Globalization and unemployment in the EU: new insights on the role of global value chains and workforce composition*

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Abstract

The European Union's participation in Global Value Chains (GVCs) is significantly higher than in North America and Asia and has steadily increased with the creation of the Single Market and the launching of the euro. We provide empirical evidence on the consequences of GVC participation on aggregate unemployment. Using data for EU countries and impulse response functions derived from local projections, we show that higher participation reduces the unemployment rate in less advanced EU economies while it increases it in core countries. Our results also show that unemployment is particularly sensitive to GVCs when the labor cost is low.

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1 Motivation

Over the past decades, the world has witnessed an upsurge in production fragmentation across borders, largely driven by the emergence of global value chains (GVCs). GVCs are characterized by a broad spectrum of business activities that firms undertake to deliver goods and services to the market, encompassing the entire value creation process from initial design to final consumption[1]. As countries have increased their participation in GVCs, more and more firms have decided to relocate their production, significantly impacting employment patterns both within and across countries (Amador and Cabral, 2016).

GVCs stand out as a prominent feature of contemporary economic globalization. Despite their prevalence, a significant gap exists in understanding their ultimate impact on aggregate unemployment. Existing literature predominantly delves into the consequences of firms engaging in value chains, highlighting winners and losers. Notably, offshoring specific production stages within GVCs often entails labor-intensive processes, resulting in a decline in corresponding employment. Conversely, offshoring enhances productivity and competitiveness in remaining activities, fostering employment growth.

GVCs thus present both opportunities and challenges for countries concerning employment dynamics (Jiang and Milberg, 2013; ILO, 2015). GVCs allow workers to apply their skills worldwide without moving countries, which affects labor markets: the demand for some skills drops as activities are offshored, exposing workers to wage reductions or job losses in the short term. In the long term, however, offshoring enables firms to reorganize and achieve productivity gains that lead to job creation. Participation in GVCs has thus the potential to reshape the employment landscape regarding activities and skill categories.

Moreover, the localized impacts of GVC participation vary significantly, complicating the assessment of overall effects on a macro scale. Consequently, understanding how the impact of GVC participation accumulates and manifests at an aggregate level remains unclear. This knowledge gap underscores the imperative for further empirical research, aligning precisely with the objective of this study in addressing this lack: what are the effects in terms of unemployment of higher participation in GVCs at the aggregate level?

However, this endeavor is a difficult task. The impact of GVCs on economies

[1]For a comprehensive revision on the concepts, nature, and determinants of GVCs see Antràs and Chor (2021).

and societies is more diffuse and less controllable than that from the initial phase of globalization (Baldwin, 2016). The reason behind this difficulty is that intra-GVC transactions are hard to observe. Nevertheless, Shepherd (2013) elaborated an interesting revision of the effects of GVCs in employment in developing countries, and Shingal (2015) reviews the labor market effects and mechanisms of GVCs integration in a more general context. From an empirical point of view, some of the few examples of research in this area that stand out are Reijnders and de Vries (2018) that examine the role of offshoring for a group of advanced and emerging countries over the period 1999-2007 using a decomposition of changes in occupational labor demand through input-output tables and Szymczak and Wolszczak-Derlacz (2022), which analyzes the effects of GVC participation on employment between 2000 and 2014 for a group of 43 countries and 56 sectors.

We contribute to the debate on the macroeconomic effects of globalization by analyzing whether involvement in GVCs affects employment and the unemployment rate across EU countries. We consider this issue empirically by estimating impulse response functions from local projections for the 28 EMU Member States over the period 1990-2015[2]. This straightforward methodology, proposed by Jordà (2005), allows us to focus on results rather than the estimation technique.

We make several novel contributions to the scarce existing literature. First, we explore some of the possible mechanisms that can explain the impact of GVCs on the unemployment rate by revisiting the link between value added and employment for the sub-sectors in manufacturing.

Second, 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 most significant degree of participation in GVCs (Baldwin and Lopez-Gonzalez, 2015). Moreover, despite the global GVC slowdown since 2012, in the EU countries, this process has been much less pronounced (ECB, 2019).

Third, we adopt a global and a sectoral approach to value chain participation to provide a richer analysis. Indeed, we analyze not only the sectoral breakdown in manufacturing but also in services. According to Timmer et al. (2013), the revealed comparative advantage of the EU27 is shifting to activities related to non-electrical machinery and transport equipment production. The workers involved in GVCs are increasingly in services rather than manufacturing industries. We also find a strong shift towards activities by high-skilled workers, highlighting the uneven dis-

[2]Although at the moment of writing the paper, the UK is no longer an EU member, it was for the sample period. The sample ends in 2015, the last year available in the sectoral data breakdown.

tributional effects of fragmentation. The results show that a GVC perspective is needed to better inform the policy debates on competitiveness. Trade in services has been frequently excluded from GVC studies. However, services have increased in value-added as well as in sophistication. Therefore, production can also be divided into several stages in different locations. According to the OECD Statistics on International Trade in Services database, the EU leads the trade in services, as the joint exports of this sector amounted to more than one trillion dollars in 2020, and its imports also surpassed 900 billion. The corresponding figures for the US were 700 billion and 460, respectively.

Fourth, we linked the GVC unemployment nexus with the workforce composition regarding skill level and labor costs. This question is highly relevant given that the literature suggests that employment creation has been biased towards more skilled workers, at least in developing countries, which contrasts with the predictions of trade theory. The skill-biased nature of GVC trade is associated with the high complexity of global supply chains and increased use of skill-intensive inputs, notably in business-to-business services. Labor costs can also contribute to the global value chain by their impact on competitiveness and cost differentials vis-à-vis other countries.

Finally, we pay special attention to possible endogeneity issues. Indeed, GVC participation can impact labor market outcomes by shaping the demand for labor and skills, but labor market outcomes also have a strong role in shaping the scale and nature of GVC participation. Thus, the direction of causality between GVC participation and jobs is often difficult to disentangle. We deal with this issue by relying on local projections and defining the causal effect on the unemployment rate on time $t + h$ of a one-time shock at time $t - 1$. Considering both the shock and all explanatory variables at $t-1$ our analysis should provide some comfort in addressing endogeneity. However, we also implement an instrumental variable (IV) approach to mitigate such concerns completely. As an instrument, we use the average changes in the participation of the other countries in the sample.

Our results show that value chains affect unemployment in different ways: while they have the potential to raise employment and, therefore, reduce the unemployment rate in less advanced EU countries, the impact of this characteristic of the globalization process can be detrimental to labor markets in core economies. In line with this result, we show that countries with low labor costs and skills benefit more from GVC participation. Finally, our results indicate that sub-sectors with higher GVC participation growth in the manufacturing sector can generate more employment, although the capacity to increase value added is more limited.

This paper is organized as follows. Section 2 relates the present research with previous theoretical and empirical literature. In Section 3 we describe the data. The methodology employed is presented in Section 4. In Section 5 we present the results. Section 6 shows the impact of the workforce composition on the GVC-unemployment link. Section 7 concludes.

