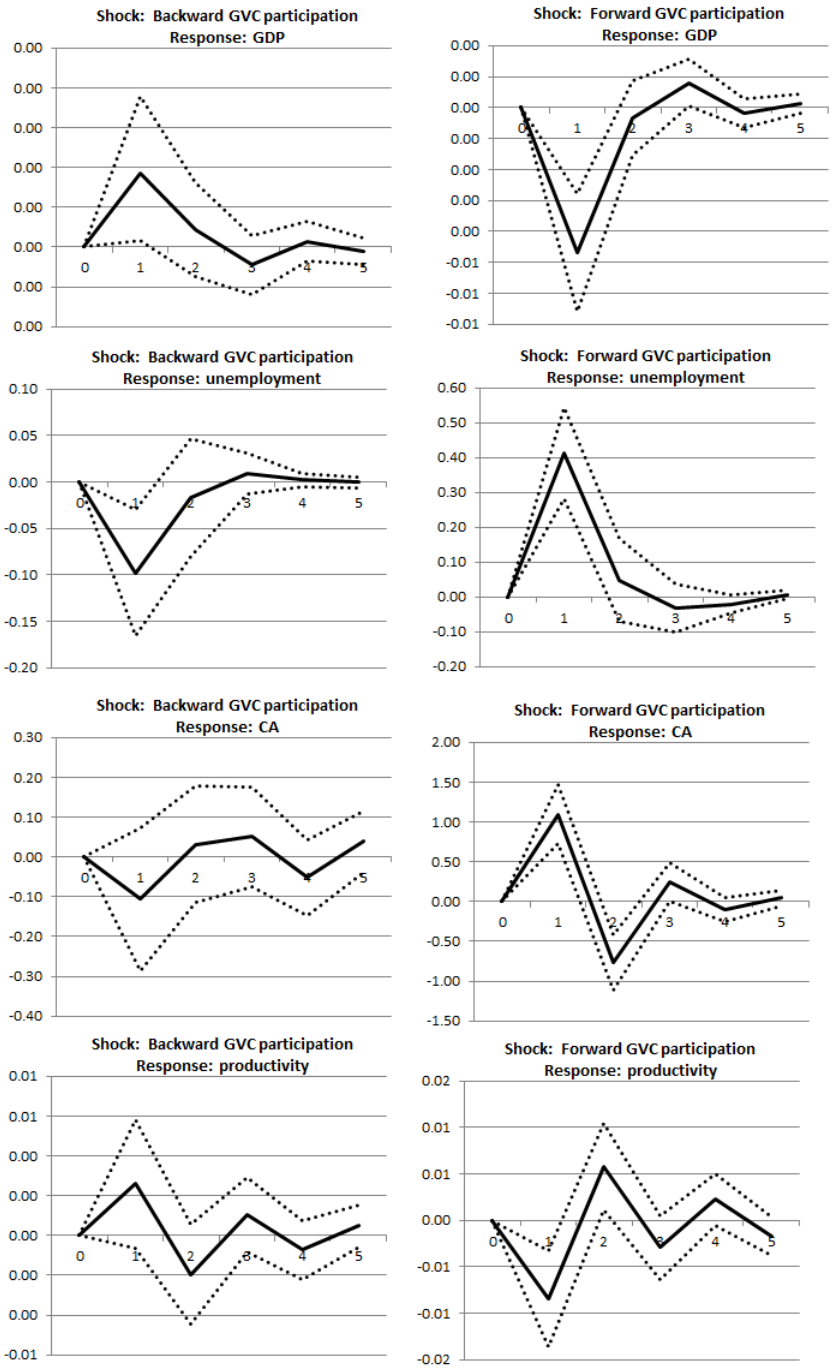
[20]Regarding the control variables, note that inflation and the terms of trade, turn out to be significant in many of the local projections. In particular, inflation is significant, both for backward and forward participation (with a negative sign in the cases of income and productivity and a positive one on unemployment and the current account, no matter the direction). The terms of trade are relevant for participation effects on income and productivity, with a negative sign on the former and positive on the latter.

Our results show that the impact of GVC participation on economic performance depends crucially on a country's position in the production process. Countries can achieve very different results in terms of output, unemployment and external balance depending on their position and degree of participation in the corresponding GVCs. At the same time, the benefits of joining GVCs have not always accrued to all countries, and may also vary across different skill levels for labour. Indeed, whereas global backward participation is linked to better economic performance in terms of GDP growth and unemployment, the effect on the current account is not conclusive. These results are qualified when we account for backward-forward linkages. As for global forward participation, it leads to economically and statistically significant declines in domestic output and a rise in unemployment, which tend to generate improvements on the current account position. These results persist after several robustness checks. First, the effects of both backward and forward participation on output persist but are heterogeneous in size, depending on the countries analyzed. In general, these effects are magnified for the peripheral euro countries as well as for CEE countries, becoming to some extent negligible for the core euro area countries. Surprisingly, at the country level, the transmission mechanism between GVC participation and the macroeconomy is not productivity: contrary to firm-level evidence, intermediate goods and services crossing borders several times seem not to be translated into higher aggregate productivity. Second, the consideration of RVC does not change the sign of the results, although their significance and size are smaller. Third, the main results remain valid after implementing a general VAR analysis and accounting in a complementary way for a set of possible omitted variables (real effective exchange rate, inflation rate, FDI , terms of trade and dependence ratio).

