European Economic Review 174 (2025) 104966

Contents lists available at ScienceDirect

European Economic Review

journal homepage: www.elsevier.com/locate/eer

Global value chains and the Phillips curve: A challenge for monetary policy☆

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ARTICLE INFO

JEL classification:
E32
F41
F62

Keywords:
Monetary policy
Global value chains
Phillips curve
Price stickiness
Variable markups

ABSTRACT

This paper studies how participation and position in Global Value Chains (GVCs) affect the slope of the Phillips Curve (PC) and, consequently, the ability of monetary policy to control inflation. Using data from the European Monetary Union (EMU) and value added measures of GVCs, we show that, beyond the role of trade openness, higher participation leads to a flatter PC. This evidence is consistent with the theoretical literature emphasising how globalisation can reduce the sensitivity of prices to unemployment due to stronger strategic complementarities, to higher market power and to imperfect exchange rate pass-through. On the other hand, the role of GVC position is not statistically significant.

1. Introduction

The shape, the slope and even the existence itself of the Phillips Curve – the relationship between inflation and unemployment – is currently under scrutiny. Alongside being an important ingredient of macroeconomic models, the Phillips curve (PC) retains its central role in understanding the effects of macroeconomic policies. In particular, the existence and the slope of the PC is key for the ability of central banks to influence inflation. A steep PC in fact, implies that the monetary authority can affect prices by triggering small movements of unemployment around its natural – non-inflationary – level. Vice-versa, if the PC is flat, monetary policy needs to strongly intervene on the economic slack to be able to move inflation towards its target.

Both for Europe and for the U.S, economists argue that the slope of the PC has always been relatively flat and/or that it has progressively weakened, in particular in the decade following the Great Recession (GR) - see Blanchard (2016) and Moretti et al.

☆ We thank Giuseppe Berlingieri, Ambrogio Cesa-Bianchi, Nuno Coimbra, Giancarlo Corsetti, Luca Dedola, Aydan Dogan, Giulia Felice, Davide Furceri, Sophie Guilloux-Nefussi, Basile Grassi, Luigi Iovino, Aikaterini Karadimitropoulou, Andrei Levchenko, Miriam Manchin, Michele Mancini, Massimiliano Marcellino, Enrico Marvasi, Silvia Miranda-Agrippino, Tommaso Monacelli, Luca Sala, Julia Schmidt, Aditya Soenarjo, Lucia Tajoli, Fabrizio Venditti and participants to the 2024 EUI-BDF Workshop, 10th BdF-BoE-BdI Intl Macro Workshop, 2024 PRIN Padova Workshop, SNEE 2024, Liverpool Macro Workshop 2024, DEMUR workshop, ICAMIF 2024, IWH Workshop and seminars at Banque de France, Bocconi University, Politecnico di Milano, Roma Tre and Università Cattolica di Milano for their helpful comments and suggestions. The views expressed in this paper are those of the authors and do not necessarily reflect those of the Banque de France. Florio and Siena acknowledge financial support from the Italian Ministry of Education, Universities, and Research (PRIN 2022, grant 2022A9PAT3). All the remaining errors are ours.

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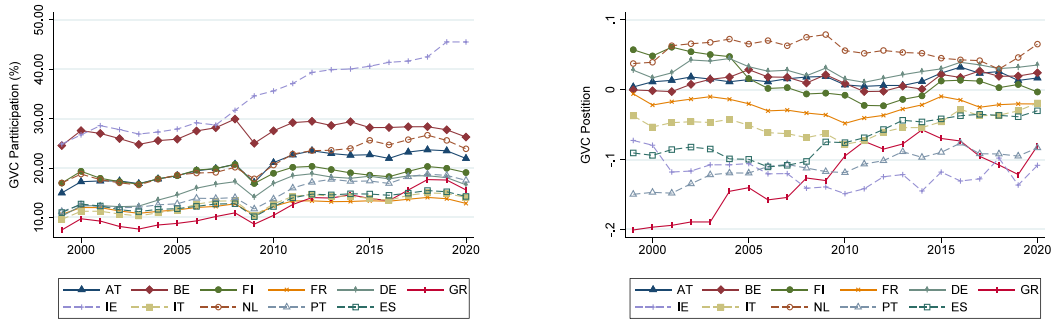
https://doi.org/10.1016/j.euroecorev.2025.104966
Received 4 June 2024; Received in revised form 22 January 2025; Accepted 24 January 2025
Available online 8 February 2025



(a) GVC Participation (b) GVC Position

Fig. 1. GVC Participation and Position.
Note: Panel (a) plots GVC participation between 1999 and 2020. GVC participation is measured as the share of gross output depending on connections with more than one country. Panel (b) plots GVC position, a measure ranging from −1 to +1 and expressing respectively whether a country is at the bottom or at the top of the GVC.

(2019) among many others. However, after the Covid-19 crisis, the PC seems to be back and in good shape. In fact, when considering the PC specification from Stock and Watson (2019) and estimating the slope of the curve for the first 11 countries that joined the EMU (the focus of our paper),[4] we find that the PC was indeed alive, albeit with a modest slope, from 1999 until the GR. After that, it experienced a severe flattening, while, following the Covid-19 pandemic crisis, it has exhibited a significant steepening (see Table A.1 in Appendix A).

This paper contributes to the literature aimed at shedding light on these dynamics. Previous studies explaining changes in the slope of the PC over time attribute them to two main factors: inflation anchoring and structural changes in the economy. In this paper, we focus on the latter. In particular, we investigate the role of an important structural change that has characterised all economies since the 1990s: the integration of the domestic production structure in Global Value Chains (GVCs).

GVCs entail the international sharing of production, where its processes are broken down into various activities and tasks carried out across different borders. Two are the important metrics measuring GVCs: participation and positioning. Participation in GVCs assesses the extent to which a country is integrated into international production networks. We will focus on GVC-related output measures that evaluate how much a country contributes to the value-added creation within global supply chains (Borin et al., 2021). Positioning, on the other hand, refers to the specific activities it undertakes within the chain. For instance, a country participating in a GVC might engage in downstream activities such as the assembly of components or product distribution (backward participation). Alternatively, it might specialise in upstream activities, such as producing raw materials (forward participation). We are going to focus on a metric summarising the overall position of the country within the GVCs, measured as the difference between forward and backward participation (Borin et al., 2021).

The involvement and positioning of a country within GVCs extend beyond the mere implications of openness or trade: they entail a deep structural change in the composition and organisation of domestic production and price setting. In fact, by affecting the environment in which firms decide their own prices, GVCs play a crucial role in shaping the relationship between prices and economic slack, as described by the PC, and thus the entire supply side of the economy.

Theoretically, the presence of GVCs could push the slope of the PC either ways. The curve could flatten if, for example, (1) the use of international intermediate inputs is subject to imperfect exchange rate pass-through (Monacelli, 2007) and/or (2) price rigidities accumulate at each step of the production chain Rubbo (2023) and/or (3) the desired markup for domestic producers declines due to strategic complementarity (Sbordone, 2007; Guerrieri et al., 2010) and/or (4a) GVCs increase market power (enhancing the ability to adjust markups). On the other hand, it would result in a steeper PC if, for example, (4b) firms would be pushed in the position of the production network with lower markups (Battiati et al., 2021) and/or (5) the increase in the number of varieties reduces firms' market shares (Benigno and Faia, 2016).

This paper aims at investigating empirically the implications of GVCs for the PC. Focusing both on participation and position within GVCs, we shade light on the importance of these opposing forces. In fact, by analysing the role of participation, we can understand if channels (1), (3), (4a) and (5) are present and which force is stronger. For example, if the PC is flatter for countries more involved in GVCs, this would imply that imperfect exchange rate pass-through, strategic complementarities and higher market power are there and stronger than the potential effect of increased varieties. Moreover, focusing on the country position in GVCs, we can test the presence and strength of mechanisms (2) and (4b). On one hand, economies positioned downward in the production structure (closer to the final good) should have a flatter PC due to accumulating rigidities at each step of the chain Rubbo (2023). On the other hand, downstream firms could have lower markups (as found for France, Germany, Italy and Spain by Battiati et al., 2021), reducing the possibility of limiting fluctuations of prices in response to changes in marginal costs. Therefore, accounting for

[4] Although Luxembourg was among the first countries to join the EMU, we exclude it from our sample for data availability.

the type of participation allows us to understand whether and how these factors influence the elasticity of price setting to marginal costs.

We leverage on recent data on GVCs participation and GVCs position from Mancini et al. (2024). These are GVC-output measures encompassing the chain activities traced in value-added (VA) and final goods, while also accounting for all input exchanges occurring at intermediate stages of production. For our purpose, these measures have clear advantages with respect to standard trade-related indicators. First, GVCs trade-indicators may understate the importance of GVCs for services and upstream manufacturing that do not actively engage in exports. Second, they may overstate GVC relevance in countries or sectors whose exports represent a small share of domestic output.

As Fig. 1 shows, EMU countries exhibit heterogeneous participation and position into GVCs between 1999 and 2020. In Panel (a) of Fig. 1, we plot GVC participation VA-shares across EMU countries. Most countries exhibit a general upward trend with a slight dip around the global financial crisis (2008–2009) followed by a subsequent recovery. Panel (b) shows the GVC position VA-measure, which ranges from −1 (closest to the final good) to +1 (furthest from the final good). This indicator reflects, respectively, whether a country occupies a downstream or upstream position in global value chains. These series highlight the heterogeneity across EMU countries, with core economies like Germany maintaining leadership in upstream roles, while other countries exhibit more modest or mixed patterns in both GVC participation and position. We exploit this cross-country heterogeneity to test whether these two channels affect the PC.

First, we start by augmenting the standard New Keynesian Phillips Curve (NKPC) with these GVC's indicators. We estimate it on core inflation for the EMU11 from 1999 to the Covid-19 crisis. By instrumenting all endogenous variables, like the unemployment gap, with monetary policy shocks, we find that only the participation channel significantly affects the slope of the PC. In particular, higher participation leads to a flatter PC. This result, as mentioned earlier, is in line with the theory on imperfect pass-through, strategic complementarities and increased market power (i.e. channels (1), (3), (4a) seem to be stronger than channel (5)). Through a back-of-the-envelope exercise, we claim that the participation channel accounts for 13% of the flattening of the PC in pre-Covid years. Conversely, we do not find any significant evidence for the GVC position channel. This could be due to the fact that, in this case, there are two opposing forces – (2) and (4b) – which are equally strong and therefore do not allow to find an average effect. However, the negative point estimates suggest that the higher is the position in the GVC, the steeper is the PC. This seems somehow supporting the theory of compounding effect of price stickiness at each step along the production chain.

Our analysis does not stop here and tries to fill a gap in the literature. In fact, previous research on this topic focused just on tradable prices. The motivation for that choice was that those prices should be more effective in revealing the influence of global factors on the domestic economy. Guerrieri et al. (2010), for example, find that foreign competition, by reducing the desired markups of domestic producers, lowers the inflation rate and the slope of the PC for tradable goods, leaving for future research the use of measures of domestic inflation, e.g non-tradable inflation, that could potentially magnify these effects. However, GVCs are increasingly important in the production of non-tradable goods, in particular services. In light of this, we decide to investigate the unexplored role of positioning and participation in GVCs when considering non-tradable inflation.