2 Related literature

Firms' and sectors' participation in GVCs creates or strengthens cross-country linkages via trade in intermediate inputs with potentially significant macroeconomic consequences. However, from all the potential consequences of international involvement in GVCs, the labor market is probably crucial and deserves more attention. First, employment, productivity, and growth are interlinked, both cyclically and in the short and long term, with distinctive characteristics in each case (Antràs, 2020).[3] Second, from a socio-political point of view, the development of GVCs has been considered one of the causes of the increase in inequality in developed countries (López-Gonzalez et al., 2015). Finally, the new wave of re-shoring after the pandemic may also have consequences in the labor markets, something to be considered from an economic policy point of view (Szymczak and Wolszczak-Derlacz, 2022). This section reviews the theoretical and empirical literature on GVCs' effects on the labor market.

Theoretically, the relationship between GVC participation and employment (or unemployment) is a complex and controversial issue. Indeed, according to the Ricardian comparative advantage model, trade openness creates employment for the home country and its trading partners (see, e.g., Dutt et al., 2009). On the contrary, under the Heckscher–Ohlin model, trade liberalization may have a detrimental effect on employment in a labor-scarce economy that trades with a labor-abundant economy (see, e.g., 2011 or Heid and Larch, 2016). These models have one thing in common: they are based primarily on trade in final goods. In contrast, trade in intermediate goods came to the fore in the early 1980s with increasing importance, followed by intra-industry trade in differentiated products.

The theoretical literature on the effects of globalization and GVCs on unem-

[3]For example, Taglioni and Winkler (2016) argue that GVCs can benefit labor markets through three channels: first, a demand effect, as multinationals (and other GVC participants) have a high demand for skilled labor; second, a training effect, as local firms participating in GVCs may receive training from either multinationals or their foreign buyers; third, a labor turnover effect, as knowledge embodied in the workforce of participating firms moves to other local companies.

ployment is equally inconclusive. Some authors, like Feenstra and Hanson (1996) or Helpman and Itskhoki (2010), provide arguments for a positive link. Yet, others, like Mitra and Ranjan (2010), Heid and Larch (2016), Farole et al. (2018) or World-Bank (2020) show that globalization reduces unemployment. Finally, others, like Moore and Ranjan (2005), Şener (2001), or more recently, Szymczak and Wolszczak-Derlacz (2022) provide a discussion leading to an uncertain relationship.

Some contributions have detected several "benefits"to increase participation in GVC. In general, the idea is that trade liberalization, within the framework of multilateral cooperation, has been a key factor driving global economic prosperity, especially in developing countries. In particular, it is suggested that GVC trends have important implications for productivity, with potential gains through firms and countries specializing in their most productive tasks and utilizing new varieties and higher quality foreign goods, services, and intangible inputs (Kummritz, 2016). Moreover, the positive view on GVCs suggests that those productivity gains coincide with or even cause scale effects that further allow for fast job growth, at least in less developed countries (OECD, 2013).

On the other hand, there is a growing belief that rising trade fragmentation can lead to unemployment (Dutt et al., 2009). Indeed, one of the main motivations for fragmenting the production process is the ability to procure inputs at a lower cost from abroad than at home. Moreover, it is also argued that GVC participation is associated with reduced job growth because GVC trade fosters falling labor requirements in participating firms (i.e., fewer workers are needed per unit of production) (Rodrik, 2021).

In sum, even if firms with the strongest international linkages, i.e., firms that participate in a GVC, create jobs, the relationship between GVC integration and unemployment is not necessarily positive at the aggregate level. Evidence and intuition suggest that GVC participation will have distributional implications concerning where jobs go, the types of jobs, and who gets them. Of course, at the national level, the crucial question is whether there are spillovers that operate through labor markets, leading to less unemployment at the aggregate level and if they are happening over time.

Using the workhorse Ricardian trade model of Eaton and Kortum (2002), Caliendo and Parro (2015) provide a solid base to incorporate the role of GVCs and international linkages through a formulation in the form of a gravity equation. However, they do not account for unemployment. Dix-Carneiro et al. (2021), starting from Caliendo and Parro (2015) approach, extend the model to study the effects on un-

employment.

Carrère et al. (2020) have recently proposed a trade model about the effects of trade openness on employment. In this context, trade affects unemployment through two channels: expansion and reallocation. The expansion effect occurs when a trade reform results in efficiency gains. These gains imply more jobs, higher welfare, and less unemployment. The reallocation effect results from different degrees of friction across labor market sub-sectors. Thus, individual effects are heterogeneous, and there are winners and losers in employment. Trade changes displace workers and adjustment takes time.

From an empirical point of view, using local projections, Camarero et al. (2021) provides an in-depth analysis of how GVC participation affects growth, productivity, unemployment, and the current account balance. According to World-Bank (2020), GVCs are supposed to deliver more and better jobs as production is more capital-intensive.[4] Although this may reduce employment, the overall effect is primarily positive due to the increase in exports. Participation in GVCs may affect employment through job destruction and job creation. 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 unclear if increasing participation in GVCs helps reduce the share of disadvantaged employees, such as informal employees in the labor force (Artuc et al., 2019). Furthermore, trade liberalization and participation in GVCs affect labor market outcomes and are highly country-specific (Shingal, 2015). The latter suggests the necessity for additional studies on this issue. Moreover, as multiple channels explain how GVCs may affect labor markets, the implications of participation in GVCs for employment remain fully misunderstood and can be diverse. Moreover, according to OECD (2013) or ECB (2019), participation in GVCs can change the composition of the labor force. Low-skilled jobs would be affected, with downward pressure on wages. 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 and export these products to other countries, creating new employment opportunities.

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

This paper focuses on EU countries for several reasons related to the region's particularities. Indeed, three interconnected production hubs have been established around the world: North America (centered in the United States), Asia (with China playing a dominant role), and Europe (with Germany as the core). Overall, the participation of Europe in GVCs is significantly higher than the other two, and it has steadily increased with the creation of the Single Market and the launching of the euro (Huidrom et al., 2019). Therefore, value chain participation has significant economic implications for the euro area economies. (ECB, 2019).

In addition, within the EU, the distribution of economic activities presents a core-periphery pattern, with the bulk of investments concentrated in core countries. Nonetheless, peripheral countries have gained prominence with the acceleration of the economic integration process in the EU. Since tariffs and non-tariff barriers were already eliminated in the 1990s, the Central Eastern European Countries (CEECs) accession into the EU in 2004 provides a quasi-natural experimental setting that can be used to investigate the importance of behind-the-border barriers across integrated markets. Most of the literature has been pessimistic, arguing that increased competition in an integrated area would force firms to trim their workforce and shift towards more capital intensive "advanced"technology, thereby restricting employment expansion and a marked trend towards the informalization of the workforce (Mundle, 1993). More recently, the problem has been formulated as the seemingly paradoxical "pair of concerns": more advanced countries worry about the potential loss of manufacturing jobs going to lower-cost countries, whereas the countries that host the new production worry about receiving the wrong type of jobs (as formulated by Baldwin and Ito, 2022). Motivated by these developments, it is increasingly important to understand the implications for labor markets that result from GVCs.

