Global Value Chains and Inflation Dynamics: Does the Source of Inputs Matter?*

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November 2025

Abstract

This paper investigates how Global Value Chains (GVCs) shape inflation dynamics and whether the source country of imported inputs matters. We develop a two-country model with input-output linkages and show that greater reliance on imported intermediate goods—our measure of GVC integration—affects inflation dynamics through two mechanisms: a direct cost channel, which flattens the Phillips curve by reducing the sensitivity of marginal costs to domestic conditions, and a cyclical channel, in which terms-of-trade movements transmit international relative-price fluctuations into domestic production costs. We test these predictions using UK industry-level data for 2000–2014 and find that industries with higher foreign-input shares exhibit a weaker relationship between inflation and the output gap. Crucially, this pattern is driven by inputs sourced from Emerging Market Economies (EMEs), not from advanced economies. To interpret this source asymmetry, we extend our model to a dynamic, multi-sector New Keynesian model with input–output linkages. Tariff-induced de-integration shocks generate similar aggregate responses but markedly different sectoral dynamics: sectors that rely heavily on foreign intermediates experience temporary expansions driven by strong substitution toward domestic inputs, while less open sectors exhibit broad output declines. These results show that the composition of GVCs—across both source countries and sectors—is central for understanding inflation dynamics in advanced economies.

Keywords: Global value chains, inflation dynamics, Phillips curve.
JEL codes: E30, E31, E32, F41, F44.

*The views expressed in this paper are solely those of the authors and so cannot be taken to represent those of the Bank of England and the IMF, its Executive Board, or IMF management. The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Boston or the Federal Reserve System. For helpful comments and suggestions, we thank Laura Alfaro, Ravi Balakrishnan, Laurence Ball, Ambrogio Cesa-Bianchi, Diego Comin, Giancarlo Corsetti, Federico Di Pace, Sophie Guilloux-Nefussi, Simon Gilchrist, Alex Haberis, Ida Hjortsoe, Simon Lloyd, Riccardo Masolo, Ricardo Reis, Rana Sajedi, Ayşegül Şahin, Boromeus Wanengkirtyo, Jonathan Wright and Robert Zymek. We are also grateful to participants at numerous seminars and conferences including at the Bank of England, Johns Hopkins University, LSE and the NY FED. We thank Veronica Veggente and Jack Terry for excellent research assistance.

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1 Introduction

In recent years, there has been renewed interest in how the globalization of production shapes inflation dynamics. Rising trade fragmentation and protectionist policies have brought Global Value Chains (GVCs) to the forefront of macroeconomic discussions, raising the question: how do changes in GVC participation affect the relationship between output and inflation? More specifically, does reliance on imported intermediates—especially from emerging rather than advanced economies—affect the Phillips curve dynamics? In this paper, we examine the role of imported inputs in understanding inflation dynamics and assessing whether the source-country matters for the strength of the link between inflation and domestic activity.

Recent trade tensions, supply-chain disruptions, and the reorganization of global production networks have heightened concerns about inflation's sensitivity to global shocks. For advanced open economies, imported intermediates constitute a large share of production costs, particularly in manufacturing and capital goods sectors. Figure 1 shows the changes in intermediate inputs over time. Understanding how shocks to these inputs propagate into domestic inflation is therefore central for evaluating the transmission and effectiveness of monetary policy.

We begin by developing a static, two-country model with input–output linkages with a round about production structure. We show that the share of imported intermediates directly affects the slope of the Phillips curve: greater reliance on foreign inputs flattens the Phillips curve. Imported inputs affect this relationship through two channels: (i) a direct cost channel, through which foreign-input share determines how marginal costs respond to shocks, and (ii) a substitution channel, through which the elasticity of substitution between domestic and foreign inputs governs the pass-through of relative-price movements into production costs. We then extend the model to a multi-sector setting and derive an sectoral Phillips curve relationship which we can take to the data.

Guided by these predictions, we examine whether changes in the use of imported intermediates influence the empirical relationship between inflation and real activity. Empirically, we find that GVC integration does not uniformly affect the inflation–output relationship: greater reliance on EME-sourced intermediates significantly weakens the link between the inflation and output gap, whereas integration with advanced economies does not. Using industry-level data from the World Input–Output Database, for the United Kingdom (UK) over 2000–2014 we study how changes in sector-level GVC integration, measured as the change in imported intermediate input share, affect the inflation-output gap relationship. The UK is particularly well suited for this analysis given its openness and the increased share of imported intermediates from Emerging Market Economies (EMEs) during this period.

These findings highlight the importance of the 'sector–source' dimension. EME integration is heavily concentrated in capital goods industries, suggesting that these sectors may transmit changes in imported-input dependence into domestic inflation differently. To understand the mechanisms behind this pattern, we extend our model to a dynamic, multi-sector, two-country New Keynesian model with trade in intermediate and final goods. While the static model clarifies the channels through which imported-input share affects inflation, it cannot capture dynamic propagation through production networks or interactions with nominal rigidities and monetary policy. Our quantitative model, calibrated to EME and advanced-economy data for services, manufacturing, and capital goods sectors, allows us to simulate sector-specific GVCs shocks and single out the mechanisms operating behind the empirical patterns.