The focus on non-tradable prices is crucial for several reasons. First, it allows to disentangle the effect of GVCs from openness to trade. In fact, as non-tradables are sold only domestically, the elasticity of their prices to the economic slack can be imputed to changes in marginal costs and their production structure, and not directly to international competition. Second, the surge in demand for services has altered their significance in calculating inflation. In fact, core inflation itself, a critical metric for central bank decisions, is heavily influenced by the prices of services as their importance is increasing.[5] Third, non-tradable prices usually exhibit greater stickiness compared to tradable ones and price rigidity obviously is crucial for the real effects of monetary policy. For example, Altissimo et al. (2005) and Dhyne et al. (2006) find that firms which produce non-tradable goods have more rigid prices. They also provide evidence of downward consumer price stickiness in the services sector, possibly linked to downward wage rigidity. Fourth, non-tradable goods are increasingly important as intermediate inputs in the production of both tradable and non-tradable goods (referred to as "servicification"). Consequently, sticky service prices have a broader impact on the economy through their effect on firms' marginal costs. The "servicification" trend has the potential to further diminish the short-term impact of monetary policy impulses on inflation.

In light of this argument, we estimate a Regional Phillips curve á la Hazell et al. (2022) using non-tradable prices. This has three main advantages also for the empirical identification of the PC: (i) non-tradable prices are more sensitive to regional unemployment than the aggregate core inflation; (ii) inflation expectations can be properly controlled for by using time fixed effects, as we focus on countries sharing the same monetary policy since 1999; (iii) other differences across regions, as long as these differences are constant over time, will be absorbed by country fixed effects.

When considering non-tradable prices, our results are confirmed: participation in GVCs decreases non-tradable prices' reaction to domestic slack, while the position within the GVCs does not play a significant role. Furthermore, we find that participation in GVCs has a negative and significant impact on the level of inflation. Through a back-of-the-envelope calculation, we find that the effect is magnified: GVCs participation accounts up to 32% of the observed flattening of the PC in pre-pandemic years. This exercise allows a strengthening of results by Guerrieri et al. (2010), as we find that foreign competition, by reducing the desired markups of domestic producers, lowers the inflation rate not only for tradable goods but also for non-tradables. This could be due to the broad use of non-tradables in the GVC or to the increasing complementarity between tradables and non-tradables (see Craighead (2024)).

[5] "In the euro area, the weight of services in core inflation has increased by approximately 10 percentage points since the introduction of the single currency in 1999. Similarly, in the United States, services now constitute three-quarters of the core CPI basket" (Coeuré, 2019).

Thereafter, we perform two robustness checks to corroborate our results. First, we exploit the Covid-19 crisis to study how the exogenous variation in GVC participation and position, due to the pandemic shock, has affected the PC in recent years. The pandemic indeed led to a decline in participation of all countries, but resulted in heterogeneous changes in GVC positions. We exploit this variation and confirm previous results: in the post-Covid years, the fall in GVC participation explains 8% of the recent steepening of the PC. GVC position does not play a significant role. Finally, we make sure that GVC participation is not simply capturing openness to trade. In fact, by including both GVC measures and trade openness in the empirical models, our results are confirmed.

For example, in April 2024, the ECB faced a challenging decision regarding whether to begin to decrease policy rates or not. In fact, despite high policy rates and falling headline inflation, core inflation and in particular service prices, were remaining persistently strong. High service inflation is in fact an important indicator of wage dynamics and therefore of labour market tightness. But then, do GVCs increase or decrease the sensitivity of core inflation to the domestic labour market? Does participation in GVCs have a direct impact on non-tradable prices? We believe addressing these questions is crucial for an appropriate monetary policy response.

Our paper is organised as follows. Section 2 presents the literature review. Section 3 introduces the conceptual framework. Section 4 presents data and the empirical analysis. Section 5 concludes.

2. Literature review

This paper relates to three strands of literature. The first one concerns global value chains, documenting the extent of countries' and industries' involvement in GVCs and the nature of their participation. Building on the definition of GVCs proposed by Hummels et al. (2001) – trade must cross at least two country borders – many studies have undertaken the challenging task of assessing the presence of GVCs in trade and output.

We closely follow Borin and Mancini (2015), who provided a quantitative assessment of trade crossing at least two borders, and Borin and Mancini (2023), who proposed a comprehensive methodology for value-added accounting of trade flows at the aggregate, bilateral, and sectoral levels. See Antras and Chor (2022) for a review and critical evaluation of the differences across GVCs indicators.

Our paper also closely relates to the recent literature questioning if GVCs are increasing or decreasing output volatility. The debate concludes that there is no an easy answer as many factors come at play. What matters is the nature of the shock (see Acemoglu et al. (2015) and Carvalho and Tahbaz-Salehi (2019)), the position of the country in the GVCs (Ferrari (2024), Borin et al. (2021)) and the substitutability of factors of production (Barrot and Sauvagnat (2016) and Baqaee and Farhi (2019)). During the recent Covid-19 pandemic crisis, Bonadio et al. (2021) show that lockdowns had worse economic consequences on countries with lower GVC participation, while Berthou and Stumpner (2024) find that GVCs synchronised the business cycle across countries and hence transmitted shocks across borders. More recently, Ascari et al. (2024a) show that shocks to global supply chain pressures were the dominant driver of euro area inflation in 2022, and that these shocks have a highly persistent and hump-shaped impact on inflation. Closely connected to this literature, our paper uses the findings of those studies that cope with shocks propagation in a production network, like for example Boehm et al. (2019), Carvalho et al. (2021), Dhyne et al. (2021) and Rubbo (2023).

The second strand of literature explores the flattening of the PC, employing both empirical and theoretical approaches. On the empirical front, numerous studies on both sides of the Atlantic investigate this phenomenon. In the U.S, according to Blanchard (2016), Murphy (2018), and Powell (2018), the PC remains extant, but its slope started to flatten as early as the 1980s, coinciding with more anchored inflation expectations. Similarly, Hooper et al. (2020), Fitzgerald et al. (2022), and Mavroeidis et al. (2014) support this trend. McLeay and Tenreyro (2020) extend this observation to the state and city levels, noting a stronger correlation between unemployment and inflation in aggregate time series. Del Negro et al. (2020) present evidence suggesting that the flattening began in the 90s, accompanied by a progressive flattening of the aggregate supply curve. Additionally, Beaudry et al. (2024), Portier et al. (2023) show that the PC has been quite flat in the last two decades.

In the European context, Ball and Mazumder (2021), Moretti et al. (2019), Deroose et al. (2017), and Berson et al. (2018) indicate that the PC flattened after the 2008 financial crisis. However, they emphasise that the structural relationship between price dynamics and economic slack variables, including unemployment, persists. In contrast, Giannone et al. (2014) contend that the PC was steeper during the GR, while (Ciccarelli et al., 2017) propose that the disconnect between prices and unemployment emerged after 2012, attributing it to both structural and cyclical factors affecting aggregate demand.

Across both continents, the prevalent explanation for the Phillips Curve flattening is the increased importance of inflation expectations over past inflation in explaining current price dynamics. This shift is attributed to the more firmly anchored inflation expectations by the Fed and the ECB, as evident in works from Roberts (2006) and Bernanke (2007) to Ng et al. (2018) and Hazell et al. (2022) for the U.S. and from Draghi (2015) to Bobeica and Jarociński (2019) for Europe.

Alternative explanations for the flattening delve into structural changes, such as demographic shifts and technological advancements in economic fundamentals (see, among others, Daly et al. (2016), Yoon et al. (2018), Pfajfar and Santoro (2008), and Bruine de Bruin et al. (2010)). Regarding technology, Mincer and Danninger (2000), Jorgenson (2001), Akerlof et al. (1996) and others argue that technological innovation, digitalisation, automation, and ICT contribute to the long-term downward trend in inflation. Additionally, a growing body of literature attributes PC flattening to labour market dynamics and characteristics (see, among others, Ball and Mazumder (2011), Daly and Hobijn (2014), Benigno and Ricci (2011), Faccini and Melosi (2023), Petrosky-Nadeau et al. (2020), Lombardi et al. (2023) and Siena and Zago (2022, 2024)). Real factors have also been shown to play an important role on the slope of the PC. In particular, strategic complementarities in price-setting, arising from firm-specific capital and/or labour (see, among others, Sveen and Weinke (2005, 2007), Altig et al. (2011), Giuli and Tancioni (2012) and Madeira

(2015)) and endogenous demand elasticities (Kimball (1995) and Eichenbaum and Fisher (2007)). Lastly, but strongly connected to our work, there is the literature connecting the slope of the PC to international strategic complementarities and openness. In line with Sbordone (2007), Guerrieri et al. (2010), Benigno and Faia (2016), Guilloux-Nefussi (2020), Lodge et al. (2021) and Hottman and Reyes-Heroles (2024), we show that international forces are important drivers of the slope of the PC. However, differently from them, we show that the crucial driver are GVCs and not only openness to trade. Similar results are found, for the UK, in a recent paper by Aquilante et al. (2024) that shows that higher GVC integration into Emerging Market Economies (only) flattens the PC.

We also refer to a third strand of literature showing the interrelationship between endogenous market structures, strategic interaction and variable markups. Etro and Colciago (2010) show how markups vary counter-cyclically due to entry on competition while Colciago and Rossi (2015) show how strategic interactions among producers lead varying price markups. We borrow from this literature the conceptual framework and extend it to an international setting.

3. Conceptual framework

In this section, we rely on the existing theoretical literature to construct a conceptual framework to guide our empirical analysis of the role of GVCs on the functioning of the supply side of the economy. The presence of GVCs could push the sensitivity of inflation to economic slack (i.e. the slope of the PC) either ways. We identified five main channels in the literature through which GVCs can influence the slope of the PC. While these theories were not originally formulated to explicitly account for GVC participation, their reasoning can be extended to include GVCs. We first explain the five channels in details. Afterwards, we show how using both measures of participation and position within GVCs in the estimation of the PC can help disentangling some of these operative channels.

(1) *Imperfect exchange rate pass-through*. GVCs are backward and forward exchange of intermediate and final goods crossing at least two borders. This implies that transactions in different currencies are at the core of every GVC, even within a monetary union. In fact, each EMU-11 country has different baskets of imports and exports of tradable goods and services, from/to countries which price their products not in euro (Comunale and Kunovac, 2017). But producers are not changing prices at the speed of exchange rate movements, creating the so-called imperfect exchange rate pass-through, which will be different across countries depending on GVC participation and position. This, as shown by Monacelli (2007) for imports, implies that the elasticity of inflation to unemployment depends on the share of GVCs in total consumption/production. In particular, an increase in participation contributes to an increase in real rigidities, as consumers and firms are more subject to imperfect price movements. As a result, the PC flattens as GVCs participation increases. Formally, Monacelli (2007) shows that the Phillips curve has the following form:

$$\pi_t = \beta \mathbb{E}_t \pi_{t+1} + (1-\lambda)(1-\phi)\xi x_t + \chi_t \tag{1}$$

where π_t is consumer price inflation, $E_t\pi_{t+1}$ is inflation expectation, ξ is the slope of the domestic Phillips curve, as in the typical Calvo-Yun model (i.e. $\xi = \frac{(1-\theta\beta)/(1-\theta)}{\theta}$, where θ is the Calvo parameter and β the discount factor), and x_t is a function of the marginal cost. It is easy to see that, in this case, the elasticity of inflation to economic slack $(1-\lambda)(1-\phi)\xi$ depends on λ and ϕ, which are measuring, respectively, the degree of openness in both consumption and production imports. An increase in either λ or ϕ corresponds to a flattening of the PC. Therefore, increase in participation to GVCs should flatten the Phillips curve.