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 GVC participants' activities influence labor market outcomes. A priori, workers who perform manual or cognitive tasks that lend themselves to automation or codification (e.g., bookkeeping, monitoring processes, processing information) are most likely affected by GVCs; many of these tasks can be offshored as services. However, such tasks may complement those that cannot easily be digitalized or offshored due to high transaction costs or the need for contact with customers. GVCs contribute to shifting demand for skills, but it is not easy to know how much is due to trade and how much to technology. 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 more significant 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. This change can now be measured with the availability of world input-output tables.

For the case of the EU, ECB (2019) suggests that participation in GVCs is likely essential for labor market outcomes, and the impact of GVCs on labor market dynamics should be further analyzed from a sectoral perspective.

3 Data and descriptive statistics

3.1 Data and definitions

We collected data for the 28 EU members from 1990-2015. Within the EU, we consider not only the total area but also different groups: "Core"(Austria, Belgium, Denmark, Finland, Germany, France, Luxembourg, the Netherlands, Sweden, and the UK), "Periphery "(Cyprus, Greece, Ireland, Italy, Malta, Portugal, and Spain), and Central European Economies or "CEECs"(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 geographical coverage and relatively recent input-output data. Measuring GVCs is far from 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.[5] 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. Key progress in GVC measurement has come from constructing multi-country input-output tables that link national input-output tables using bilateral trade flows (De Backer et al., 2018). Those tables allow quantifying the contributions of each production stage within the global supply chain to the value of the final product. The Eora global supply chain database (UNCTAD) is particularly well suited for this purpose, as it consists of a multi-region input-output table and is currently the most commonly used in the literature.

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

Based on this data and following Koopman et al. (2014), 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 in country i; FVA_i stands for foreign value added in country i; and VAX_i is country i's value added exports.

Similarly, a country i's backward participation in GVC is defined as:

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

Thus, backward participation looks upward at the value chain at the imports used in producing exports, such as raw materials or intangibles involved at the beginning of the production process (e.g., research, design). $Backward_i$ 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 the 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:

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

Forward linkages imply producing and exporting intermediates, to which importing countries will add further value and export as finished products or intermediates to other production stages. 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).

To provide a quick glance at the effects of GVCs on labor markets, we first used value-added, at constant prices, and employment. Our breakdown, in this case, includes eight sub-sectors in manufacturing for which we have the same desegregation level as for GVC participation: i) Food and beverages, ii) Textiles and wearing apparel, iii) Wood and paper, iv) Petroleum, chemicals, and non-metallic mineral prods., v) Metal products, vi) Electrical and machinery, vii) Transport equipment

and viii) Other Manufacturing (source: EU KLEMS database)[6]. To quantify the macroeconomic impact, we use the harmonized unemployment rate for the subsequent analysis (source: Eurostat). The rest of the variables entering the specifications are GDP growth (source: IMF) and labor productivity growth (source: Eurostat).

3.2 Descriptive statistics and some stylized facts

In this section, we describe the participation of the EU countries in GVCs as defined above. In addition, we also present the three groups (core, periphery, and CEE countries) of EU members that we will analyze later.

Table 1 describes the evolution of the variables at the beginning of the sample (1990) and the end (2015). Some patterns can be inferred from them. First, the smaller EU countries need to source a more significant share of inputs from abroad, so their participation in GVCs is higher than that of the bigger economies. Second, Cyprus and Greece may have obtained their positions due to their specific domestic export structure; both countries are specialized in the tourism sector, located at the end of the supply chain, and are relatively less vertically fragmented. Also an exporter of services, but on the opposite extreme, Luxembourg appears to be involved in much supply chain trade, 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, specialize in production stages at the 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, exhibits a middle level of participation (between 50% and 60%).

The picture that emerges from the data is that the EU countries are active participants in value chains, reflecting the high level of openness and economic integration of the EU economies. Moreover, participation in the backward and forward stages of production is relatively balanced. However, the relative position of the countries depends on their size and specialization.[7]

[6]Note that we exclude services since, although EU KLEMS provides data for services, it is not at the same desegregation level as for GVC participation.

[7]The relative position of the countries is not homogeneous: smaller countries are placed more downstream (these are the cases of Belgium, Estonia, Ireland, Luxembourg, or Slovakia) than larger EU countries, which tend to lie more upstream. According to ECB (2019), compared with the world average, EU countries are placed relatively downstream, signaling that the foreign content of its production is larger compared to the inputs that EU countries supply to other countries. The

Table 1: Global value chain participation, 1990 and 2015

Country	1990	2015
Austria	0,59	0,72
Belgium	0,71	0,79
Bulgaria	0,40	0,60
Croatia	0,51	0,63
Cyprus	0,42	0,51
Czech	0,53	0,74
Denmark	0,56	0,68
Estonia	0,67	0,75
Finland	0,54	0,67
France	0,53	0,62
Germany	0,51	0,60
Greece	0,49	0,60
Hungary	0,57	0,79
Ireland	0,61	0,71
Italy	0,41	0,54
Latvia	0,60	0,64
Lithuania	0,69	0,70
Luxembourg	0,79	0,85
Netherlands	0,67	0,78
Poland	0,49	0,71
Portugal	0,53	0,60
Romania	0,49	0,68
Slovakia	0,peripheral	
Slovenia	0,62	0,75
Spain	0,48	0,59
Sweden	0,54Source7	
UK	0,52	0,62
Mean EU-28	0,56	0,68

Source: own calculations, using UNCTAD Eora data.

United States is positioned more upstream than the EU mainly due to its specialization in natural resources, research and development, and financial services, all serving as intermediate inputs to other sectors. Within the EU, there are also pan-European production chains, where the larger countries produce intermediate goods and services, while the assembling process takes place in the smaller or CEE countries.

4 Empirical strategy

To quantify the effects of GVC participation on the labor market, our strategy is based on the local projection (LP henceforth) method proposed by Jordà (2005) to flexibly document the dynamic response of unemployment 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 for recovering the dynamics of the dependent variable after a shock. Local projections have become increasingly popular because of their robustness to misspecification and flexibility. More specifically, they have several 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 each horizon's impulse response is estimated separately. Second, it allows controlling for a relatively large set of variables, which would be impractical in a standard VAR setting. Third, it allows for inference directly from the estimated impulse responses. Finally, they can easily accommodate non-linear specifications, which we use to uncover patterns.

In sum, quoting the title of a recent paper by Plagborg-Møller and Wolf (2021) "local projections and VARs estimate the same impulse responses": the only requirement to obtain this result is an unrestricted lag structure. The latter represents a critical outcome, as it supports the use of local projections as a suitable method for many empirical applications, with all the advantages enumerated above.