To disentangle these forces and shed light on the mechanisms behind our empirical findings, we simulate sector-specific tariff shocks in our model that raise the relative price of foreign intermediate goods and thereby reduce imported-input shares. We find that at the aggregate level, these tariff shocks generate qualitatively similar macroeconomic responses: higher inflation, lower output and real wages, and a real appreciation of the domestic currency. Yet the transmission to sectoral variables differs substantially across sectors. A tariff shock in capital goods raises inflation and output in that sector, while lowering output and raising inflation in the others. In contrast, manufacturing-sector shocks produce more conventional supply-driven patterns, falling output and rising inflation, whereas services-sector shocks resemble negative demand disturbances, reducing both output and inflation.

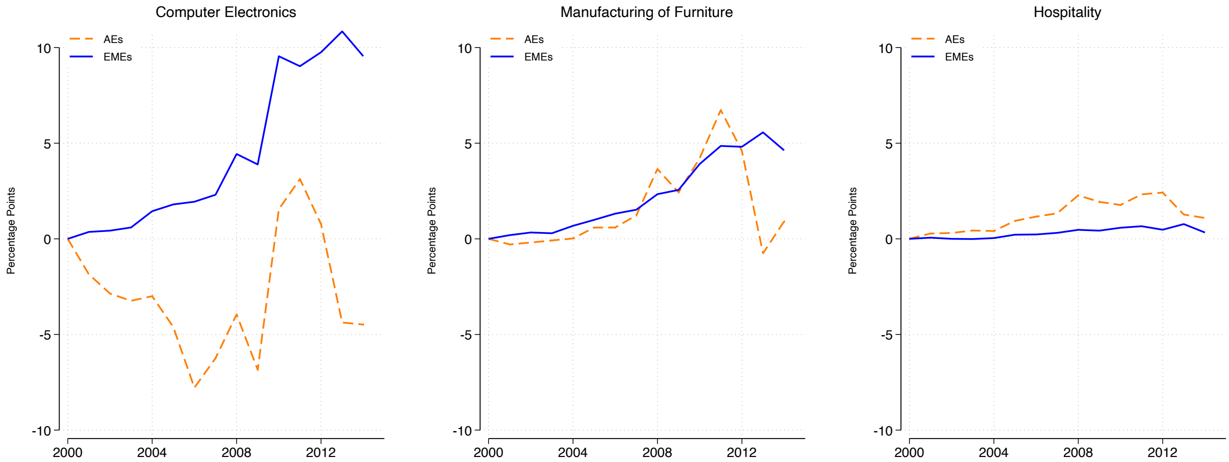
To understand the sources of this heterogeneity, we conduct counterfactual exercises that isolate the roles of input–output linkages, sectoral openness, and the elasticity of substitution between domestic and foreign intermediates. First, we show that the 'demand-like' responses in capital goods and services arise from input–output linkages. When we eliminate cross-sector input use by imposing a roundabout production structure in which each sector relies only on its own intermediates, both capital goods and services exhibit falling output and rising inflation after a tariff shock. Without the ability to source from other sectors, the negative supply shock becomes stronger and more localized, as sectors can no longer share or absorb cost increases through the production network. Moreover, under all GVC shocks, non-targeted sectors experience declines in both output and inflation—a pure income effect reflecting higher effective import costs, lower real wages, and weaker aggregate demand.

We then examine the role of sectoral openness. In the benchmark calibration, capital goods is highly open, while services is almost entirely closed and relies overwhelmingly on domestic inputs. This asymmetry is crucial. When the imported-input share falls, highly open sectors such as capital goods can expand output because firms substitute aggressively toward domestic intermediates producing a net demand-like response despite the underlying cost shock. In contrast, the less-open manufacturing sector displays a standard negative supply response, while services, being largely non-traded, are dominated by the decline in real wages and aggregate demand.

These mechanisms provide a clear interpretation for our empirical results. GVC integration with EMEs has risen most sharply in capital goods industries—the very sectors where openness and substitutability amplify the effects of input-cost shocks. As a consequence, changes in the availability or price of EME-sourced intermediates generate large reallocation of input demand and pronounced movements in marginal costs in these sectors. In our empirical analysis, we measure GVCs as the share of imported intermediate inputs in sectoral production. In the model, this share is determined by the input–output structure—namely, how intensively each sector uses intermediates from all others and by the degree of openness of each sector to foreign production. Importantly, however, imported-input shares are not purely technological objects: they also respond to international relative prices via movements in the terms of trade. This means that our empirical measure of GVCs reflects both underlying structural openness and cyclical fluctuations in relative prices.

Taken together, our findings offer a unified explanation for why rising dependence on EME-sourced intermediate goods, concentrated in highly open capital goods sectors, has materially weak-

Figure 1: Change in Imported Intermediate Goods Share



Note: Source - WIOD. Figure plots the change in the shares of imported intermediate goods for selected sectors. Country classifications follow IMF and details are provided in Appendix A.

ened the inflation–output relationship in advanced open economies.