(2) *Compounding rigidities at each step of the production network*. GVCs can be interpreted as production networks where the final product is the outcome of different production steps made across different borders. Rubbo (2023) shows, in a closed economy framework, that production networks have a mitigating effect on the slope of the PC. In economies characterised by multiple sectors and intermediate inputs, the responsiveness of inflation to changes in economic conditions is moderated, due to the compounding of nominal rigidities at each step of the chain. In a GVC context, this theory would imply that countries more downstream should have a PC which is flatter than countries at the beginning of the network (i.e. upstream).

(3) *Strategic complementarities and international competition*. Regarding the competitive environment, economic theory has long recognised (see, for example, Woodford (2003)) that the stronger strategic complementarity (i.e the extent a firm considers the behaviour of other firms in its own decisions.), the weaker the relationship between inflation and the marginal costs (the flatter the PC). Sbordone (2007) shows that increased variety of goods fosters competition, leading to more elastic demand curves and reducing desired mark-ups, setting up a force that would flatten the PC. Also focusing on increased competition, Guerrieri et al. (2010) show that in a New Keynesian model in which firms face an elasticity of demand that depends on its price relative to its competitors, the following PC arises:

$$\pi_t = \beta \mathbb{E}_t \pi_{t+1} + \xi \left[(1-\Psi)x_t + \Psi\phi p_{M,t}\right] \tag{2}$$

where $p_{M,t}$ represents import prices relative to domestic prices. Therefore, $\xi * (1-\Psi)$ is the response of inflation to fluctuations in marginal costs and Ψ controls the variations of the desired markups (i.e. the strategic response of firms) in response to increased international competition. A higher value of Ψ has a double effect: it reduces the sensitivity to real marginal costs, while it raises the reaction of domestic prices to import prices. The rise in foreign competition, which lowers import prices, diminishes the desired markups of domestic producers, thereby exerting downward pressure on the inflation rate for domestic goods. Participation to GVCs can be seen as a measure of domestic firm openness and exposure to foreign competition. Therefore, following Guerrieri et al. (2010), increased GVC participation should be associated with lower inflation levels and a flatter PC.

(4) *Market power and network structure*. This channel focuses on how international openness affects firms' network and market structures. Specifically, depending on whether GVCs favour larger, more productive firms over smaller, less productive ones or

viceversa, market power – and therefore markups – can be affected by the presence of GVCs. Participation in GVCs is shown to increase average markups for firms in advanced economies (while the opposite is true in developing economies), as highlighted in the World Development Report 2020. This would suggest that higher participation flattens the PC (channel 4a). However, Ascari et al. (2024b) further show that market power depends on a firm's positioning within GVCs, with significantly different implications across countries. Focusing on France, Germany, Italy, and Spain (a subset of our countries), Battiati et al. (2021) find that, in Europe – unlike in the US – markups are negatively correlated with GVC backward participation. Consequently, among the EMU-11 countries, downstream participants should exhibit a steeper PC, as their price elasticity to marginal cost would be higher (channel 4b).

(5) *Price elasticity and markups*. Increasing the variety of goods available affects the price elasticity of the demand for both final and intermediate goods. As shown by Benigno and Faia (2016) and Guilloux-Nefussi (2020), firms internalise their influence on the sectoral output when setting their optimal plans. Therefore, the price-elasticity of demand plays a crucial role as it determines the desired markup, which is a function of the market share. Larger variety of goods can result in lower market share (Benigno and Faia, 2016). Therefore, firms become less prone to absorb marginal cost shocks by decreasing their desired markup, implying higher sensitivity of price adjustment to changes in marginal cost. As a result, GVCs, by introducing more varieties of final and domestic goods can steepen the PC.

Summarising, the effect of GVCs on the slope of the PC is ultimately an empirical question. Using theory to guide the empirical analysis, we are going to use both participation and position within GVCs to shade light on the relative importance of the above mechanisms. Analysing the role of participation, we can understand if any combination of channels (1), (3), (4a) – which push towards a flattening of the PC – is stronger than the effect of channel (5) — which would imply a steeper PC. Turning to the role of country position in GVCs, we can test the presence and strength of channels (2) and (4b), affecting the slope in opposite ways.[6]

4. Empirical analysis

4.1. Data

Our focus is on the first eleven countries joining the European Monetary Union from the introduction of the single currency in 1999 (EMU11): Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain.[7] Focusing on EMU11 countries from 1999q1 onwards allows the estimation of the PC over the longest time-span. This alleviates concerns about inflation expectations, as all countries are subject to the same monetary policy ruled by a common central bank with a specific and common mandate on inflation.

Data come from five main sources. The series for participation and position in GVCs come from Mancini et al. (2024) and are available at yearly frequency. We mainly focus on measures related to output and not only trade. This is to properly account for all the activities within the global supply network, even those corresponding to non-tradable goods such as services. As explained in Borin et al. (2021), "looking only at GVC trade understates the actual extent of GVCs by around US$10 trillion, as GVC trade amounts to about $10 trillion, while GVC output to about $20 trillion". We express the participation of a country to the GVC as the share of gross output depending on connections with more than one country. Borin et al. (2021) provides also a measure of position in GVCs. Through a score ranging from −1 to +1, this measure tells whether a country is overall located at the bottom (−1) or at the top of the GVC (+1). Being at the bottom (top) of the GVC means that a country is fully dependent (independent) on all passages and transformation of intermediary goods through the GVC. Both GVC measures are available only at yearly frequency between 1995 and 2020.

We use quarterly unemployment data for the population aged 15-75 from the OECD Data Warehouse. The natural level of unemployment (NAIRU) is taken from the most recent OECD Economic Outlook, for which these data are available (May 2021). We use the NAIRU and the rate of unemployment to construct the quarterly unemployment gap. We use the Eurostat data to build country-specific quarterly series of core inflation, i.e. the year-on-year percentage change in the Consumer Price Index (CPI), energy and food prices excluded. Using data from the ECB Data Warehouse, we construct a series for non-tradable inflation. Following Siena (2021), we calculate this series as the year-on-year change in the GDP deflator for non-tradable sectors. Additionally, we derive relative non-tradable prices from the same source. We consider these series from 1999q1 up to 2023q4. Finally, we use data from the ECB Survey of Professional Forecasters that provides information on expected CPI inflation by country. All series are at quarterly frequency. Appendix B reports details on the construction of each variable along with figures for all series and countries in the sample.

[6] For example, regarding participation, if the PC is flatter for countries more deeply involved in GVCs, this would suggest that imperfect pass-through and/or strategic complementarities and/or increased market power are there and stronger than the potential effect of increased varieties. On the other hand, when considering position, while economies positioned downward in the production process (closer to the final good) should have a flatter PC due to the accumulation of rigidities at each step of the chain, firms positioned downward could have lower markups, which could increase the elasticity of prices to changes in marginal costs.

[7] For data availability and reliability, we exclude Luxembourg.

4.2. Participation and position in GVC across EMU countries

Fig. 1, Panel (a) shows that all eleven EMU members participated in GVCs between 1999 and 2020, albeit with significant heterogeneity in both levels and evolutions of participation across countries. For instance, in 1999, Greece had the lowest percentage (7.46%) of GVCs value-added shares embedded in each unit of gross output produced. On the other hand, Belgium and Ireland had the highest observed participation (24%) in the same period. All countries experienced a positive increase in participation over time, particularly pronounced for Greece and Ireland. Moreover, almost all countries experienced two major slowdowns. The first one occurred during and just after the Great Recession. As discussed in Cigna et al. (2022), the speed of growth in GVC participation has slowed in post-recession years partly due to the increase in low GVCs sectors, such as construction and services. However, in Europe GVCs have retained a strong regional dimension, as illustrated in Fig. 1. The second decline in GVCs participation occurred in 2020, when the Covid-19 pandemic hit Europe.[8]

Fig. 1, Panel (b) plots the evolution of the position of each EMU11 country in GVCs. Here, heterogeneity in levels and dynamics is even more marked. For example, Portugal, Spain and Greece moved upstream in the GVC between 1999 and 2020. Conversely, other countries, such as Ireland and Finland, have moved downstream in their position within GVCs. The position of all other countries remained roughly the same, despite fluctuations over time around the same initial level.

In the next sections, we are going to exploit this heterogeneity to account for the role of GVCs on the slope of the PC. In particular, first we are going to use both series of GVC participation and position to study whether they contributed effectively to changes in the slope of the PC in the long run, i.e. until the Covid-19 Crisis. We will then leverage the Covid-19 shock as a natural experiment to investigate how recent shifts in the PC dynamics can be explained by variations in GVC participation and position resulting from the global pandemic shock. Finally, in the last sub-section, we check that the measures of GVC participation are not simply capturing openness to trade.

4.3. The slope of the phillips curve and GVC

Do participation and position in GVCs matter for the relationship between price dynamics and unemployment? In order to check this point, we start by plotting the cross-country correlation between the slope of the Stock and Watson PC and the mean value of GVC participation and position. The slope of the Stock and Watson PC is estimated for each country over the 1999q1-2019q4 window (see Appendix A for details).[9] The country specific mean-level of GVC participation and position are calculated over the same periods.

Panel (a) in Fig. 2 shows a positive correlation between the slope of the PC and the average level in participation to the GVC. In other words, countries with higher contribution of the GVC to their home-production are the same with a flatter PC. This first-hand evidence is consistent with all the theories showing that an increase in GVCs participation flattens the PC (see Section 3). On the other hand, Panel (b) in Fig. 2 shows that there is a negative correlation between the slope and the (average) position of a country within the GVC. That is, countries at the top (bottom) of the GVC exhibit a steeper (flatter) PC. This evidence is more in line with theories suggesting that a change in the supply structure depends on the position in the production network.

Yet, it is important to move from correlations to a causal analysis in order to assess to which extent the two dimensions of the GVC (participation vs. position) matter for the PC. This is an empirical challenge as there are several sources of endogeneity. First, the estimates of the PC could be biased as there are factors that can influence both unemployment and inflation at the same time (e.g. supply shocks). Second, there are other long-run and structural factors that might have influenced the slope of the PC and GVCs contemporaneously such that their relationship is spurious.

4.4. GVCs participation vs. Position

This section exploits the cross-country variation in the participation and position in GVCs to test whether these are important determinants of the slope of the PC. We use the New Keynesian Framework to study if GVCs affect the PC as predicted by the theory. By estimating an augmented New Keynesian Phillips Curve (NKPC) for core inflation and using both GVC position and participation measures, we can test which theoretical channel matters the most for the recent observed dynamics of the PC.