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:

$$\Delta y_{i,t+h} = \alpha_i + \gamma_t + \beta_h \Delta GVC_{i,t-1} + \nu X_{i,t} + \epsilon_{i,t+h} \tag{4}$$

where $y_{i,t}$ is the outcome variable of interest (employment or the unemployment rate) 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, ν is a vector of nuisance coefficients, $X_{i,t-1}$ is a vector of potentially endogenous controls lagged for one period to address endogeneity concerns arising from reverse causality[8]. This vector includes:

[8]Another potential source of endogeneity is the correlation between the lags of the dependent variable and the unobserved country effect in the error term, which we control for using country

a) changes in the dependent variable, b) changes in the GVC participation score, and c) in GDP and productivity growth. Finally, the error term is $\epsilon_{i,t}$.

For robustness purposes and inspired by earlier studies in the empirical trade literature, we also address endogeneity concerns related to GVC participation by implementing an instrumental variable (IV) approach. As an instrument, we use the change in participation in the other countries of the group -core, peripheral, or EEC- over the same period. This instrument is meant to capture the variation in the participation driven by changes in conditions in foreign but similar countries that are not driven by domestic industry-specific shocks, which might be endogenous to GVCs. [9]

The coefficients on the variations of participation, β_h, trace out the effect of an increase in participation at time t on labor market 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, GDP in logarithms, and productivity in changes, the estimated coefficients on GVC quantify the percentage change in the outcome variable at time $t+h$ in response to a one percentage point in participation at time t.

5 Results

5.1 GVCs and employment

Numerous studies on the impact of trade on unemployment lack consensus, and the topic remains open to empirical investigation. As evidenced in the literature, trade can impact unemployment through two broad channels: the substitution effect and the scale effect. In a simple framework, the substitution effect, or direct effect, implies a direct negative substitution effect of import competition on employment. On the other hand, there are other, often positive, indirect effects. In particular, the scale effect refers to the advantages of using cheaper imported inputs. Domestic firms can increase production and exports and hire more workers when these inputs become cheaper. Higher exports and production create more employment opportunities under the scale effect of trade (Sen, 2008). Empirically, a large, mainly micro-oriented, literature finds that firms that engage in international trade tend to employ more workers than firms that do not internationalize at all (World-Bank, 2020).

fixed effects.

[9] See, among others, Autor et al. (2013); Dauth et al. (2014); Hummels et al. (2014); Bloom et al. (2016).

An indirect way to check these two opposite hypotheses is to analyze if GVCs have the potential to create employment through their influence on promoting domestic value-added creation. Even though empirical estimates of these effects would require working on firms individually, we rely instead on sub-sectors of the manufacturing industry for which data on value-added, at constant prices, and employment are available and can be matched with our GVC-related trade data. The source of final demand strongly influences the organization of value chains. Gains/losses associated with value chain trade do not accrue to countries uniformly. Therefore, to gather richer results, we examine heterogeneity among EU countries by distinguishing between core, periphery, and Central and Eastern European (CEEs) Countries[10].

In Figure 1, we present the results of the impact of an increase in participation on real value-added growth (left-hand side column) and employment growth (right-hand side column) in the manufacturing sub-sectors. The countries are grouped using the core-periphery-CEEs criterion. In none of the groups, there is a significant response of real value added[11]. In contrast, employment grows in peripheral and CEE countries, with more persistence in the latter.
Although it may seem paradoxical that employment responds positively to participation. In contrast, higher participation does not affect value-added (at least in the short-run); we should consider that these results correspond only to manufacturing sectors. As most of the European value added is now concentrated in services, what we have found does not mean that aggregated value-added does not grow with more participation in GVCs. Recent empirical results by Meng et al. (2020) obtain the smile curves for GVCs using input-output data with the expected V-shape. They confirm that value added (and jobs and better salaries) is mostly generated at both sides of the smile via services, whereas the production process is disadvantaged. Baldwin and Ito (2022) also analyze the sources of value added in manufacturing and conclude that value-added has shifted towards services. Some decades ago, these services were provided within the firm's production process, but now they are externalized and, very frequently, produced elsewhere in the value chain. Suppose we complement these results with our findings concerning the sub-sectors in services. In that case, we can understand why manufacturing jobs are more concentrated in peripheral and CEECs, but their contributions to value added are modest. Services are currently the main source of employment in European countries through their

[10]The groups and countries included in each group are: "Core"(Austria, Belgium, Denmark, Germany, Finland, France, Luxembourg, the Netherlands, Sweden, and the UK), "Periphery "(Cyprus, Greece, Ireland, Italy, Malta, Portugal, and Spain), and CEEs economies (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Slovak Republic, and Slovenia).

[11]We have also repeated the analysis with nominal value-added, finding significant responses.

participation in GVCs, and they continue to be concentrated in the core countries.

5.2 GVC and the unemployment rate

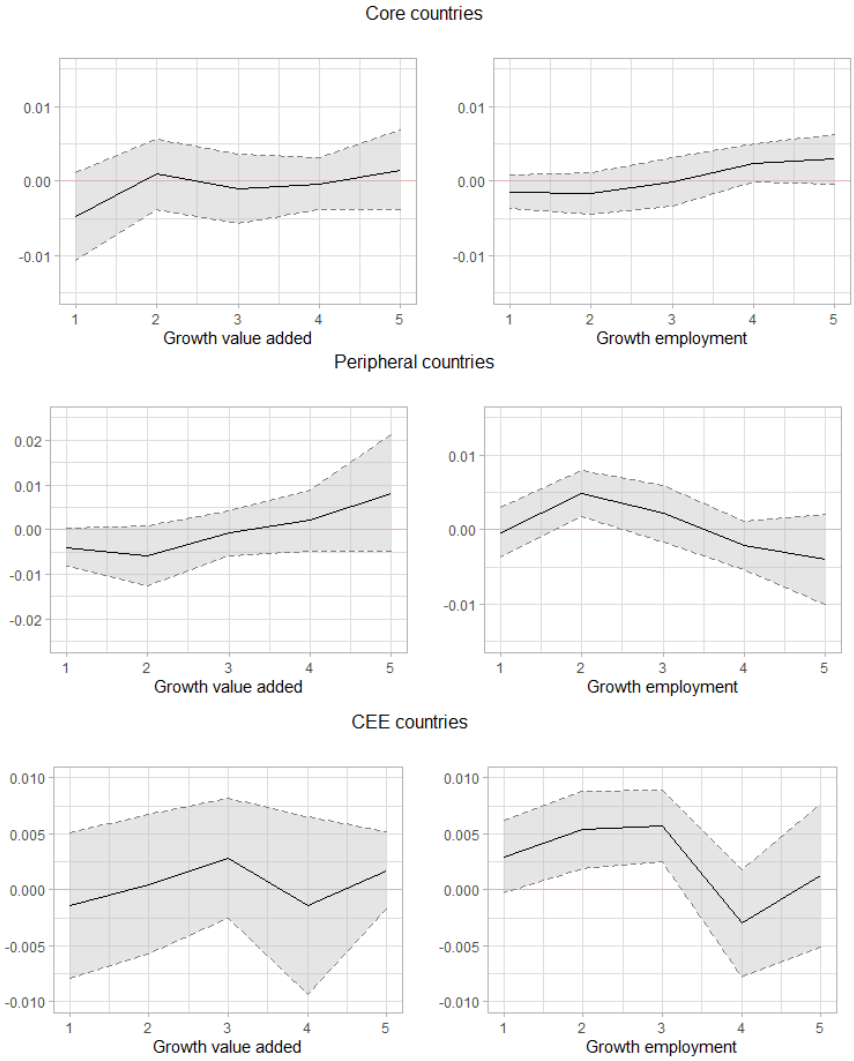
Our previous section shows evidence that GVC participation creates and destroys jobs. We now study whether participation in value chains, by affecting employment, has an aggregate impact on the economy via the unemployment rate. This question is not trivial, given the evidence, mainly micro-oriented, of the drastic effects of this type of trade on workers of different categories. Therefore, in this section, we are interested in the impact of increased participation on the unemployment rate.