Related Literature. Our paper builds on the large literature examining how globalization influences inflation dynamics. Previous work has highlighted the role of global factors in shaping the sensitivity of inflation to domestic slack (e.g. Auer and Fischer, 2010; Bianchi and Civelli, 2015; Forbes, 2019; Guerrieri et al., 2010; Guilloux-Nefussi, 2020; Heise et al., 2022; Obstfeld, 2020). Our empirical strategy is closest to Gilchrist and Zakrajsek (2019), who use industry-level data to show that greater trade integration contributed to the decline in the sensitivity of U.S. inflation to the domestic output gap. We also rely on industry-level data but depart from their approach in two key respects. First, rather than considering overall trade integration—which combines final and intermediate goods—we focus specifically on imported intermediate inputs, isolating the GVC dimension of openness. Second, while the existing empirical work is largely U.S.-focused and abstracts from the rise of EMEs in global production, we show that the source-sector dimension of GVC integration is central for understanding the inflation dynamics of open economies such as the UK.

Our modeling strategy is related to Comin and Johnson (2020), who develop a small-open-economy New Keynesian model with trade in intermediate and final goods to study the effects of a permanent increase in trade openness on U.S. inflation. In contrast, we focus on shocks that reduce imported input shares and analyze their transmission in a two-country framework that distinguishes between sectors. Rather than studying inflation in levels, we examine how these shocks shape the inflation–output trade-off, highlighting the role of sectoral exposure to foreign intermediates. Our work is also connected to Rubbo (2023), who show in a closed economy that the use of intermediate inputs flattens the Phillips curve. Using a related multi-sector structure in an open-economy setting, we show how trade in intermediates can similarly flatten the slope of the Phillips curve.

A growing literature studies shocks to GVCs, particularly in the context of pandemic-era inflation (e.g. Amiti et al., 2023; Di Giovanni et al., 2023). Rather than explaining a specific inflation episode, we focus on the broader question of how shocks to GVCs integration shape inflation dynamics in open economies. In this respect, our paper relates to recent work on trade fragmentation. Using a two-sector small-open-economy New Keynesian model, Ambrosino et al. (2024) examine various fragmentation scenarios and show that fragmentation may not be inflationary if households anticipate it and adjust demand accordingly. We differ in focus and mechanism: rather than studying anticipatory behavior or terms-of-trade shocks, we analyze how sector-specific reductions in imported-input shares propagate through production networks and alter the inflation-output relationship, emphasizing the role of sectoral openness and substitutability.

Closely related, Kalemli-Özcan et al. (2025) develop a New Keynesian open-economy model with input–output linkages to examine how tariff-induced distortions propagate through global production chains and shape the inflation–output trade-off. Like us, they underline the importance of sectoral production linkages and shocks to imported intermediates. Our contribution is complementary: we provide new empirical evidence on sector-source heterogeneity in the Phillips curve, and we develop a two-country, multi-sector quantitative model specifically designed to uncover the mechanism rooted in the prominence of EME-sourced intermediates in capital goods sector that drives our empirical findings.

Roadmap. Section 2 introduces the static model of global value chains, which clarifies how trade in intermediate inputs affect the Phillips curve relationship. Section 3 presents the empirical analysis and a set of robustness checks. Section 4 presents the multi-sector, two-country DSGE model, its calibration, and the counterfactual exercises that uncover the mechanisms behind the empirical results. Section 5 concludes.

2 A Model of Global Value Chains

This section introduces a static model featuring global value chains. We first introduce a two-country model with a roundabout production structure and derive the Phillips curve. The model predicts how the a country's integration to the global value chain affects the Phillips curve relationship. Next, we extend the model to include multiple sectors. The introduction of multiple sectors allow us to formulate a sectoral producer price index (PPI) Phillips curve, which we use to motivate our empirical specification.

2.1 Roundabout Production with Imported Intermediate Inputs

In this section, we analyse how GVC integration affects the slope of the Philips Curve. We build on the work of Rubbo (2023) to derive a theoretical relationship between GVC integration and the Phillips curve. Here we simplify our model by abstracting from multiple sectors and focusing on one period only as we are interested in how the use of imported intermediate affects the slope of the Phillips curve. Throughout the paper, we use the notation " $*$ " to capture variables in the foreign economy.

Households. Households in each country consume Home and Foreign goods according to a general consumption aggregator,

$$C = \mathcal{C}\left(C_H, C_F\right) \,, \tag{1}$$

and supply labor to firms under standard iso-elastic preferences,

$$u(C,L) = \frac{C^{1-\sigma}}{1-\sigma} - \frac{L^{1+\varphi}}{1+\varphi}\,, \tag{2}$$

where σ and φ denote the inverse of inter-temporal elasticity of substitution and Frisch elasticity of labor supply, respectively.

Production. Firms in each economy are identical and use labor (L) and intermediate inputs (M) to produce a unit of output as before. Production has a round-about structure. The production function has the following constant-returns-to-scale functional form

$$Y_H(i) = AL(i)^{\delta} M(i)^{1-\delta}\,, \tag{3}$$

where Y_H denotes firm i's gross-output of home goods, A is the aggregate productivity and δ denotes the share of labor in production. Intermediate goods used by the firms are a CES aggregate of home and foreign-produced intermediate inputs

$$M(i) = \left[\mu^{\frac{1}{\phi}}(M_H(i))^{\frac{\phi-1}{\phi}} + (1-\mu)^{\frac{1}{\phi}}(M_F(i))^{\frac{\phi-1}{\phi}}\right]^{\frac{\phi}{\phi-1}}\,, \tag{4}$$

where $M_H(i)$ and $M_F(i)$ denote the demand for domestically and foreign-produced intermediate goods, respectively and ϕ denotes the elasticity of substitution between home and foreign-produced intermediate goods. The parameter μ captures home-bias in intermediate inputs.