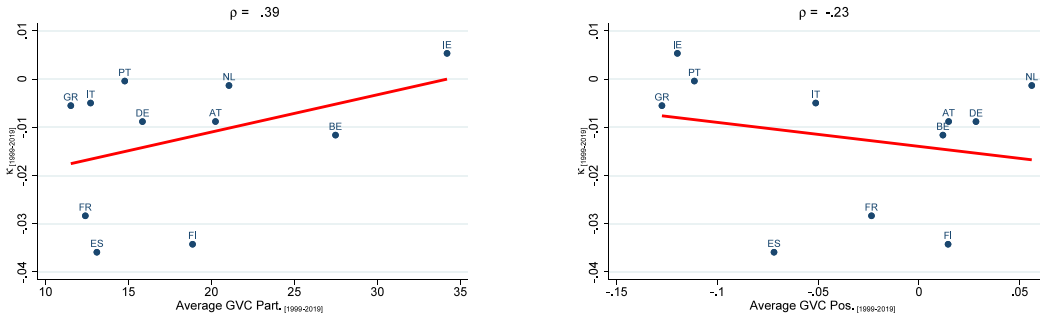
Thereafter, we follow the most recent developments in the empirical literature on the PC estimation and consider the regional framework á la Hazell et al. (2022), using non-tradable inflation. This exercise not only helps corroborate our results, but also shows the importance of GVCs for non-tradable price dynamics, an intuition that has been suggested but not explored in Guerrieri et al. (2010).

Both analysis are conducted initially for periods before the Covid-19 Crisis. In particular, given different variable definitions across the empirical models, for consistency between the New Keynesian and the regional PC estimation, we consider observations from 2002q1 up to 2018q4. Later on, we extend the sample and use the pandemic as a natural experiment to validate our results and rationalise recent PC dynamics.

To conclude the analysis, we do some robustness checks. The most important is to assure that our GVC participation measure is not simply capturing trade openness.

[8] This, as showed by Ascari et al. (2024b), was also due to strong sectoral reallocation and GVCs restructuring.

[9] Building on Stock and Watson (2019), for each country we estimate the following model: $\Delta\pi_{i,t}^{Core} = \alpha + \kappa_i \hat{u}_{i,t} + \varepsilon_{i,t}$, where the $\Delta\pi_{i,t}^{Core}$ is the difference between the moving average of core inflation measured between t and $t-3$ and the moving average of core inflation measured between $t-4$ and $t-7$. α is the constant term. $\hat{u}_{i,t}$ in the percentage deviation of the moving average of unemployment, measured between t and $t-3$, and the NAIRU. See Appendix A for details.



(a) GVC Participation (b) GVC Position

Fig. 2. Global Value Chain and the Phillips Curve.
Note: Figure (a) plots the mean GVC participation index over the slope of the Stock and Watson Phillips Curve. In Figure (b), the mean GVC position index is on the x-axis.

4.4.1. *Core inflation - The New Keynesian framework*

Empirical model. Consider the following augmented NKPC:

$$\begin{aligned}\pi_{i,t}^{Core} &= \alpha_i + \kappa\hat{u}_{i,t} + \gamma_1\mathbb{E}(\pi_{i,t+4}) + X'_{i,t}\gamma_2 \\ &+ \sum_{j=\{part.,pos.\}} \left\{\kappa_j\hat{u}_{i,t}GVC^{j}_{i,t-4} + \delta_j GVC^{j}_{i,t-4}\right\} \\ &+ \kappa_{GR}\hat{u}_{i,t} \times After_{GR} + \delta_{GR}After_{GR} + \varepsilon_{i,t}\end{aligned} \tag{3}$$

where $\pi_{i,t}^{Core}$ is the year-on-year core inflation observed in country i at time t; α_i is the country i fixed-effect; $\hat{u}_{i,t}$ is the unemployment gap, i.e. the percentage deviation of unemployment from the NAIRU; $\mathbb{E}(\pi_{i,t+4})$ is the level of inflation expected in country i one year from now; $X_{i,t}$ controls for the country-specific import price index, a dummy variable indicating whether the country i is in a business cycle phase of expansion or recession,[10] and a year dummy to net out other potential contemporaneous and common event affecting our country-specific GVCs measures (expressed at early frequency).[11] $GVC^{part.}_{i,t-4}$ expresses to which extent a country participates to GVCs, i.e. the share of value-added created through global supply chains. We consider the 4th lag of this variable to reduce endogeneity. Similarly, $GVC^{pos.}_{i,t-4}$ captures the top-vs.-bottom position of the country in the GVC and it is expressed as a score ranging between -1 and $+1$. $After_{GR}$ is a dummy taking value one for periods after the GR, according to CEPR business cycle dates. $\varepsilon_{i,t}$ is the error term.

In words, the first line of Eq. (3) is the baseline NKPC; the second line takes into account the role of GVCs participation and position both for the slope of the PC and the level of inflation; the third line controls for recent dynamics in the PC following the GR as done in Siena and Zago (2024), i.e. we control for a structural break in the slope of the PC in post-recession years. In light of this, we use the augmented PC of Eq. (3) to test whether GVC participation and position matter for the slope of the PC and how. Formally, we want to test

$$H_0 : \kappa_j = 0, \quad \forall j = \{part., pos.\}.$$

However, this hypothesis cannot be tested using Ordinary Least Square (OLS). In fact, these estimates would be biased as supply shocks can contemporaneously affect the unemployment gap, inflation and inflation expectations. Therefore, all unemployment gaps and their interactions, as well as inflation expectations should be instrumented. For the unemployment gap and all its interactions, we use aggregate off-the-shelf high-frequency monetary policy shocks for the Euro Area (mps_t) from Altavilla et al. (2019). In this paper, monetary policy surprises are identified as exogenous/unexpected changes in the 3-month Overnight Index Swap that occur during the monetary policy communication window. We select those shocks that are not correlated with the stock market to separate them from information shocks (see Jarociński and Karadi, 2020). We sum these shocks at quarterly frequency and use mps_{t-k}, $mps_{t-k} \times After_{i,c}$, $mps_{t-k} \times GVC^{j}_{i,t-4}$, for $j \in \{part., pos.\}$ and $k \in \{2, \dots, 6\}$ as instruments for the unemployment gap and all its interaction terms. On the other hand, we instrument country-specific inflation expectations with the lag of the aggregate inflation expectations for the EMU11 (i.e. the average of lagged inflation expectations across countries). The fact that these instruments are common across all countries and that the MP surprises are quarterly aggregation of high frequency shocks could potentially be a threat for our identification. Despite this, these instruments are sufficiently relevant (Wald F-stat = 14.50) and valid (Sargan-Hansen statistic = 7.10; p-value = 0.96)[12] Moreover, under this specification, the model does not exhibit cross-sectional dependence[13].

[10] Following Siena and Zago (2024), we use CEPR business cycle dates to identify the expansion before the GR, the GR, the expansion following the GR but before the Sovereign Debt Crisis (SDC), the SDC and periods after the SDC.

[11] Yearly GVC data is merged with quarterly data without any interpolation, i.e. GVC measures take the same value for four consecutive quarters within the same year and country. Using interpolation methods to transform the GVC measures from yearly to quarterly does not significantly affect the results of our

Table 1
The New Keynesian Phillips Curve and GVCs.

	(1) π^{Core}	(2) π^{Core}	(3) π^{Core}	(4) π^{Core}	(5) π^{Core}
$\hat{u}$	−0.0081**	−0.0321***	−0.0075	−0.0544**	−0.0605***
	(0.0035)	(0.0070)	(0.0118)	(0.0216)	(0.0220)
$\hat{u} \times GVC_{part.}$		0.0007***		0.0007***	0.0005**
		(0.0002)		(0.0002)	(0.0002)
$GVC_{part.}$		−0.0203		−0.0569	0.0340
		(0.0198)		(0.0416)	(0.0699)
$\hat{u} \times GVC_{pos.}$			0.0109	−0.1982	−0.0570
			(0.0984)	(0.1543)	(0.1777)
$GVC_{pos.}$			−0.7755	−1.9539	−6.0901*
			(1.0748)	(1.7852)	(3.1181)
Observations	748	748	748	748	748
Country Fe	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Post-GR break	No	No	No	No	Yes
Time Fe	No	No	No	No	No
IV	MP	MP	MP	MP	MP

Note: The variable of interest in column (1)–(5) is core inflation measured as the year-on-year change in CPI inflation (energy and food excluded). $\hat{u}$ is the percentage deviation of unemployment from the NAIRU. $GVC^{part.}$ is the share of gross output depending on connections with more than one country. $GVC^{pos.}$ is an index ranging from −1 to +1 and it expresses respectively whether a country is at the bottom or at the top of the GVC. The sample is composed of all countries that joined the EMU before 2002 (Luxembourg excluded). Data is quarterly and spans from 2002q1 until 2018q4. Standard errors in parentheses. *, **, *** indicate significance at 90%, 95% and 99%.

Results. Table 1 shows two-stage least-square estimates of model (3). As shown in column (1), we find that the PC has overall a small negative slope equal to −0.008. When controlling for the role of GVC participation in column (2), the curve is instead steeper (−0.03). However, the estimate $\kappa_{part.}$ for the interaction term $\hat{u} \times GVC^{part.}$ is positive and significant. In other words, countries with higher participation in the GVC exhibit a flatter NKPC. In column (3), we control for the role of $GVC^{pos.}$ alone. The point estimate of the slope of the PC is now closer to that found in column (1), while GVC position surprisingly has a positive effect on the slope. Yet, all estimates are not significantly different from zero, suggesting that not only does GVC position play no role, but the inclusion of this control also increases the standard errors for the estimate of the slope estimate.[14] In column (4), we control for both GVC participation and position. Now, the estimate of the slope κ is significantly different from zero and slightly bigger than what found in column (2). The estimate of $\kappa_{part.}$ remains significant and unchanged with respect to what previously found. Despite the fact that now the estimate of $\kappa_{pos.}$ is negative, there is again no significant evidence that the GVC position matters for the slope of the PC. In column (5), we control for the post-GR structural break in the slope of the PC, as documented in Siena and Zago (2024). Under this further check, the results remain (roughly) unchanged.

In light of this evidence, we can derive two conclusions. First, (1) imperfect exchange rate pass-through and/or (2) strategic complementarities and/or (4a) higher market power are stronger than the potential effect of (5) increased varieties. Second, as positioning does not statistically affect the slope of the PC, we can either conclude that countries upward and downward behave similarly, or, more likely, that the two opposing forces (i.e. (3) more compounding rigidities (Rubbo, 2023) and (4b) lower markups as we go downstream Battiati et al. (2021)) offset each other. Further analysis, using sectoral decompositions, could shed more light on the role of GVCs positioning.

To conclude, only participation matters for the slope of the New Keynesian PC. In particular, according to the estimates of column (5), as the average value for $GVC_{part.}$ is 18% (see Appendix B.1), participation in the GVC accounts for $(18.7 * 0.0005/(0.0605 + 18.7 * 0.0005)) \approx 13\%$ of the flattening of the PC witnessed in the pre-Covid years.

4.4.2. Non-tradable inflation - The regional framework

By focusing only on tradable prices, Guerrieri et al. (2010) present empirical evidence of the flattening of the U.S. PC as the share of imports increases. In the previous section, we extended this analysis to EMU11 countries and found a significant role of GVCs in affecting also core inflation, a broader measure that also includes non-tradable prices. Here, we further develop this finding. We explore whether our results hold true when we only use non-tradable prices, which are generally considered to be primarily influenced by domestic factors. However, GVCs are increasingly important in the production of non-tradable goods, in particular

empirical analysis.