The aggregated results of both the benchmark and the IV equations are presented in Figure 2. The shock consists of a one-standard-deviation rise in participation, corresponding to an increase of about 1.66 percentage points, well within the standard range of the data. In all our LP results, we present the cumulative response after a shock with a time horizon of 5 periods. As shown in Figure2, the response of the unemployment rate is significant in both specifications. In particular, the first two periods show a negative response, signaling the macroeconomic relevance of changes in GVC participation.

The previous results give a general idea of participation's impact on EU countries' unemployment rate. However, they do not provide information on the heterogeneity across countries. Therefore, we consider the effects on the three groups of countries mentioned above. Figure 3 shows a significant negative response for Peripheral and CEECs. This response is large and long-lasting, notably in CEECs. Surprisingly, perhaps, there is a significant increase in unemployment in core EU countries. This result can be linked to the Stolper-Samuelson trade theorem (1941), which postulates that more trade implies gains for the factor in abundance, i.e., a country engaging in international trade enjoys a comparative advantage in the abundant factor. Higher exports should lead to higher employment since labor is abundant in most emerging economies, such as the CEECs. This result (more unemployment in richer countries and less in emerging economies) would correspond to one part, at least, of the "concern"as formulated by Baldwin and Ito (2022), as the production of labor-intensive processes is displaced toward CEECs in regional value chains.

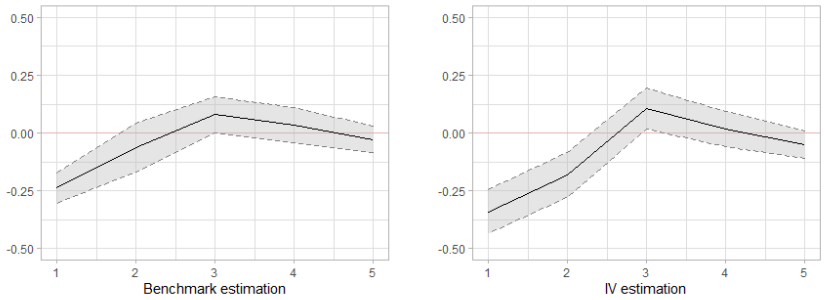
A logical step forward regarding heterogeneity is the sectoral breakdown analysis. This point is essential since, due to the characteristics of the production process, some sectors are closer to the final stages. Therefore, we can gain a richer analysis by distinguishing i) Agriculture, forestry, and fishing, ii) Mining and quarrying, iii) Manufacturing, and iv) Services. Our breakdown includes eight sub-sectors in man-

Figure 1: The effect of sectoral GVC participation's shocks on sectoral value added and employment. Manufacturing



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

Figure 2: The effect of GVC participation's shocks on aggregate unemployment



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

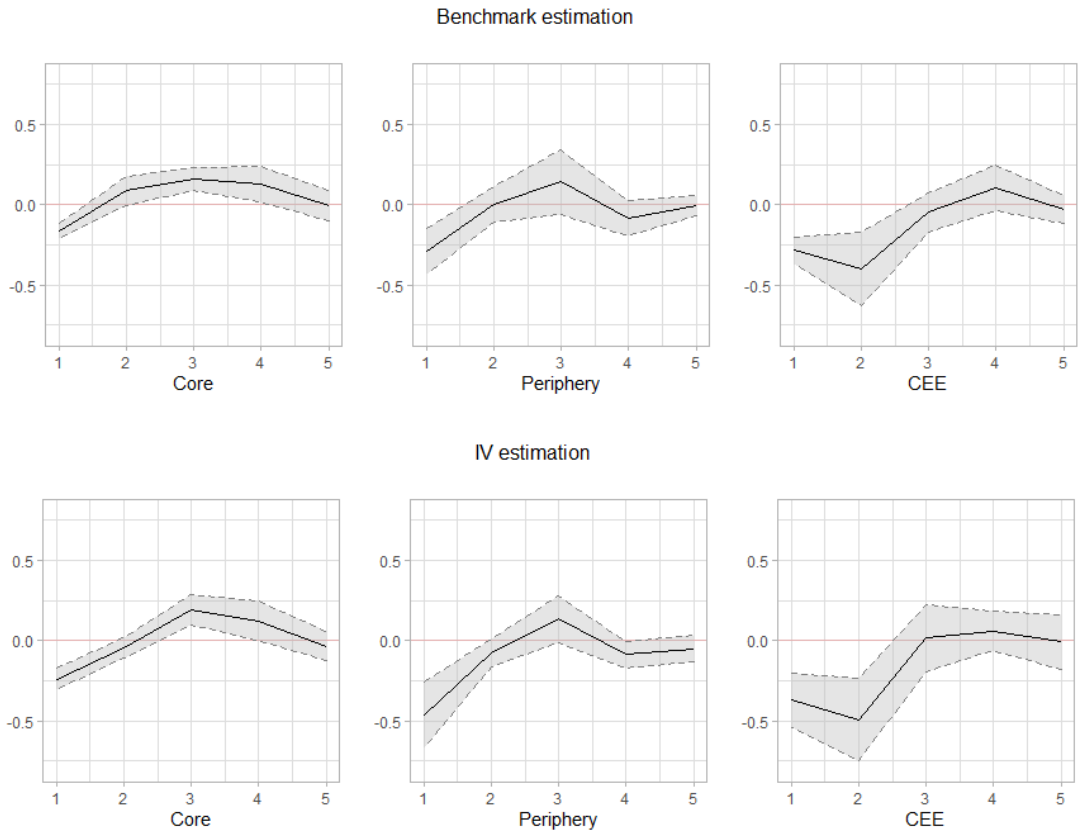
ufacturing and services and represents the main economic activities.