We present strong evidence that the gains/looses from GVC trade are unequally distributed across countries in the EU, the impact being more important for less developed ones. Benefits of GVCs may vary depending on whether a country operates at the high or at the low end of the value chain. As for the costs of joining GVCs, our results are in line with the so-called "Paradoxical Pair of Concerns "between developed and developing countries. Indeed, as with conventional trade, GVCs can boost economic growth and create jobs. However, there are no guarantees that the GVCs will benefit all countries equally. For instance, GVCs may drive local companies out of business if it becomes cheaper for local firms to unbundle production into tasks performed at other locations, to take advantage of lower factor costs. In our case, due to comparative advantages, while rich EU core countries may tend to engage in high-end and intangible production activities (R&D, design and brand building in the upstream stages and after-sales services and, marketing in the downstream stages) low-technology, low-wage peripheral EU countries may tend to focus on tangible production activities (such as manufacturing and assembly) being locked into GVCs at the bottom (low end) of the so-called "smile curve ". Although we do not

make straight calculations of the smile curve, our results tend to give support to the existence of it at the country level, increasing this still scarce empirical literature at this level of aggregation. Under this scenario, it could be argued that GVCs may also hurt domestic jobs and cause economic damage to some countries. Since the impact of value chain participation on economic performance depends crucially on the country's position in the production chain, it seems natural to promote GVC participation as well as policies that ensure a fair distribution of benefits across societies, like the EU structural and cohesion funds or the more recent investment protection or unemployment insurance schemes.

Figure 6: Macroeconomic effects of backward and forward participation. PVAR estimation



Notes: Time is portrayed on the x-axes; the solid lines represent the average estimated response, and we include its 90% confidence interval as dotted lines (computed using robust standard errors).

Table 2: Local Projections with control variables

	Backward participation				**Forward participation**			
Dependent var.	(1) Dep: Y Coeff. (s.e)	(2) Dep: U Coeff. (s.e)	(3) Dep: CA Coeff. (s.e)	(4) Dep: Prod Coeff. (s.e)	(5) Dep: Y Coeff. (s.e)	(6) Dep: U Coeff. (s.e)	(7) Dep: CA Coeff. (s.e)	(8) Dep: Prod Coeff. (s.e)
Dep. variable at								
h=0	-0.128	-0.051	-0.125	0.324	-0.297	0.27**	0.067	-0.015^{**}
	(0.141)	(0.061)	(0.103)	(0.763)	(0.183)	(0.102)	(0.175)	(0.007)
h=1	-0.065	-0.172	-0.100	-0.125	-0.642^{***}	0.5627^{**}	0.096	-0.008
	(0.195)	(0.113)	(0.136)	(0.565)	(0.278)	(0.195)	(0.247)	(0.008)
h=2	0.111	-0.260^{***}	-0.277^{**}	-0.098	-0.931^{***}	0.7057^{**}	0.436^{*}	-0.002
	(0.199)	(0.119)	(0.135)	(0.626)	(0.341)	(0.252)	(0.259)	(0.011)
h=3	0.020	-0.315^{**}	-0.401^{***}	0.166	-0.849	0.7857^{**}	0.698^{***}	-0.005
	(0.254)	(0.162)	(0.147)	(0.714)	(0.402)	(0.332)	(0.323)	(0.012)
h=4	-0.008	-0.341^{**}	-0.424^{***}	0.028	-0.731^{***}	0.7157^{**}	0.646^{***}	-0.003
	(0.303)	(0.169)	(0.157)	1.093	(0.437)	(0.344)	(0.245)	(0.016)
h=5	-0.026	-0.335^{***}	-0.200	0.766	-0.604^{**}	0.7467^{**}	0.424^{***}	-0.011
	(0.440)	(0.156)	(0.179)	(1.083)	(0.440)	(0.329)	(0.339)	(0.015)
Inflation	-0.211^{***}	0.008^{**}	0.277^{***}	-0.774^{***}	-0.168^{***}	0.007^{***}	0.236^{***}	-0.059^{***}
	(0.000)	(0.005)	(0.079)	(0.010)	(0.001)	(0.004)	(0.006)	(0.002)
Real appreciation	-0.062^{*}	0.338	-1.284	-0.007	-0.037	-0.053	-0.042	0.014
	(0.037)	(1.112)	(2.091)	(0.109)	(0.312)	(0.100)	(0.193)	(0.067)
ToT	-0.445^{***}	0.082	0.041	0.727^{***}	-0.358^{***}	-0.394	0.041	0.074^{***}
	(0.162)	(0.105)	(0.030)	(0.326)	(0.123)	(0.963)	(0.029)	(0.032)
Dep. ratio	-0.001	0.025	0.005	0.030	-0.002	-0.001	-0.005	0.002
	(0.003)	(0.136)	(0.004)	(0.049)	(0.003)	(0.001)	(0.004)	(0.004)
FDI	0.001	-0.001	-0.004	0.005	0.006	-0.001	-0.003	0.001
	(0.003)	(0.002)	(0.006)	(0.010)	(0.005)	(0.009)	(0.006)	(0.002)

Notes: The dependent variables are the log difference of GDP (Y), the difference of the unemployment rate (U), the first difference of the current account (CA) and the log difference of productivity. The results of the regressions for horizons h=1,..., 5 include all controls. All regressions include country fixed effects. Cluster-robust standard errors in parentheses.

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