[12] See Appendix C for first-stage statistics.

[13] The average cross-sectional correlation of the error (across panel groups) is small (0.16) and the Frees statistic is below the critical value, i.e. $0.27 < Q_{0.01} \approx Z_{0.01}$. In other words, we cannot reject the null hypothesis of crossectional independence (see De Hoyos and Sarafidis (2006)).

[14] In presence of supply shocks in specific sectors, a bad position over the GVC can reflect into price and inflation dynamics in a way that local conditions may result less statistically relevant for inflation.

services. In light of this, we decide to investigate the unexplored role of positioning and participation in GVCs when considering non-tradable inflation. Additionally, focusing on non-tradable prices allows to better disentangle the effect of GVCs from openness to trade. In fact, as non-tradables are sold only domestically (but use also tradable goods as intermediate inputs), the elasticity of their prices to the economic slack can be imputed to changes in marginal costs and their production structure, and not directly to international competition.

Empirical model. We follow the most recent developments in the literature and consider the regional PC of Hazell et al. (2022) using non-tradable prices, applied to the euro area as in Siena and Zago (2024). Estimating a regional PC has several advantages: (i) using non-tradable (NT) prices reduces the bias due to inflationary spillovers from one country to another; (ii) variation in long-run inflation expectations (due to the behaviour of the central bank) can be controlled for by using time fixed effects; (iii) other differences across regions, as long as these differences are constant over time, will be absorbed by country fixed effects. Given this empirical setup, we augment the baseline regional PC as discussed in the previous section. Formally, we consider the following equation:

$$\begin{aligned}\pi^{NT}_{i,t} &= \alpha_i + \xi_t + \kappa \hat{u}_{i,t} + \gamma_1 \overline{p}^{NT}_{i,t} + X'_{i,t}\gamma_2 \\ &+ \sum_{j=\{part.,pos.\}} \left\{ \kappa_j \hat{u}_{i,t} GVC^{j}_{i,t-4} + \delta_j GVC^{j}_{i,t-4} \right\} \\ &+ \kappa_{GR} \hat{u}_{i,t} \times After_{GR} + \delta_{GR} After_{GR} + \varepsilon_{i,t} \end{aligned} \tag{4}$$

where $\pi^{NT}_{i,t}$ is non-tradable inflation in country i at time t, measured as the year-on-year percentage change of the GDP deflator for non-tradable sectors (see Siena, 2021). ξ_t is the time fixed effect, which captures common changes in monetary policy across EMU members (see Hazell et al., 2022). Following Hazell et al. (2022), now $\hat{u}_{i,t}$ is the discounted sum of 4-quarter of future unemployment in deviation from its long-run equilibrium level (NAIRU), and $p^{NT}_{i,T}$ is the 4-quarter discounted sum of future levels of non-tradable prices (relative to the overall price level). All the rest is the same as defined for the NKPC with the exception of $X_{i,t}$ which does not include import prices.

Also in this case, we cannot use OLS for estimation. Hence, we rely on internal instrumental variables (IVs). In particular, we use $\hat{u}_{i,t-4}$, $\hat{u}_{i,t-4} \times GVC^{j}_{i,t-4}$ and $\hat{u}_{i,t-4} \times After_{GR}$ as instruments for the unemployment gap and all its interaction terms. On the other hand, we instrument country-specific relative non-tradable prices with their fourth lag ($\overline{p}^{NT}_{i,t-4}$). This set of instrument results to be relevant (Wald F-stat = 47.34)[15] and, under this specification, the model does not exhibit cross-sectional dependence.[16]

Results. In column (1) of Table 2, we present the results from the regional PC. The slope is negative, relatively small (−0.012) and significant. In column (2), we control for the role of GVC participation both on the level of inflation and, more importantly, on the slope of the PC. Also in this case we find that the slope is larger (−0.028), and GVC participation plays a significant role in the flattening of the PC. In column (3) we control for GVC position alone. Differently from the corresponding results for the NKPC, in this case the slope of the PC is significant whereas the point estimate of $\kappa_{pos.}$ is negative and not significant. When controlling for GVC participation and position at the same time, we confirm that position in the GVC does not play any significant role whereas participation does. When controlling for a structural break in the PC in post-GR (column (5)), results do not change. Differently from the case with core inflation, when we use NT prices, participation in GVCs has always a negative and significant impact on the level of inflation: for every level of unemployment the PC shifts downwards.

Also in this set-up, our results are in line with theories (see Section 3) of imperfect pass-through, strategic complementarities and increased market power: the more a country is integrated in the GVC, the flatter is its PC. According to the estimates of column (5), the contribution of this channel to the pre-pandemic flattening of the PC is $18.7 * 0.0008/(0.032 + 18.7 * 0.0008) \approx 32\%$. Positioning, on the other hand, does not statistically affect the slope of the PC. As mentioned in the previous paragraph, this could well be due to equally strong opposing forces, cancelling the average effect.

As sensed in Guerrieri et al. (2010), using non-tradable inflation indeed magnifies the effect of participation in the GVCs on the slope of the PC. The intuition behind this is that non-tradable prices usually exhibit greater stickiness compared to tradable ones, for two reasons. Firstly, firms producing non-tradable goods employ higher shares of labour than those producing tradable goods, leading to more rigid pricing structures (see Altissimo et al. (2006), Alvarez and Shimer (2011), Dhyne et al. (2021)). Secondly, the lower level of competition for non-tradable goods may enable service firms to adjust their prices less frequently.

This result reinforces the findings of Guerrieri et al. (2010) as GVCs contribute to making inflation more rigid not only for tradable goods but also for the typically more rigid non-tradable goods. This could be due to the broader use of non-tradables in the GVC or to the increasing complementarity between tradables and non-tradables (see Craighead, 2024).

In Appendix D.1, we verify that these results hold also when using other measures of positioning in GVCs. Following Antràs et al. (2012), Fally (2012) and Antràs and Chor (2013), we consider two standard indexes computed using the inter-country input output tables: upstreamness and downstreamness. The former measures the distance of a country's production from the final demand. The farther a country is positioned within a GVC from final use, the higher its indicator will be. On the other hand, downstreamess of a country measures the distance of the country from the factors of production. We use these measures from 1999 to 2020 applied

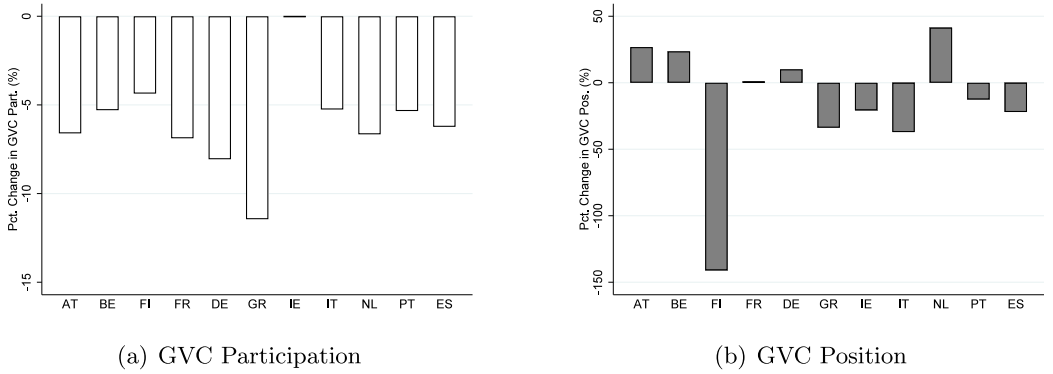
[15] See Appendix C for first-stage statistics.

[16] The average cross-sectional correlation of the error (across panel groups) is small (0.25) and the Frees statistic is below the critical value, i.e. $0.79 < Q_{0.01} \approx Z_{0.01}$. In other words, we cannot reject the null hypothesis of cross-sectional independence (see De Hoyos and Sarafidis (2006)).

Table 2
The Regional Phillips Curve and GVCs.

	(1) π^{NT}	(2) π^{NT}	(3) π^{NT}	(4) π^{NT}	(5) π^{NT}
$\hat{u}$	−0.0120***	−0.0281***	−0.0189***	−0.0334***	−0.0319**
	(0.0038)	(0.0040)	(0.0048)	(0.0096)	(0.0133)
$\hat{u} \times GVC_{part.}$		0.0009***		0.0008***	0.0008***
		(0.0001)		(0.0002)	(0.0002)
$GVC_{part.}$		−0.5249**		−0.5810**	−0.6076**
		(0.2504)		(0.2947)	(0.2867)
$\hat{u} \times GVC_{pos.}$			−0.0707	−0.0531	−0.0557
			(0.0617)	(0.0592)	(0.0563)
$GVC_{pos.}$			12.9549	15.4676	17.2247
			(18.6807)	(20.2432)	(20.8298)
Observations	748	748	748	748	748
Country Fe	Yes	Yes	Yes	Yes	yes
Controls	Yes	Yes	Yes	Yes	Yes
Post-GR break	No	No	No	no	Yes
Time Fe	Yes	Yes	Yes	Yes	Yes
IV	Int.	Int.	Int.	Int.	Int.

Note: The variable of interest in column (1)-to-(5) is non-tradable inflation measured as the year-on-year percentage change of non-tradable prices. $\hat{u}$ is the 4-quarters discounted sum of future unemployment in deviation from the NAIRU. $GVC^{part.}$ is the share of gross output depending on connections with more than one country. $GVC^{pos.}$ is an index ranging from −1 to +1 and it expresses respectively whether a country is at the bottom or at the top of the GVC. The sample is composed of all countries that joined the EMU before 2002 (Luxembourg excluded). Data is quarterly and spans from 2002q1 until 2018q4. Standard errors in parentheses are clustered at country-level. *, **, *** indicate significance at 90%, 95% and 99%.



(a) GVC Participation (b) GVC Position

Fig. 3. Change in GVC Participation and Position due do Covid-19.
Note: Panel (a) plots the percentage change in GVC participation between 2019 and 2020, i.e. the year of the Covid-19 recession according to CEPR business cycle dates. GVC participation is measured as the share of gross output depending on connections with more than one country. Similarly, Panel (b) plots the percentage change in GVC position between 2019 and 2020. This measure ranges from −1 to +1 and expresses respectively whether a country is at the bottom or at the top of the GVC.

to the OECD TiVA Input-Output tables, as in Mancini et al. (2024). We find that all our results are robust when using these two alternative indicators of positioning. Only participation matters for the slope of the Phillips Curve. As a further robustness check, in Appendix D.2 we follow Bernardini et al. (2020) and control if our results hold true also when considering the effect of recent local recessions and their implications for the slope of the PC and level of inflation. In this case as well, the effect of GVC participation on the slope remains. Finally, in Appendix D.3 we re-estimate Eq. (3) with producer price inflation as dependent variable. This is an important exercise as ultimately GVCs affect the competitiveness and price adjustments of producers. Hence, if our evidence holds for core inflation and non-tradable inflation, it should be true also when considering producer price inflation as dependent variable. This is the case: only GVCs participation matters for the slope of the PC and leads to flattening; on the other hand, GVC position does not have any significant effect.