Table 2 shows sectoral GVC participation between 1990 and 2015. In all cases, GCV participation has increased by around 20% on average during the period, the increase being stronger in agriculture and the service sector. Regarding manufacturing, the highest levels of participation are found in sectors strongly linked to raw materials (chemicals, petroleum, metal products), which are located upstream and provide primary inputs. In services (some in upstream locations, others downstream), wholesale and transport are the sub-sectors with the highest participation. This ranking has changed little over time.

Several questions about the role of sectoral GVC participation and unemployment can be explored. The first is whether the response to increased participation differs depending on which sector is affected. In Figure 4, we present the response to increased GVC participation in the four larger sectors (Agriculture, Mining, Manufacturing, and Services). The answer to our question is negative: the response is relatively homogeneous, although services are the sector whose integration in GVC affects the EU country's macro-unemployment rate and shows more persistence. We should remember that even if the EU constitutes the most prominent trade bloc globally, the present leadership is more in services than manufacturing. As some services are provided upstream but others are closer to the consumer, a further breakdown of services into sub-sectors provides additional insights.

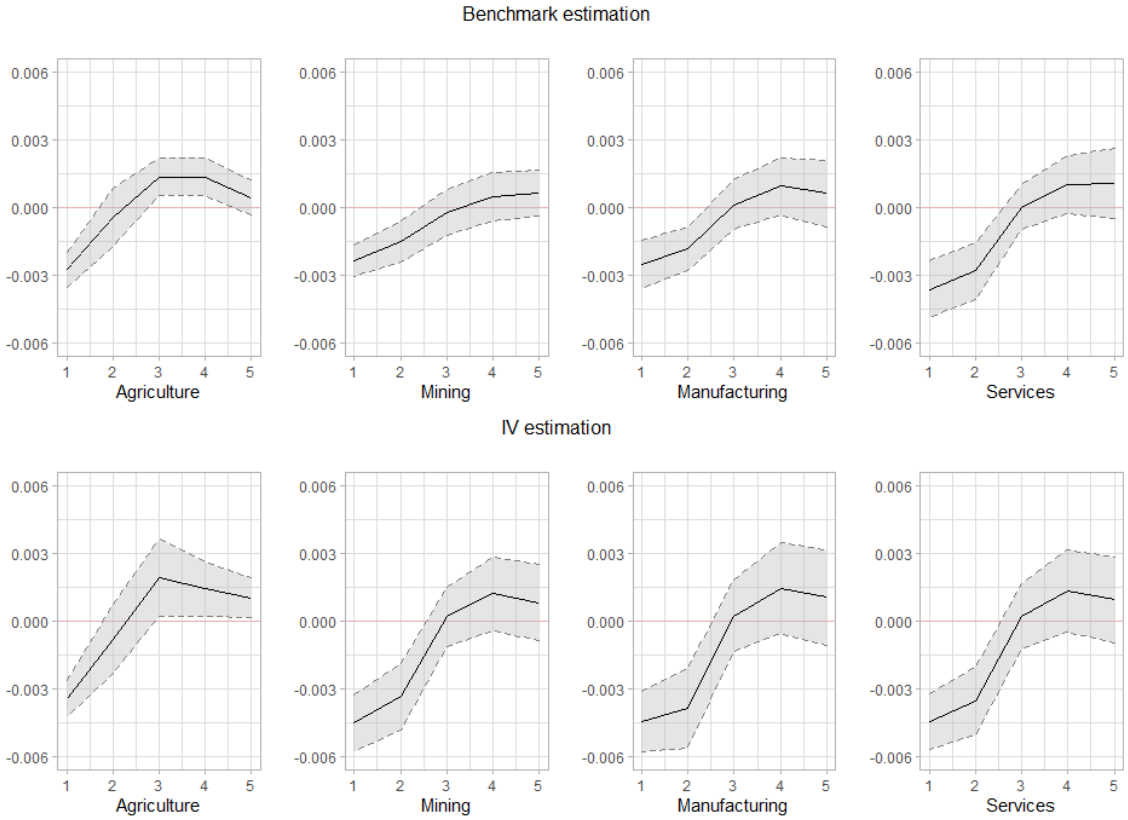
At a higher degree of decomposition, we distinguish eight sub-sector breakdowns

Figure 3: The effect of GVC participation on unemployment, by group of countries



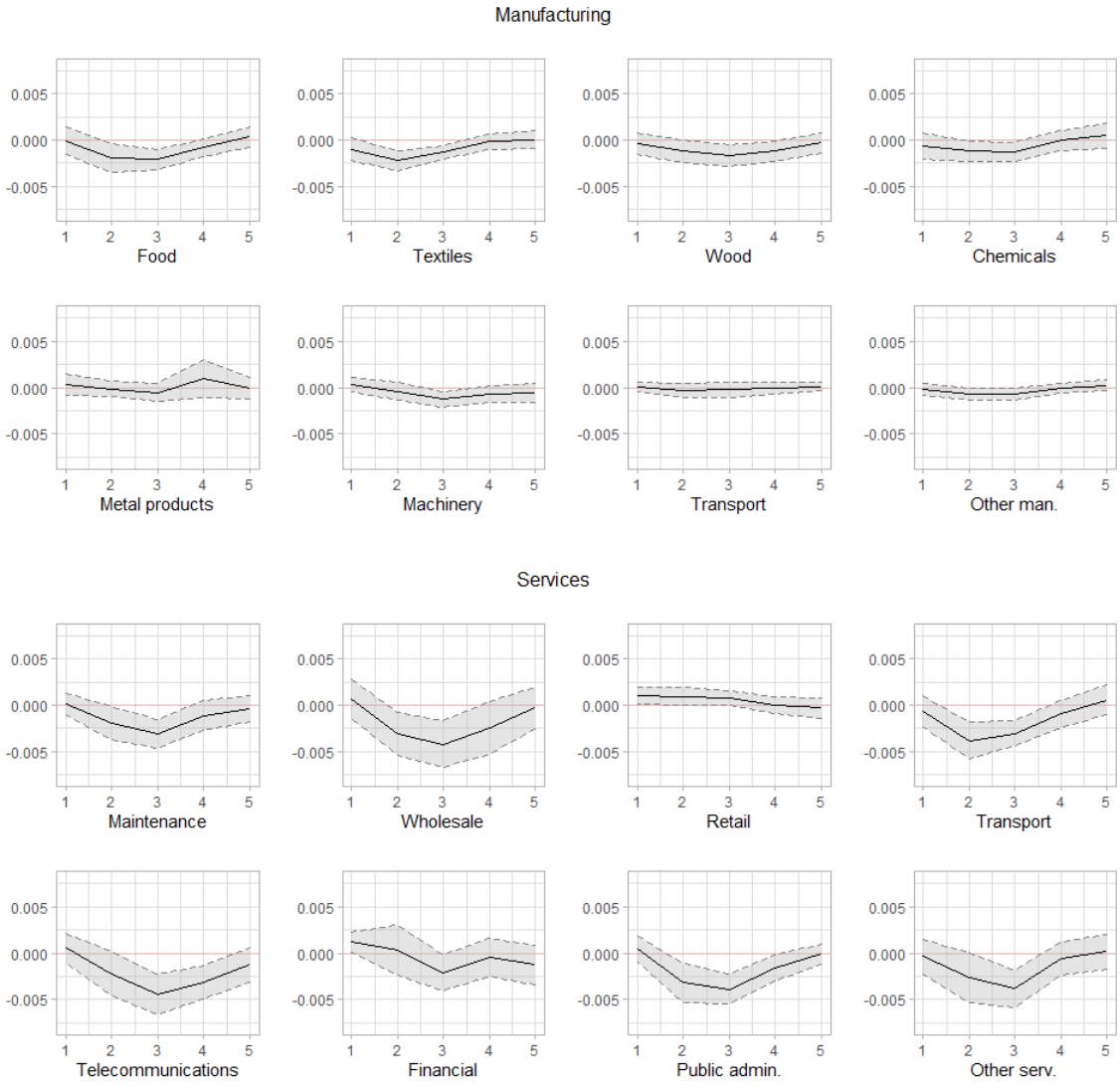
Notes: Time is portrayed on the x-axes; the solid lines portray the average estimated response, and we include its 90% confidence interval (computed using Driscoll-Kraay standard errors).