Pricing. To introduce a Phillips Curve into the model, we allow for nominal rigidities in the form of sticky information as in Mankiw and Reis (2002). The timing within the period is as follows. 1. All firms pre-set their price as a markup over the expected marginal cost. 2. A fraction $1-\theta$ of firms observe the aggregate shocks in the economy and update their price. As such, Home and Foreign firms pre-set their price to a markup over their expected marginal costs,

$$P_H^{\#}(i) = \frac{\epsilon}{\epsilon-1}\mathbb{E}[MC] \;\text{ and }\; P_F^{*\#}(i) = \frac{\epsilon}{\epsilon-1}\mathbb{E}[MC^*]\,, \tag{5}$$

where the expectation is taken over aggregate states. A fraction $1-\theta$ of Home firms observe the realization of aggregate shocks and hence update their price. These firms change their prices to charge a markup over their actual marginal costs,

$$\widetilde{P}_H(i) = \frac{\epsilon}{\epsilon-1}MC \;\text{ and }\; \widetilde{P}_F^*(i) = \frac{\epsilon}{\epsilon-1}MC^*\,, \tag{6}$$

where $MC = \left(\frac{W}{\delta}\right)^{\delta}\left(\frac{P^M}{1-\delta}\right)^{1-\delta}$. The aggregate price level at the end of the period is given by $P_H^{1-\epsilon} = \theta P_H^{\#1-\epsilon} + (1-\theta)\tilde{P}_H^{1-\epsilon}$ and inflation is defined as the change in prices relative to the pre-set price before any shocks hit the economy. Inflation occurs when the actual marginal cost rises above the expected marginal cost and is approximated to first order by, [1]

$$\pi_H \equiv d\log P_H = (1-\theta)d\log MC\ . \tag{7}$$

A symmetric expression holds for the foreign economy to define π_F^*. We assume producer currency pricing as the baseline.

The Global Phillips Curve. We can relate a firm's pricing decisions to a measure of real activity in each country. Let $\log \mathbf{p} = \begin{pmatrix}\log P_H & \log P_F^*\end{pmatrix}'$ denote a vector of prices of Home and Foreign goods, $\log \mathbf{A} = \begin{pmatrix}\log A & \log A^*\end{pmatrix}'$ denote a vector of TFP levels. Also define three matrices,

$$\Phi = \begin{pmatrix}\alpha & 1-\alpha \\ 1-\alpha^* & \alpha^*\end{pmatrix}, \quad \Omega = \begin{pmatrix}\omega^H & \omega^F \\ \omega^{H*} & \omega^{F*}\end{pmatrix}, \quad \Theta = \text{diag}(1-\theta, 1-\theta^*)\ ,$$

where Φ is the matrix of consumption weights such that the consumer price index is $\log \boldsymbol{P} = \Phi \log \boldsymbol{p}$. Ω represents the global input-output matrix and Θ is the matrix of the frequency of price adjustment. The elements of Ω include the domestic intermediate input share

$$\omega^H = \frac{P^H M^H}{\text{MC}\cdot Y} = \frac{1-\delta}{1+\left(\frac{1-\mu}{\mu}\right)(\bar{P}^{\text{TOT}})^{\phi-1}}\ , \tag{8}$$

and the imported intermediate input share

$$\omega^F = \frac{P^F M^F}{\text{MC}\cdot Y} = \frac{1-\delta}{1+\left(\frac{\mu}{1-\mu}\right)(\bar{P}^{\text{TOT}})^{1-\phi}}\ , \tag{9}$$

where $\bar{P}^{\text{TOT}} = \frac{\bar{P}^H}{\bar{P}^F}$ denotes the steady-state terms-of-trade (expressed in the same currency). ω^{H*} and ω^{F*} are define symmetrically. Note that the intermediate input shares are mechanically related to the home-bias parameters, the labor share and the terms-of-trade. The relationship with the elasticity of substitution is more subtle. If either $\phi = 1$ (Cobb-Douglas) or $\bar{P}^{\text{TOT}} = 1$, then steady-state intermediate input shares do not depend on the elasticity of substitution. In particular, if the two countries are symmetric, this is a sufficient condition for the steady-state terms-of-trade to be equal to 1. The results are summarized in the following lemma.