4.5. Covid-19 as a shock to GVCs

Here we exploit the Covid-19 crisis to study how exogenous variations in our GVC measures influence the PC in post-pandemic periods. To do so, first we build the percentage change in $GVC^{part.}$ and $GVC^{pos.}$ between the end of 2019 and the end of 2020. Panel (a) of Fig. 3 shows that all countries experienced a decline in GVC participation, as the Covid-19 pandemic and the following social and work restrictions led to the collapse of the GVC through interruption of production, trade, etc. The average decline in

Table 3
The Covid-19 GVC shock and the PC.

	(1) π^{NT}
$\hat{u}$	−0.0104***
	(0.0011)
$\hat{u} \times After_{covid} \times \Delta GVC_{part.}$	0.0144**
	(0.0067)
$After_{covid} \times \Delta GVC_{part.}$	−3.3756**
	(1.5153)
$\hat{u} \times After_{covid} \times \Delta GVC_{pos.}$	−0.0003
	(0.0003)
$After_{covid} \times \Delta GVC_{pos.}$	0.0910
	(0.0864)
Observations	924
Country Fe	Yes
Controls	Yes
Post-GR break	Yes
Time Fe	Yes
IV	Int.

Note: In column (1), the variable of interest is non-tradable inflation. $\Delta GVC^{part.}$ is the percentage change of $GVC^{part.}$ between 2019 and 2020, i.e. the year of the Covid-19 recession according to CEPR business cycle dates. $GVC^{part.}$ is the share of gross output depending on connections with more than one country. $\Delta GVC^{pos.}$ is the percentage change of $GVC^{pos.}$ between 2019 and 2020. $GVC^{pos.}$ is an index ranging from −1 to +1 and it expresses respectively whether a country is at the bottom or at the top of the GVC. The sample is composed of all countries that joined the EMU before 2002 (Luxembourg excluded). Data is quarterly and spans from 2002q1 until 2022q4. Standard errors in parentheses. *, **, *** indicate significance at 90%, 95% and 99%.

participation due to the pandemic shock is −5.5%,[17] with Ireland experiencing the smallest change while Greece the largest. On the other hand, the effect of the pandemic shock on the country position in the GVC is more heterogeneous. As plotted in Fig. 3, Panel (b), countries like Austria, Belgium, Germany and the Netherlands experienced an upstream movement in the GVC, whereas all the other countries moved downstream. The average change in position is -13%, with Finland being the country that moved downstream the most, while the Netherlands being the one that moved upstream the most.

Once endowed with these exogenous changes, we can use them to understand to which extent countries experiencing larger variation in participation and position during the Covid-19 crisis also witnessed changes in the PC and in which direction.

Here we estimate only the Regional Phillips Curve.[18] Our specification now is:

$$\pi_{i,t}^{NT} = \alpha_i + \xi_t + \kappa \hat{u}_{i,t} + \gamma_1 \overline{p}_{i,t}^{NT} + \sum_{j=\{part.,pos.\}} \left\{ \kappa_j \Delta GVC_{i,Covid}^{j} \times After_{Covid} \times \hat{u}_{i,t} \right\} + \kappa_{GR} After_{Covid} \times \hat{u}_{i,t} + \delta_{GR} After_{Covid} + \varepsilon_{i,t} \quad (5)$$

where the novelty is the variable $After_{Covid}$, which takes value one for periods after the Covid-19 recession according to CEPR business cycle dates. In other words, this model studies how the changes in participation and position in the GVCs due to the Covid-19 shock affect the post-Covid slope of the PC, once netting out other potential sources of structural change in the relationship between unemployment and inflation. Variables and instruments are defined as in Section 4.4.2.[19] The analysis now also covers the period 2020–2022.

As Table 3 shows, coherently with the results of Section 4.4.2, also in this case we find that the pre-Covid slope is very small. Once again, only participation in GVC matters for the recent change in slope, with $\kappa_{part.}$ being positive and significant. Conversely, although negative, $\kappa_{pos.}$ is not significant.

Doing the same back-of-the-envelope calculation as before, we find that –for the average decline in participation equal to 6.1% (see Appendix B.2)– the participation channel accounts for $0.061 * 0.0144/(0.0104 + 0.061 * 0.0144) \approx 8\%$ of the recent steepening of the PC. To sum up, by exploiting the Covid-19 pandemic, we confirm the results from the previous section: the GVC participation

[17] See Appendix B.2 for summary statistics.

[18] This is due to the fact that, with only 12 quarters of observations available after the beginning of the pandemic, the instrumentation of the NKPC with core inflation results weak.

[19] See Appendix C for first stage statistics.

Table 4
Openness to Trade and GVCs in the NKPC with core inflation.

	(1) π^{NT}	(2) π^{NT}	(3) π^{NT}	(4) π^{NT}
$\hat{u}$	−0.0339**	−0.0321**	−0.0288**	−0.0248**
	(0.0135)	(0.0143)	(0.0120)	(0.0123)
$\hat{u} \times GVC_{part.}$	0.0018***	0.0009***	0.0018**	
	(0.0006)	(0.0002)	(0.0007)	
$GVC_{part.}$	−0.8525***	−0.5931**	−0.7826***	
	(0.2418)	(0.2987)	(0.2524)	
$\hat{u} \times GVC_{pos.}$	−0.0525	−0.0504		−0.0246
	(0.0516)	(0.0559)		(0.0440)
$GVC_{pos.}$	17.6976	17.3126		8.4888
	(20.1517)	(21.8408)		(15.5116)
$\hat{u} \times Openness$	−0.0002		−0.0002	0.0001***
	(0.0001)		(0.0001)	(0.0000)
$Openness$	0.0386	−0.0203	0.0479	−0.0823*
	(0.0488)	(0.0293)	(0.0464)	(0.0468)
Observations	748	748	748	748
Country Fe	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Post-GR break	Yes	Yes	Yes	Yes
Time Fe	Yes	Yes	Yes	Yes
IV	Int.	Int.	Int.	Int.

Note: The variable of interest in column (1)-to-(4) is respectively core inflation. $\hat{u}$ is the percentage deviation of the unemployment rate from the NAIRU. $GVC^{part.}$ is the share of gross output depending on connections with more than one country. $GVC^{pos.}$ is an index ranging from −1 to +1 and it expresses respectively whether a country is at the bottom or at the top of the GVC. $Openness$ is the sum of imports and exports divided by GDP. The sample is composed of all countries that joined the EMU before 2002 (Luxembourg excluded). Data is quarterly and spans from 2002q1 until 2018q4. Standard errors in parentheses. *, **, *** indicate significance at 90%, 95% and 99%.

channel is important for the slope of the PC and it contributes to its flattening. On the other hand, GVC position does not play a significant role. These results are in line with the recent literature. For example, Ari et al. (2023) document both the flattening of the Phillips curve in recent decades and post-Covid signs of its steepening. Using sectoral data from 24 advanced economies in Europe, they find, in line with Alfonso C et al. (2021), that the acceleration of e-commerce during the pandemic may have raised price flexibility. Additionally, they suggest that de-globalisation may have made inflation more responsive to domestic economic conditions[20]

4.6. Robustness: GVCs and openness to trade

The results of sub-Sections 4.4.1 and 4.4.2 are exposed to an important critique: the measure of GVCs participation could potentially just capture the openness to trade of a country rather than the peculiarities of its international production network. In fact, as shown in Appendix B.6.4, there is a small but significant correlation (roughly equal to 0.20) between openness to trade and GVCs participation (whereas there is no correlation between openness and GVCs position). This rises a red flag, as the imputed role of GVCs participation for the PC could be – to a certain extent – simply a by-product of international trade.

To investigate this point, here we augment both the NKPC of Eq. (3) and the regional PC of Eq. (4) with a measure of openness to trade to check if our main results hold. In particular, we use data from the World Bank on World Development Indicators and build a standard measure of openness ($Openness_{i,t}$) as the sum of total import and exports over GDP (see Appendix B.5). Hence, to both empirical models (3) and (4), we add the interaction term $\hat{u}_{i,t} \times Openness_{i,t-4}$ and the variable $Openness_{i,t}$ alone. These two elements will control respectively for the role of openness to trade on the slope of the PC and on the level of (core or non-tradable) inflation.

We begin by considering the NKPC with core inflation. As in Section 4.4.1, we instrument the unemployment gap and its interactions with monetary policy shocks alone and interacted with the measure of openness at $t-4$. Table 4 shows results.[21]

As shown in column (1) of Table 4, our previous findings are confirmed. Despite controlling for the role of trade openness, only participation in GVCs, and not positioning, matters for the slope of the PC. Moreover, trade openness has a contemporaneous and significant effect on the slope as well: the higher the openness to trade the steeper is the NKPC. By using these estimates, also here

[20] See Razin (2020) who contends that trade globalisation has reversed its course since the global financial crisis. A similar dynamics of the PC is present in the US. Benigno and Eggertsson (2023), observing that labour shortages are often accompanied by inflationary spikes, incorporate labour market tightness as an explanatory variable in the Phillips Curve and find that the rise in labour shortages, such as the one experienced after the COVID-19 crisis, caused the PC to become non-linear, with the slope becoming steeper than usual.

[21] See Appendix C for first-stage statistics.

Table 5
Openness to Trade and GVCs in the Regional PC.

	(1) π^{NT}	(2) π^{NT}	(3) π^{NT}	(4) π^{NT}
$\hat{u}$	−0.0339**	−0.0321**	−0.0288**	−0.0248**
	(0.0135)	(0.0143)	(0.0120)	(0.0123)
$\hat{u} \times GVC_{part.}$	0.0018***	0.0009***	0.0018**	
	(0.0006)	(0.0002)	(0.0007)	
$GVC_{part.}$	−0.8525***	−0.5931**	−0.7826***	
	(0.2418)	(0.2987)	(0.2524)	
$\hat{u} \times GVC_{pos.}$	−0.0525	−0.0504		−0.0246
	(0.0516)	(0.0559)		(0.0440)
$GVC_{pos.}$	17.6976	17.3126		8.4888
	(20.1517)	(21.8408)		(15.5116)
$\hat{u} \times Openness$	−0.0002		−0.0002	0.0001***
	(0.0001)		(0.0001)	(0.0000)
$Openness$	0.0386	−0.0203	0.0479	−0.0823*
	(0.0488)	(0.0293)	(0.0464)	(0.0468)
Observations	748	748	748	748
Country Fe	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Post-GR break	Yes	Yes	Yes	Yes
Time Fe	Yes	Yes	Yes	Yes
IV	Int.	Int.	Int.	Int.

Note: The variable of interest in column (1)-to-(4) is non-tradable inflation. $\hat{u}$ is the 4-quarters discounted sum of future unemployment in deviation from the NAIRU. $GVC^{part.}$ is the share of gross output depending on connections with more than one country. $GVC^{pos.}$ is an index ranging from −1 to +1 and it expresses respectively whether a country is at the bottom or at the top of the GVC. $Openness$ is the sum of imports and exports divided by GDP. The sample is composed of all countries that joined the EMU before 2002 (Luxembourg excluded). Data is quarterly and spans from 2002q1 until 2018q4. Standard errors in parentheses are clustered at country-level. *, **, *** indicate significance at 90%, 95% and 99%.

we can do a back-of-the-envelope calculation to quantify the impact of GVC participation on the flattening of the NKCP. As the mean value of $Openness$ is 92.94%,[22] we can say that the net effect of GVC participation on the slope of the PC (netting out the effect of openness to trade) is $[18.6 * (0.0047) + 92.94 * (-0.0007)]/[0.0493 + 92.94 * (0.0007) + 18.6 * (0.0047)] \approx 11\%$.