Figure 4: The effect of GVC participation's shocks on unemployment, by sectors



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

Figure 5: The effect of GVC participation's shocks on unemployment, by sub-sectors



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

Table 2: Global value chain participation by sectors, 1990 and 2015

Sector	**1990**	**2015**	% Change
Agriculture, forestry and fishing	**36.25**	**46.03**	**27.0**%
Mining and quarrying	**52.85**	**62.45**	**18.2**%
Manufacturing	**51.03**	**59.69**	**17.0**%
Food and beverages	31.73	40.84	28.7%
Textiles and wearing apparel	45.29	54.24	19.8%
Wood and paper	51.00	60.65	18.9%
Petroleum, chemicals, and nonmetallic mineral products.	57.19	66.22	15.8%
Metal products	61.94	71.56	15.5%
Electrical and machinery	48.84	57.17	17.1%
Transport equipment	54.43	60.94	12.0%
Other Manufacturing	37.97	45.04	18.6%
Services	**35.34**	**43.07**	**22.0**%
Maintenance and repair	37.89	45.47	20.0%
Wholesale trade	46.08	58.21	26.3%
Retail trade	20.89	28.30	35.5%
Transport	40.83	48.98	20.0%
Post and communication	34.56	43.19	25.0%
Financial intermediation	34.10	41.44	21.5%
Public administration	16.53	20.28	22.7%
Education, health and and other services	20.76	25.68	23.7%

Notes: Based on data from the EORA database.

of manufactures and services and concentrate on the response of unemployment. The response to an increase in total GVC participation from the different sub-sectors is shown in Figure 5. The first two rows of the graph are devoted to manufacturing sub-sectors. Increased GVC participation in *Food and beverages* and *Textiles and apparel* generates a negative and relatively long-lasting response in unemployment. Note that these are sectors that are characterized by low labor skills. Later absorbed, a short negative impact is captured for *Wood, Paper, and Chemicals*. The remaining manufactures are mostly unaffected. The response of unemployment to GVC participation in services is depicted in the two lower rows of Figure 5. As seen, the rise of global services value chains and, particularly, *Maintenance, Wholesale* (placed upstream), *Transport*(in a downstream position), *Communications* (which comprises *Publishing, Audiovisual and Broadcasting Activities, Telecommunications and IT and other Information Services)*, *Public Administration* and *Other services* have a strong impact on unemployment. Only *Financial services* and *Retail* (mostly non-tradable) do not show a significant impact. Taglioni and Winkler (2016) find (for a group of developed and developing countries) that with GVCs, employment has grown more in services than in manufactures, with some exceptions, such as

China and Turkey. In particular, in Germany, Italy, and Spain, the increase in GVCs-related service jobs is larger than the loss of jobs in manufacturing and agriculture. Our results align with those found by Timmer et al. (2013), who stress that a myopic approach to policies focusing on the manufacturing sector only is missing out on this important trend. Producing final manufactures includes activities in the manufacturing sector and supporting industries such as business, transport communication, and finance services by delivering intermediate inputs needed to produce manufacturing goods.

The former result is relevant as it stresses the relatively modest role of manufacturing subsectors in GVCs for employment. Therefore, neglecting other sectors from the discussion, mainly services would be a mistake. Indeed, the past few decades have witnessed an unprecedented shift of employment and output shares toward services. Moreover, services increasingly set up their value chains. The "production process"of certain services allows for fragmentation similar to that of goods. *Delivering software*, for instance, involves many discrete steps, most of which can be performed remotely. This fact enables countries to join services GVCs just as they joined goods GVCs (see Asian Development Bank, 2021). As a result, more value-added has also shifted from manufactures to services (Baldwin and Ito, 2022).

6 What makes unemployment more sensitive to GVCs?

Our results show a link between GVC participation and unemployment. Moreover, this relationship is characterized by significant heterogeneity, particularly at the country level. A relevant question immediately arises: Which country-level characteristics shape the impact of the GVCs on unemployment?

In this section, we aim to shed light on the drivers of such heterogeneity. From the potential factors, we focus on two characteristics of the workforce composition: skills and costs. Indeed, our first intuition is that the mix of skilled and unskilled jobs in the economy can affect the link between economic globalization and unemployment. There is a general view that, in developed countries, low-skilled workers have been most affected by increasing unemployment due to competition from developing countries workers and also as a result of technological progress (see Meng et al., 2020; Szymczak and Wolszczak-Derlacz, 2022). However, the workforce in developing countries is becoming better qualified and increasingly engaging in more sophisticated, service-oriented activities. As such, skilled workers in developed coun-

tries increasingly feel the competition of their counterparts in developing countries (Farole et al., 2018).

Labor costs might also be a mechanism amplifying the impact of value chains on the unemployment rate. Indeed, factors that allowed globally "footloose" firms (i.e., firms that are not tied to any particular location or country) to locate in the host economy also will enable them just as easily to shift out to a lower-cost area, and governments may be locked into a "race to the bottom" on costs, which will most likely result in suppression of employments (Shingal, 2015; Farole, 2016).