Lemma 1. *If the elasticity of substitution $\phi \neq 1$ and the steady-state terms-of-trade $\bar{P}^{TOT} \neq 1$, then the domestic and imported intermediate input shares varies with the elasticity of substitution.*

The proof follows from computing the derivatives,

$$\frac{\partial \omega^H}{\partial \phi} = -(1-\delta)\left(\frac{1-\mu}{\mu}\right)\frac{\log(\bar{P}_{\text{TOT}})\bar{P}_{\text{TOT}}^{\phi-1}}{\left[1+\frac{1-\mu}{\mu}\bar{P}_{\text{TOT}}^{\phi-1}\right]^2}, \quad \frac{\partial \omega^F}{\partial \phi} = (1-\delta)\left(\frac{\mu}{1-\mu}\right)\frac{\log(\bar{P}_{\text{TOT}})\bar{P}_{\text{TOT}}^{1-\phi}}{\left[1+\frac{\mu}{1-\mu}\bar{P}_{\text{TOT}}^{1-\phi}\right]^2}\ .$$

[1] Formally, $d\log P_H \equiv \log P_H - \log P_H^{\#}$ and $d\log MC \equiv \log MC - \log \mathbb{E}[MC]$.

Intuitively, if $\bar{P}^{TOT} > 1$, it means that Home goods are more expensive than Foreign goods. Therefore, an increase in the elasticity of substitution makes it easier for firms to substitute away from the more expensive good. As a result, the domestic intermediate share decreases and the imported intermediate share increases. If $\bar{P}^{TOT} < 1$, it means the Foreign goods are more expensive than Home goods and we get the opposite result where the domestic intermediate share increases and the foreign intermediate share decreases.

One way to model changes to global value chain integration is by changing taxes on imports. In this case, $\bar{P}^{\text{TOT}} = \frac{\bar{P}^H}{(1+\tau)\bar{P}^F} < 1$. Introducing such a tax makes it more likely that we are in the second case. Now we can proceed with the expression of the Global Phillips Curve.

Proposition 1. *The Global (CPI) Phillips Curve is,*

$$d \log \mathbf{P} = \mathcal{K}\, \tilde{\mathbf{y}} + \mathcal{G}\, d \log \mathbf{A} + \mathcal{H}\, d \log \mathcal{E}, \tag{10}$$

where $\mathcal{K} = \Phi\Theta(\mathbf{I} - \Omega\Theta)^{-1}\delta \left[\mathbf{I} - ((\mathbf{1} + \sigma\Phi - \sigma\mathbf{I})\Theta(\mathbf{I} - \Omega\Theta)^{-1}\delta\right]^{-1} (\sigma + \varphi)$ *is the slope of the Phillips Curve and* $\mathcal{E}$ *is the nominal exchange rate (units of foreign currency in home currency).*

The proof and expressions for the $\mathcal{G}, \mathcal{H}$ matrices are shown in Appendix B.1. This expression shows that inflation dynamics are driven by: (i) domestic and foreign output gap, (ii) cross-country relative productivity, and (iii) exchange rate fluctuations. The main diagonal of $\mathcal{K}$ represents the *slope* of the Phillips Curve – the dependence of CPI inflation on the domestic output gap. The off-diagonal elements of $\mathcal{K}$ capture the dependence of domestic inflation on the foreign output gap.

The matrix $(\mathbf{I} - \Omega\Theta)^{-1}$ captures the adjusted Leontief inverse similar to Rubbo (2023). The key difference is that we emphasize the role of intermediate input shares in decoupling inflation from the (domestic) output gap whereas Rubbo (2023) stresses the role of price-stickiness along the production network. This leads us to the following corollary.

Proposition 2. *The higher the imported intermediate good share, the lower is the slope of the Phillips curve. That is,*

$$\frac{\partial \mathcal{K}_{ii}}{\partial \Omega_{ii}} > 0\ .$$

The proof follows directly from computing the derivative. Intuitively, as firms depend more on intermediate inputs imported from abroad, their marginal costs are less exposed to the domestic output and more exposed to foreign output. As a result, inflation depends less on the domestic output gap and more on the foreign output gap. Given that the share of imported goods (both final demand and intermediate) is proportional to the country size as in De Paoli (2009), the relative country size will matter for the slope through α and μ. Smaller countries like the UK are more open, so all else equal should have a flatter Phillips Curve. In addition, unsurprisingly, the Phillips Curve become steeper as labor share increases, consistent with the standard three-equation closed-economy New Keynesian model.

In addition, the price stickiness of domestic and foreign goods, captured by Θ, is also amplified along the production network. The price stickiness of foreign goods implies that the cost of imported intermediate goods, and hence the marginal costs for home firms, do not rise by as much as in the flexible-price case. This then implies that domestic prices do not rise by as much.

Note that this channel also interacts with the degree of exchange rate pass-through. Under producer currency pricing, the price of goods is sticky in the currency of the producer. Therefore, the changes in import prices are transmitted through the nominal exchange rate, which is captured in the $\mathcal{H}$ matrix. International relative prices are very volatile in the data, and in the presence of GVCs, relative prices affect the firm's marginal cost directly as some inputs are sourced from abroad. The following section will introduce a dynamic, multi-sector version of our model, exploring the importance of international relative price fluctuations for inflation dynamics.