In column (2)-to-(4), we further check the robustness of these results by investigating more in detail the role played by trade. In column (2), we drop the interaction term $\hat{u} \times Openness$ to check if international trade alone affects the role played by GVCs participation on the slope of the PC. In this case, the slope results are slightly larger, while the impact of GVC participation on the slope is much smaller. Moreover, for the first time, the effect of GVCs position on the slope is significant. This indicates that ignoring the effect of trade on the slope of the PC would lead to underestimate the role of GVC participation and to overestimate the role of GVC position. In column (3) and (4) we respectively drop $\hat{u} \times GVC_{pos.}$, $GVC_{pos.}$ and $\hat{u} \times GVC_{part.}$, $GVC_{part.}$ while continuing to control for both $\hat{u} \times Openness$ and $Openness$. This allows to better understand the influence of trade on each GVC channel. In line with the results of column (1), again we find that – once netting out the effect of trade – only GVCs participation matters.

Table 5 shows results for the regional PC, where – similarly to Section 4.4.2 – we instrument the new interaction term with $\hat{u}_{i,t-4} \times Openness_{i,t-4}$.[23] Column (1) confirms the results of the previous sections: only GVC participation matters for the slope of the regional PC. In this case openness to trade does not have any significant effect. This, as explained in the introduction, confirms the rational of using non tradable prices for estimating the effects of GVCs on the PC: it allows to separate the effects of GVCs from openness. When doing the usual back-of-the-envelope calculation, we find that GVC participation contributes to the flattening of the regional PC by $[18.7 * (0.0018) + 92.94 * (-0.0002)]/[0.0339 + 92.94 * (0.0002) + 18.7 * (0.0018)] \approx 17\%$.

In column (2)-to-(4) we further investigate the role of openness for the regional PC. As from column (2), not including the interaction term $\hat{u} \times Openness$ will underestimate the role of GVC participation on the role of the PC. When studying participation and positioning separately in column (3) and (4), we find that only GVCs participation matters for the slope of the regional PC.

The comparison between Tables 4 and 5 provides additional insights regarding the interaction between GVC participation and openness. In particular, using core inflation (the NK framework), openness affects the PC slope only if GVC participation is considered: openness alone might not capture all the nuances of inflationary dynamics without considering how countries are integrated into GVCs. In fact, participation in GVCs means that a country not only trades internationally but is also integrated into a global production network. This influences production costs, prices, and thus inflation dynamics. Core inflation is more influenced by production costs that better reflect participation in GVCs.

On the other hand, when considering non-tradable prices (the Regional framework), openness affects the slope only if GVC participation is not considered. This supports the idea that non-tradable prices are affected by the international production network

[22] See Appendix B.3.

[23] See Appendix C for first-stage statistics.

but not by trade openness per-se. However, if GVC participation is omitted, the measure of openness partially captures this international supply chain effect. Summarising, the relevance of openness and GVC participation for the slope of the Phillips Curve varies depending on the type of price used in the analysis: GVC participation seems to play a crucial role for more stable prices related to international production costs, while for NT prices, economic openness is not relevant, when GVC participation is included.

In Appendix D.1, we provide further robustness checks that confirm the role of GVC participation. We show that only participation matters also when using different measures of positioning, in particular the upstreamness and downstreamness of Antràs et al. (2012) and Antràs and Chor (2013), while controlling for the openness to trade at the same time. In Appendix D.4, we keep on taking into account for the role of openness to trade and control for the interaction between $GVC_{part.}$ and $GVC_{pos.}$ and its effect on both the level of inflation and on the slope of the PC. This helps to understand whether $GVC_{part.}$ has still a significant effect on the slope for countries with similar levels of $GVC_{pos.}$ (and viceversa). This is a way of testing the theoretical channel in which, given the same level of GVCs participation, countries in different positions within the GVCs could have different slope of the PC (see channel (4b) in Section 3). We do not find statistical evidence supporting this channel.

Finally, in Appendix D.5 we use an identifying equation similar to Eqs. (3) and (4) – where we omit all the GVCs variables – to check the direct effect of openness to trade on the slope of the PC. When dropping GVC position and participation from the controls, openness to trade has a significant effect and leads to a flattening of the PC. Yet, this effect is smaller than the estimated effect of GVC participation.

5. Conclusions

The role of Global Value Chains (GVCs) for the structure of the economy and its implication for monetary policy is only partially understood. In this paper we investigate the role of two channels through which GVCs can affect the slope of the Phillips Curve and, consequently, the transmission of monetary policy shocks. The two channels are GVCs participation and position, which capture respectively to which extent a country relies on GVCs for production and whether they are located upstream or downstream in the chain of production of the final good. Our analysis focuses on 11 EMU countries. We first estimate a NKPC for periods before the Covid-19 recession, and find that both channels operate as the theory predicts: higher participation results in a flattening of the PC, whereas an upper position in the GVC leads to a steepening. Yet, only the first channel is statistically significant. Through a back-of-the-envelope calculation, we find that the participation channel accounts for 13% of the flattening in pre-Covid years. Thereafter, we repeat the same analysis using the empirical set-up of Hazell et al. (2022), which estimate a regional PC with non-tradable prices. This exercise is important since, through the rise of the service economy, non-tradable prices play a higher role in core inflation. Moreover, they allow a better estimation of the slope of the PC as they correlate more with country-level unemployment. Also under this setup, our results are confirmed: only participation matters, while the position within GVCs does not affect the slope of the PC. Under this empirical set up, the role of participation is magnified and accounts up to 32% of the flattening of the PC in pre-Covid years. While insignificance of GVC position may challenge recent literature suggesting a compounding effect of price stickiness at each step along the production chain, the participation channel enables a reassessment of the theory proposing that foreign competition, by reducing the desired markups of domestic producers, decreases the inflation rate. This holds not only for tradable goods (as in Guerrieri et al. (2010)), but, and even more so, also for non-tradables. Finally, we extend our analysis to post Covid-19 periods. In particular, we exploit the Covid-19 pandemic as a natural experiment to evaluate the exogenous variation in GVC participation and position. Also in this case, we confirm previous results: it is only GVC participation that matters for the slope. In particular, the collapse in GVCs participation due to the Covid-19 shock can explain 8.4% of the steepening of the PC observed in post-pandemic years. We think these findings have important implications for monetary policy and contribute to a better understanding on how monetary policy can be effective.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.euroecorev.2025.104966.

Data availability

All the necessary data are described and fully available in the replication package.

References

Acemoglu, D., Akcigit, U., Kerr, W., 2015. Networks and the macroeconomy: An empirical exploration. In: NBER Macroeconomics Annual 2015, vol. 30. In: NBER Chapters, National Bureau of Economic Research, Inc, pp. 273–335.
Akerlof, G.A., Dickens, W.T., Perry, G.L., Gordon, R.J., Mankiw, N.G., 1996. The macroeconomics of low inflation. Brookings Pap. Econ. Act. 1996 (1), 1–76.
Alfonso C, V., Boar, C., Frost, J., Gambacorta, L., Liu, J., 2021. E-Commerce in the Pandemic and Beyond. Bank for International Settlements.
Altavilla, C., Brugnolini, L., Gürkaynak, R.S., Motto, R., Ragusa, G., 2019. Measuring euro area monetary policy. J. Monet. Econ. 108, 162–179.
Altig, D., Christiano, L., Eichenbaum, M., Linde, J., 2011. Firm-specific capital, nominal rigidities and the business cycle. Rev. Econ. Dyn. 14 (2), 225–247.
Altissimo, F., Benigno, P., Rodriguez Palenzuela, D., 2005. Long-Run Determinants of Inflation Differentials in a Monetary Union. CEPR Discussion Papers.
Altissimo, F., Bilke, L., Levin, A., Mathä, T., Mojon, B., 2006. Sectoral and aggregate inflation dynamics in the euro area. J. Eur. Econ. Assoc. 4 (2/3), 585–593.
Alvarez, F., Shimer, R., 2011. Search and rest unemployment. Econometrica 79 (1), 75–122.
Antràs, P., Chor, D., 2013. Organizing the global value chain. Econometrica 81 (6), 2127–2204.