This section aims to draw attention to the general relevance of these interactions as complementing factors, designed at the country level, that can magnify the impact of participation on unemployment. To capture these mechanisms, our specifications are similar to those presented before with the following modifications:

$$\Delta y_{i,t+h} = \alpha_i + \gamma_t + \beta_h^{r1}(\Delta GVC_{i,t-k} \times F(z_{i,t-1})) + \beta_h^{r2}(\Delta GVC_{i,t-k} \times (1 - F(z_{i,t-1}))) + \nu X_{i,t-1} + \epsilon_{i,t+h} \quad (5)$$

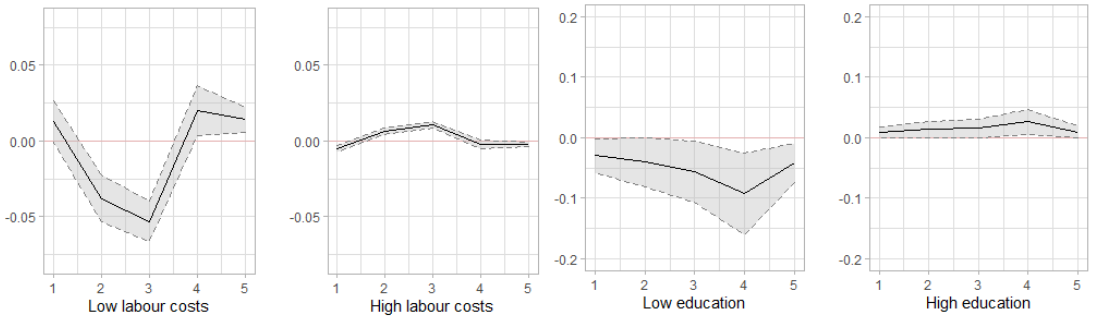
As in Eq. (4), the X vector contains changes in the GVC participation score, GDP, and productivity growth. In addition, we include skills and labor costs. In Eq. (5), we also added a logistic function, $F(z_{i,t-1})$, that governs the transition between the high and low regime, $z_{i,t-1}$ being the scalar state variable at time $t-1$. This switching variable represents the workforce composition, i.e., skills and labor costs. As standard, the transition function is the logistic transformation of the original z_t:

$$F(z_t) = \frac{1}{1 + \exp\left(-\theta(\frac{z_t - c}{\sigma^2 x})\right)} \quad (6)$$

Therefore, we obtain two impulse response functions corresponding to two regimes characterized by low and high values of the switching variables. For instance, if the transition variable captures the skill level of the labor force in (6), an increase in z_t would lead to a decrease in $F(z_t)$. Values close to zero of $F(z_t)$ would thus indicate a regime of high skill level. By interacting this transition function with the participation score in (5), we can obtain the two regimes corresponding to the high and low indicators of the workforce composition.

Our proxy for skills is the labor force with advanced education (% of the total working-age population with advanced education, source: EU Labor Force Survey, Eurostat). Labor costs correspond to unit labor costs, which measure the average

Figure 6: The effect of GVC participation's shocks on unemployment according to labor costs and skill level



Notes: Time is portrayed on the x-axes; the solid lines portray the average estimated response, and we include its 90% percent confidence interval (computed using Driscoll-Kraay standard errors). Education is the labor force with advanced education (% of the total working-age population with advanced education, source: EU Labor Force Survey, Eurostat). Labor costs correspond to the ratio of total labor costs to real output (source: OECD).

cost per unit of output and are calculated as the ratio of total labor costs to real output (source: OECD).

The results, presented in Figure 6, indicate the complex interactions between GVC and market composition in shaping aggregate unemployment. The results suggest that the negative effect is magnified in countries with lower-educated workers or cheaper workforce. The LPs show that not only lower costs or less skilled workforce are those affected by GVC participation (unemployment decreases and the effect is persistent). Moreover, unemployment increases in higher-skilled workers. Nevertheless, we should bear in mind that all the countries in the sample are EU members and labor costs and education are relative to the European level. In addition, the EU countries are involved in regional (intra-EU) GVCs and global chains as hubs or participants in some particular stages or tasks. This result, combined with previous evidence about country-group heterogeneity, implies that CEECs and peripheral countries are those where these relatively fewer skill stages are concentrated. At this level of aggregation, and taking into account that around 70% of EU value added is in services, this may be the sector that accumulates most of the activity.

7 Summary and discussion

This paper revisits the nexus between globalization and the unemployment rate by focusing on GVCs, the most prominent characteristic of globalization in recent years. Furthermore, our study provides the first empirical investigation of the impact of interactions between the workforce composition and GVC-type trade on unemployment for the 28 EU Member States from 1990-2015.

We make several contributions to the relatively scarce existing literature. First, we focus on the European Union (EU) countries, a region with the highest participation percentage in GVCs. Second, we allow for heterogeneity in two dimensions: first, by defining groups of countries with similar characteristics (core, periphery, and CEECs) and, second, by decomposing the data into sectors and sub-sectors. Third, we account for a potential nonlinearity related to the workforce composition. Finally, since caution is required concerning the direction of causality between trade and labor market outcomes, we rely on impulse response functions obtained from local projections, where we also introduce instrumental variables to overcome any endogeneity issues.

Our results show that the effects of GVC participation on the unemployment rate are not homogeneous: higher participation reduces the unemployment rate in less advanced EU economies. Still, it slightly increases it in "core"countries. Moreover, the negative impact on unemployment is reinforced in countries with lower labor costs and a higher proportion of low-skill workers. This result can be linked to the literature on "offshoring", where firms in advanced economies outsource parts of the value chain (goods production and/or services) to third countries. While many debates remain to be settled in the offshoring literature, what is becoming increasingly clear is that GVC integration for advanced economies has reinforced the effects of skills-biased technical change. That is, offshoring involves the most labor-intensive processes in the value chain. This fact will result in a reduction in employment in the short and medium term for advanced economies. On the contrary, lower-income EU countries that have successfully attracted GVC investment experience a significant increase in formal manufacturing jobs. However, in the long run, technical change in the global production of manufacturing goods has an important factor bias, which may drive down relative demand for low-educated workers throughout the chain. Increasing efficiency in automation drives the use of robots for production stages brought back in high-income countries. To minimize this possible outcome, peripheral and CEEC countries must upgrade their labor force to meet the requirements of today's global production systems

We show that GVC participation has a significant negative response impact on

aggregate unemployment that varies according to a sectoral breakdown. In particular, the manufacturing sector includes *Food and Beverages, Textiles and Apparel*, and *Wood products*. We also show that sub-sectors with higher GVC participation growth in the manufacturing sector can generate more employment, although the capacity to increase value added is more limited.

A salient feature of our findings is that an even larger response of unemployment is found in services, notably *Wholesale* (placed upstream), *Transport* (in a downstream position), and *Telecommunications* (which comprises publishing, audiovisual and broadcasting activities, telecommunications and IT, and other information services). This result is essential since the past few decades have witnessed an unprecedented shift of employment and output shares toward services, which can increasingly set up their value chains. Moreover, the production of many services allows for fragmentation due to the declining costs of services trade, thanks to digitalization. This fact opens an avenue for the less developed countries in the EU.

Indeed, some economic policy takeovers can be derived from our findings. As services sectors are subject to barriers rooted in regulations, lifting these barriers in the EU Single Market seems paramount to facilitating services-led economic growth. Policies that ensure a fair distribution of benefits across countries, like the EU structural and cohesion funds (education attainment, especially in technology adoption, as computer-aided manufacturing and robotics and R&D policies) or the Recovery and Resilience program, can be crucial to achieving these benefits.

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