2.2 Multi-sector Production

Now we extend the model to include multiple sectors with an input-output network. This enables us to take predictions of the model to the data and, derive a motivating equation for our empirical analysis. The consumption aggregator now consists of a finite number of sectoral goods indexed by s, which in turn consists of Home and Foreign goods.

$$C = \mathcal{D}(C_1, \ldots, C_S) \ \text{ where } \ C_s = \mathcal{C}\left(C_{Hs}, C_{Fs}\right) \tag{11}$$

The utility function remains as in equation (2). There is a representative firm in each sector with the production technology,

$$Y_{Hs}(i) = A_s L_s(i)^{\delta_s} M_s(i)^{1-\delta_s} \ , \tag{12}$$

where intermediate inputs in sector s is,

$$M_s(i) = \left[\sum_{s'=1}^{S} \chi_{ss'}^{\frac{1}{\phi_s}} \left(M_{ss't}(i)\right)^{\frac{\phi_s - 1}{\phi_s}} \right]^{\frac{\phi_s}{\phi_s - 1}} \ , \tag{13}$$

and each intermediate input can come from Home or Foreign sources,

$$M_{ss'}(i) = \left[\mu_{ss'}^{\frac{1}{\phi_{ss'}}} \left(M_{Hss'}(i)\right)^{\frac{\phi_{ss'}-1}{\phi_{ss'}}} + (1-\mu_{ss'})^{\frac{1}{\phi_{ss'}}} \left(M_{Fss'}(i)\right)^{\frac{\phi_{ss'}-1}{\phi_{ss'}}} \right]^{\frac{\phi_{ss'}}{\phi_{ss'}-1}} \ . \tag{14}$$

Sectors may differ across several dimensions including the labor share, its position in the input-output network, the home-bias for intermediate inputs and the elasticity of substitution. Let lowercase variables denotes log deviation from steady state. The linearized sectoral marginal costs in Home can be expressed as,

$$\mathbf{mc} = \delta \cdot w + \Omega^H \mathbf{p}^H + \Omega^F \mathbf{p}^F - \log \mathbf{A} \ , \tag{15}$$

where δ is a vector of labor shares and Ω^H and Ω^F are matrices of steady-state home and imported intermediate goods shares respectively. Formally, $\Omega^H = \{\omega^H_{ss'}\}$ and $\Omega^F = \{\omega^F_{ss'}\}$ where

$$\omega^H_{ss'} \equiv \frac{P^H_{ss'} M^H_{ss'}}{MC_s Y_s} = \frac{(1-\delta_s)\left(\frac{\chi_{ss'}(\bar{P}^M_{ss'})^{1-\phi_s}}{\sum_{k=1}^S \chi_{sk}(\bar{P}^M_{sk})^{1-\phi_s}}\right)}{1 + \left(\frac{1-\mu_{ss'}}{\mu_{ss'}}\right)\left(\bar{P}^{\mathrm{TOT}}_{ss'}\right)^{\phi_{ss'}-1}} \ , \tag{16}$$

and

$$\omega^F_{ss'} \equiv \frac{P^F_{ss'} M^F_{ss'}}{\mathrm{MC}_s Y_s} = \frac{(1-\delta_s)\left(\frac{\chi_{ss'}(\bar{P}^M_{ss'})^{1-\phi_s}}{\sum_{k=1}^S \chi_{sk}(\bar{P}^M_{sk})^{1-\phi_s}}\right)}{1+\left(\frac{\mu_{ss'}}{1-\mu_{ss'}}\right)\left(\bar{P}^{\mathrm{TOT}}_{ss'}\right)^{1-\phi_{ss'}}} \,. \tag{17}$$

The terms-of-trade term extends sector-by-sector definition $\bar{P}^{\mathrm{TOT}}_{ss'} = \frac{\bar{P}^H_{ss'}}{\bar{P}^F_{ss'}}$. The expression of the Foreign counterparts, Ω^{H*}, Ω^{F*} are symmetric. Note that the Global Input-Output matrix in the previous section is now a function of each ot these matrices. That is $\Omega = \mathcal{F}\left(\Omega^H, \Omega^F, \Omega^{H*}, \Omega^{F*}\right)$. We are now ready to derive the sectoral (PPI) Phillips curve.

Proposition 3. *The sectoral (PPI) Phillips curve is*

$$\boldsymbol{\pi}^H = (I - \Delta\Omega^H - \Delta\delta(\boldsymbol{\alpha^H})^{\boldsymbol{T}})^{-1}\Delta\left\{\delta(\gamma+\varphi)\widetilde{y} + (\Omega^F + \delta(\boldsymbol{\alpha^F})^{\boldsymbol{T}})\boldsymbol{\pi}^F + (\delta\boldsymbol{\lambda}^{\boldsymbol{T}} - I)\log\mathbf{A}\right\} \tag{18}$$

Proof. We start with the primal form of the Phillips curve,

$$\boldsymbol{\pi}^H = \Delta(\mathbf{mc} - \mathbf{p}^H_{-1}) \,.$$

Combining the expression for Home inflation and marginal cost yields

$$\left(I - \Delta\Omega^H\right)\boldsymbol{\pi}^H = \Delta\left(\delta \cdot w + \Omega^F\boldsymbol{\pi}^F - (I-\Omega^H)\mathbf{p}^H_{-1} + \Omega^F\mathbf{p}^F_{-1} - \log\mathbf{A}\right) .$$