Antras, P., Chor, D., 2022. Global value chains. In: Handbook of International Economics, vol. 5. Elsevier.
Antràs, P., Chor, D., Fally, T., Hillberry, R., 2012. Measuring the upstreamness of production and trade flows. Am. Econ. Rev. 102 (3), 412–416.
Aquilante, T., Dogan, A., Firat, M., Soenarjo, A., 2024. Global Value Chains and the Dynamics of UK Inflation. Bank of England.
Ari, A., Garcia-Macia, D., Mishra, S., 2023. Has the Phillips curve become steeper? IMF Work. Pap. 2023 (100), A001,
Ascari, G., Bonam, D., Smadu, A., 2024a. Global supply chain pressures, inflation, and implications for monetary policy. J. Int. Money Financ. 142, 103029.
Ascari, G., Bonomolo, P., Haque, Q., 2024b. The Long-Run Phillips Curve is ... a Curve. CEPR Discussion Papers No. 19069, (19069).
Ball, L.M., Mazumder, S., 2011. Inflation Dynamics and the Great Recession. National Bureau of Economic Research.
Ball, L., Mazumder, S., 2021. A Phillips curve for the euro area. Int. Financ. 24 (1), 2–17.
Baqaee, D.R., Farhi, E., 2019. The macroeconomic impact of microeconomic shocks: Beyond Hulten's theorem. Econometrica 87 (4), 1155–1203.
Barrot, J.-N., Sauvagnat, J., 2016. Input specificity and the propagation of idiosyncratic shocks in production networks. Q. J. Econ. 131 (3), 1543–1592.
Battiati, C., Jona-Lasinio, C., Marvasi, E., Sopranzetti, S., 2021. Market power and productivity trends in the European economies. A macroeconomic perspective. Working Papers - Economics, (wp2021_04.rdf), https://ideas.repec.org/p/frz/wpaper/wp2021_04.rdf.html.
Beaudry, P., Hou, C., Portier, F., 2024. Monetary policy when the phillips curve is quite flat. American Economic Journal: Macroeconomics 16 (1), 1–28.
Benigno, P., Eggertsson, G., 2023. It's Baaack: The Surge in Inflation in the 2020s and the Return of the Non-Linear Phillips Curve. Discussion Paper, (18116), CEPR Press.
Benigno, P., Faia, E., 2016. Globalization, pass-through, and inflation dynamics. Int. J. Central Bank. 12 (4), 263–306.
Benigno, P., Ricci, L.A., 2011. The inflation-output trade-off with downward wage rigidities. Am. Econ. Rev. 101 (4), 1436–1466.
Bernanke, B., 2007. Inflation Expectations and Inflation Forecasting. Board of Governors of the Federal Reserve System (US).
Bernardini, M., De Schryder, S., Peersman, G., 2020. Heterogeneous government spending multipliers in the era surrounding the great recession. Rev. Econ. Stat. 102 (2), 304–322.
Berson, C., de Charsonville, L., Diev, P., Faubert, V., Ferrara, L., Guilloux-Nefussi, S., Kalantzis, Y., Lalliard, A., Matheron, J., Mogliani, M., et al., 2018. Does the phillips curve still exist? Rue de la Banq. 56.
Berthou, A., Stumpner, S., 2024. Trade under lockdown. Journal of International Economics 152, 104013.
Blanchard, O., 2016. The Phillips curve: Back to the'60s? Am. Econ. Rev. 106 (5), 31–34.
Bobeica, E., Jarociński, M., 2019. Missing disinflation and missing inflation: A VAR perspective. Int. J. Central Bank. 15 (1), 199–232.
Boehm, C.E., Flaaen, A., Pandalai-Nayar, N., 2019. Input linkages and the transmission of shocks: Firm-level evidence from the 2011 Tōhoku earthquake. Rev. Econ. Stat. 101 (1), 60–75.
Bonadio, B., Huo, Z., Levchenko, A.A., Pandalai-Nayar, N., 2021. Global supply chains in the pandemic. J. Int. Econ. 133 (C).
Borin, A., Mancini, M., 2015. Follow the Value Added: Bilateral Gross Export Accounting. Bank of Italy, Economic Research and International Relations Area.
Borin, A., Mancini, M., 2023. Measuring what matters in value-added trade. Econ. Syst. Res. 35 (4), 586–613.
Borin, A., Mancini, M., Taglioni, D., 2021. Measuring Exposure to Risk in Global Value Chains. The World Bank.
Bruine de Bruin, W., Vanderklaauw, W., Downs, J.S., Fischhoff, B., Topa, G., Armantier, O., 2010. Expectations of inflation: The role of demographic variables, expectation formation, and financial literacy. J. Consum. Aff. 44 (2), 381–402.
Carvalho, V.M., Nirei, M., Saito, Y.U., Tahbaz-Salehi, A., 2021. Supply chain disruptions: Evidence from the Great East Japan earthquake. Q. J. Econ. 136 (2), 1255–1321.
Carvalho, V.M., Tahbaz-Salehi, A., 2019. Production networks: A primer. Annu. Rev. Econ. 11 (1), 635–663.
Ciccarelli, M., García, J.A., Montes-Galdón, C., 2017. Unconventional Monetary Policy and the Anchoring of Inflation Expectations. European Central Bank.
Cigna, S., Gunnella, V., Quaglietti, L., 2022. Global Value Chains: Measurement, Trends and Drivers. European Central Bank.
Coeuré, B., 2019. Speech at the 21st geneva conference on the world economy. Member of the executive board of the ECB.
Colciago, A., Rossi, L., 2015. Firm dynamics, endogenous markups, and the labor share of income. Macroecon. Dyn. 19 (6), 1309–1331.
Comunale, M., Kunovac, D., 2017. Exchange rate pass-through in the euro area. European Central Bank.
Craighead, W.D., 2024. Exchange rates and monetary policy when tradable and nontradable goods are complements. Int. Rev. Econ. Financ. 89, 297–309.
Daly, M.C., Hobijn, B., 2014. Downward nominal wage rigidities bend the Phillips curve. J. Money, Credit. Bank. 46 (S2), 51–93.
Daly, M.C., Hobijn, B., Pyle, B., 2016. What's up with wage growth. FRBSF Econ. Lett. 7.
De Hoyos, R.E., Sarafidis, V., 2006. Testing for cross-sectional dependence in panel-data models. Stata J. 6 (4), 482–496.
Del Negro, M., Lenza, M., Primiceri, G.E., Tambalotti, A., 2020. What's up with the Phillips curve? Brookings Pap. Econ. Act. 301–357.
Deroose, M., Stevens, A., et al., 2017. Low inflation in the euro area: causes and consequences. Econ. Rev. I, 111–125.
Dhyne, E., Alvarez, L.J., Bihan, H.L., Veronese, G., Dias, D., Hoffmann, J., Jonker, N., Lunnemann, P., Rumler, F., Vilmunen, J., 2006. Price changes in the euro area and the United States: Some facts from individual consumer price data. J. Econ. Perspect. 20 (2), 171–192.
Dhyne, E., Kikkawa, A.K., Mogstad, M., Tintelnot, F., 2021. Trade and domestic production networks. Rev. Econ. Stud. 88 (2), 643–668.
Draghi, M., 2015. Structural reforms, inflation and monetary policy.
Eichenbaum, M., Fisher, J.D., 2007. Estimating the frequency of price re-optimization in Calvo-style models. J. Monet. Econ. 54 (7), 2032–2047.
Etro, F., Colciago, A., 2010. Endogenous market structures and the business cycle. Econ. J. 120 (549), 1201–1233.
Faccini, R., Melosi, L., 2023. Job-to-Job Mobility and Inflation. Federal Reserve Bank of Chicago.
Fally, T., 2012. Production Staging: Measurement and Facts. Mimeo UC Berkeley.
Ferrari, A., 2024. Inventories, Demand Shocks Propagation, and Amplification in Supply Chains. Discussion Paper, (19716), CEPR Press.
Fitzgerald, T., Jones, C., Kulish, M., Nicolini, J.P., 2022. Is There a Stable Relationship between Unemployment and Future Inflation? Red Nacional de Investigadores en Economía (RedNIE).
Giannone, D., Lenza, M., Momferatou, D., Onorante, L., 2014. Short-term inflation projections: A Bayesian vector autoregressive approach. Int. J. Forecast. 30 (3), 635–644.
Giuli, F., Tancioni, M., 2012. Real rigidities, productivity improvements and investment dynamics. J. Econom. Dynam. Control 36 (1), 100–118.
Guerrieri, L., Gust, C., López-Salido, J.D., 2010. International competition and inflation: A new keynesian perspective. Am. Econ. J.: Macroecon. 2 (4), 247–280.
Guilloux-Nefussi, S., 2020. Globalization, market structure and inflation dynamics. J. Int. Econ. 123 (C).
Hazell, J., Herreño, J., Nakamura, E., Steinsson, J., 2022. The slope of the Phillips curve: Evidence from U.S. States. Q. J. Econ. 137 (3), 1299–1344.
Hooper, P., Mishkin, F.S., Sufi, A., 2020. Prospects for inflation in a high pressure economy: Is the Phillips curve dead or is it just hibernating? Res. Econ. 74 (1), 26–62.
Hottman, C., Reyes-Heroles, R., 2024. Globalization, Inflation Dynamics, and the Slope of the Phillips Curve. Mimeo.
Hummels, D., Ishii, J., Yi, K.-M., 2001. The nature and growth of vertical specialization in world trade. J. Int. Econ. 54 (1), 75–96.
Jarociński, M., Karadi, P., 2020. Deconstructing monetary policy surprises—The role of information shocks. Am. Econ. J.: Macroecon. 12 (2), 1–43.
Jorgenson, D.W., 2001. Information technology and the US economy. Am. Econ. Rev. 91 (1), 1–32.
Kimball, M.S., 1995. The quantitative analytics of the basic neomonetarist model. J. Money, Credit. Bank. 27 (4), 1241–1277.
Lodge, D., Pérez, J.J., Albrizio, S., Everett, M., De Bandt, O., Georgiadis, G., Ca' Zorzi, M., Lastauskas, P., Carluccio, J., Parrága, S., Carvalho, 2021. The Implications of Globalisation for The ECB Monetary Policy Strategy. European Central Bank.
Lombardi, M.J., Riggi, M., Viviano, E., 2023. Workers' bargaining power and the Phillips curve: A micro–macro analysis. J. Eur. Econ. Assoc..
Madeira, J., 2015. Firm-specific capital, inflation persistence and the sources of business cycles. Eur. Econ. Rev. 74 (C), 229–243.

Mancini, M., Montalbano, P., Nenci, S., Vurchio, D., 2024. Positioning in global value chains: World map and indicators, a new dataset available for GVC analyses. World Bank Econ. Rev. lhae005.
Mavroeidis, S., Plagborg-Møller, M., Stock, J.H., 2014. Empirical evidence on inflation expectations in the New Keynesian Phillips Curve. J. Econ. Lit. 52 (1), 124–188.
McLeay, M., Tenreyro, S., 2020. Optimal inflation and the identification of the Phillips curve. NBER Macroecon. Annu. 34 (1), 199–255.
Mincer, J., Danninger, S., 2000. Technology, Unemployment, and Inflation. National Bureau of Economic Research.
Monacelli, T., 2007. Comment on ‘‘globalization and inflation dynamics: The impact of increased competition’’. In: International Dimensions of Monetary Policy. In: NBER Chapters, National Bureau of Economic Research, Inc, pp. 579–590.
Moretti, L., Onorante, L., Zakipour Saber, S., 2019. Phillips Curves in the Euro Area. European Central Bank.
Murphy, A., 2018. The Death of the Phillips Curve? Federal Reserve Bank of Dallas. Working Paper 1801, Research Department.
Ng, M., Wessel, D., Sheiner, L., 2018. The hutchins center explains: The Phillips curve. Brookings Up Front. (August 21)..
Petrosky-Nadeau, N., Wasmer, E., Weill, P., 2020. Search Demand Effects, Equilibrium Unemployment and a Wage Phillips Curve. Working Paper.
Pfajfar, D., Santoro, E., 2008. Asymmetries in Inflation Expectation Formation Across Demographic Groups. Faculty of Economics, University of Cambridge.
Portier, F., Beaudry, P., Preston, A., 2023. Some Inference Perils of Imposing a Taylor Rule. CEPR Discussion Papers.
Powell, J.H., 2018. Monetary policy and risk management at a time of low inflation and low unemployment. Bus. Econ. 53 (4), 173–183.
Razin, A., 2020. De-globalization: Driven by Global Crises? National Bureau of Economic Research.
Roberts, J.M., 2006. Monetary policy and inflation dynamics. Int. J. Central Bank. 2 (3).
Rubbo, E., 2023. Networks, Phillips curves, and monetary policy. Econometrica 91 (4), 1417–1455.
Sbordone, A.M., 2007. Globalization and inflation dynamics: the impact of increased competition. National Bureau of Economic Research, Inc.
Siena, D., 2021. The euro area periphery and imbalances: Is it an anticipation story? Rev. Econ. Dyn. 40, 278–308.
Siena, D., Zago, R., 2022. Employment protection legislation matters for the Phillips Curve. Econom. Lett. 220 (C).
Siena, D., Zago, R., 2024. Job polarisation, labour market fluidity and the flattening of the Phillips Curve. Econ. J..
Stock, J.H., Watson, M.W., 2019. Slack and Cyclically Sensitive Inflation. Working Paper, In: Working Paper Series, (25987).
Sveen, T., Weinke, L., 2005. New perspectives on capital, sticky prices, and the Taylor principle. J. Econom. Theory 123 (1), 21–39.
Sveen, T., Weinke, L., 2007. Firm-specific capital, nominal rigidities, and the Taylor principle. J. Econom. Theory 136 (1), 729–737.
Woodford, M., 2003. Interest and Prices: Foundations of a Theory of Monetary Policy. Princeton University Press.
Yoon, J.-W., Kim, J., Lee, J., 2018. Impact of demographic changes on inflation and the macroeconomy. KDI J. Econ. Policy 40 (1), 1–30.