Get real wages to appear on the right-hand side

$$\begin{aligned}(I - \Delta\Omega^H - \Delta\delta(\boldsymbol{\alpha^H})^{\boldsymbol{T}})\boldsymbol{\pi}^H = \Delta\Big\{&\delta(w - (\boldsymbol{\alpha^H})^{\boldsymbol{T}}\mathbf{p}^H - (\boldsymbol{\alpha^F})^{\boldsymbol{T}}\mathbf{p}^F) + (\Omega^F + \delta(\boldsymbol{\alpha^F})^{\boldsymbol{T}})\boldsymbol{\pi}^F \\ &- \log\mathbf{A} - (I - \Omega^H - \delta(\boldsymbol{\alpha^F})^{\boldsymbol{T}})\mathbf{p}^H_{-1} + (\Omega^F + \delta(\boldsymbol{\alpha^F})^{\boldsymbol{T}})\mathbf{p}^F_{-1}\Big\}\end{aligned}$$

Following Rubbo (2020), real wages and the output gap is related through the following equation,

$$w - (\boldsymbol{\alpha^H})^{\boldsymbol{T}}\mathbf{p}^H - (\boldsymbol{\alpha^F})^{\boldsymbol{T}}\mathbf{p}^F = (\gamma+\varphi)\widetilde{y} + \boldsymbol{\lambda}^{\boldsymbol{T}}\log\mathbf{A} \,. \tag{19}$$

Combining the previous two equations results in,

$$\begin{aligned}\boldsymbol{\pi}^H = (I - \Delta\Omega^H - &\Delta\delta(\boldsymbol{\alpha^H})^{\boldsymbol{T}})^{-1} \\ &\Delta\Big\{\delta(\gamma+\varphi)\widetilde{y} + (\Omega^F + \delta(\boldsymbol{\alpha^F})^{\boldsymbol{T}})\boldsymbol{\pi}^F + (\delta\boldsymbol{\lambda}^{\boldsymbol{T}} - I)\log\mathbf{A} \\ &\quad - (I - \Omega^H - \delta(\boldsymbol{\alpha^F})^{\boldsymbol{T}})\mathbf{p}^H_{-1} + (\Omega^F + \delta(\boldsymbol{\alpha^F})^{\boldsymbol{T}})\mathbf{p}^F_{-1}\Big\}\end{aligned}$$

As we assume that the model is initially at the steady-state, then $\mathbf{p}^H_{-1} = \mathbf{p}^F_{-1} = 0$ and the last two terms drop out. □

Equation (18) is the motivating equation for our empirical framework. It predicts how the imported intermediate inputs affects sectoral inflation. First, any factor that is not Home labor will be entered separately from the 'slope' of the Phillips curve. Second, the main addition is foreign inflation, which appears on the right-hand side, multiplied by the matrix of imported input shares and the final consumption shares, multiplied by the labor share. Third, the factor costs as a share of total costs are constant as we are considering the effect of small shocks to first order.

Import prices. We can consider the pass-through of nominal exchange rates to imported sectoral goods,

$$\mathbf{p}^F = \mathbf{p}^{F*} + \boldsymbol{\nu} \cdot e \,, \tag{20}$$

where $\boldsymbol{\nu}$ denotes a vector of exchange rate pass-through. The case $v_j = 1$ captures full exchange rate pass-through at the sectoral level, i.e. producer currency pricing, while $v_j = 0$ captures local currency pricing. Tariffs or other distortionary trade barriers can be captured as an ad-valorem tax on the import price. This enters linearly as

$$\mathbf{p}^F = \widetilde{\mathbf{p}}^F + \boldsymbol{\tau} \,. \tag{21}$$

where $\boldsymbol{\tau}$ is a vector of sectoral tariffs. Aside from the case where $v_j = 1$, there is a deviation from the law of one price. Similarly, in partial equilibrium, a 'terms-of-trade' shock would enter linearly to the price of Foreign goods, thereby shifting the Phillips curve as opposed to changing the slope.

3 Empirics

We now turn to the data to examine whether the mechanisms highlighted by our model are reflected in the behavior of sectoral inflation. In particular, the model predicts that greater reliance on imported intermediate inputs should weaken the sensitivity of inflation to domestic slack.[2] To test this prediction, we combine quarterly UK sectoral inflation and output data from the Office of National Statistics (ONS) with annual input–output data from the WIOD for 40 industries over 2000Q1–2014Q4.[3] We construct sector-specific measures of GVC integration based on the share of imported intermediates and interact these with sectoral output gaps to assess how imported input reliance affects the inflation–output gap relationship.[4]

3.1 Sectoral Regressions

Guided by the model, we estimate the following reduced-form specification for 2000Q1–2014Q4:

$$\pi_{jt} = \beta_1 \, \widetilde{y}_{jt} + \beta_2 \, \mathrm{IIS}_{j,t-4} + \beta_3 \, \widetilde{y}_{jt} \times \mathrm{IIS}_{j,t-4} + \beta_4 \left(\frac{1}{4} \sum_{k=1}^{4} \pi_{j,t-k} \right) + \delta_j + \delta_t + \varepsilon_{jt} \,, \tag{22}$$

where $\mathrm{IIS}_{j,t-4}$ is defined above as the ratio of imported intermediate goods in total intermediate goods in sector j at time t. The IIS variable is standardised so that coefficients measure the effect of a one-standard-deviation change in imported-input dependence, facilitating interpretation of interactions. Sectoral inflation series π_{jt} are calculated as the four-quarter percentage change in PPI and SPPI,

[2] We also look at whether aggregate trade openness can affect the relationship between the UK's inflation and the output gap. We find supporting evidence that rising trade openness in the UK led to a lower correlational between the inflation and the output gap. However, given that the estimations at the aggregate level are subject to identification issues and that our focus is trade in intermediate inputs, we do not report the results in the main text. See, Appendix A.3 for details.

[3] We can merge trade, price, and output data for 40 out of 56 WIOD sectors with a balanced panel, and they comprise 70% of total UK output.

[4] Inflation and output data are winsorized at the 1st and 99th percentiles, though results are robust to not winsorizing.

and $\widetilde{y}_{jt}$ is the sectoral output gap.[5] Panel data allow us to control for time-invariant sector-specific factors using sector fixed-effects as well as time-varying aggregate factors affecting inflation such as monetary policy (McLeay and Tenreyro (2020)) and aggregate inflation expectations (Ball and Mazumder (2019)) using a time fixed-effect.[6] To control for sector-level inflation expectations, we include a moving average of past sectoral inflation.[7]

The coefficient of interest is the interaction term, β_3. A negative interaction term would imply that increased GVC integration is associated with reduced responsiveness of inflation to the domestic output gap. Table 1 presents the results from estimating equation (22). Column (1) shows the positive and significant relationship between sectoral inflation and the output gap. This finding suggests that the UK Phillips curve can be precisely estimated using sectoral data. This aligns with the McLeay and Tenreyro (2020) critique, which posits that successful monetary policy might have contributed to a flattening in the Phillips curve by responding to inflation in timely manner and attenuating its reaction to demand-side shocks at the aggregate level. Exploiting the panel structure in inflation and output gap, and after controlling for aggregate level time-varying trends using time fixed-effects, we find a positive and significant Phillips curve coefficient in the UK within our sample period.

Moving to our main argument that increasing input trade might be related to reduced responsiveness of UK's inflation to domestic demand conditions, we present the results from the interaction of the sectoral output gap with the imported intermediate goods share in column (2). The coefficient of the interaction term (the third row) is negative, pointing to a role for GVCs in explaining the heterogeneity in inflation and output gap relationship across sectors. However, the coefficient is insignificant, implying an insufficient heterogeneity in the imported intermediate share variable to precisely estimate the role of GVCs in weakening the link between inflation and the output gap.

Source of Inputs. Given the weak role of overall IIS, we next investigate whether the source of imported intermediates matters. Aggregating across all trading partners may mask offsetting effects. Figure 1 compares the change in the share of AEs and EMEs in intermediate inputs used by three types of sectors, services, and capital goods manufacturing, and non-capital goods manufacturing. Notably, the figure displays a widespread rise in integration to the EMEs compared to the stable levels of dependence on AE imports between 2000 and 2014. This integration is particularly striking in sectors which manufacture capital goods, such as 'Computer Electronics', where the share of intermediate goods from EMEs has increased up to sixfold. By decomposing the $\text{IIS}_{j,t-4}$ variable into regional sources of imports, we observe the heterogeneity arises primarily from the EMEs rather than AEs or EU countries. Services sectors such as 'Hospitality' experienced an increase in IIS, but less is coming from EMEs. Non-capital goods manufacturing, which we term 'manufacturing', experienced an increase in IIS from EMEs, but less than that of capital goods manufacturing.

To formally differentiate the roles of integration of the UK sectors to different regions, we estimate

[5]Both sectoral inflation and output series are at a quarterly frequency and $\text{IIS}_{j,t-4}$ is available at the annual frequency. Details about the data sources can be found in Appendix A.

[6]We use *year* fixed-effects in our benchmark analysis, however, our results are robust to using *quarterly* fixed effects. Our results are also robust to including sector trends. Results from these estimations are available upon request from the authors.

[7]Inflation and output data are winsorized at the 1st and 99th percentiles; results are nearly identical without winsorization.

Table 1: GVCs and the UK Phillips Curve

	(1) Output Gap Only	(2) Role of GVCs
$\widetilde{y}_{jt}$	0.0430***	0.0426***
	(0.0138)	(0.0128)
$\text{IIS}_{j,t-4}$		-0.103
		(0.399)
$\widetilde{y}_{jt} \times \text{IIS}_{j,t-4}$		-0.00765
		(0.0216)
Average of Lags	0.376***	0.369***
	(0.0429)	(0.0486)
Industry FE	Y	Y
Time FE	Y	Y
No of Obs.	2158	2030
R^2	0.251	0.244

Note: Results are from Equation (22). Column (1) uses the equation without IIS_{jt} term. Column (2) estimates the full equation. Driscoll-Kraay standard errors are in parenthesis with a lag of 8.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Equation (22) by distinguishing between different source-region in variable $\text{IIS}_{j,t-4}$ as follows:

$$\text{IIS}^{\text{AE}}_{j,t-4} = \frac{\text{Imported Intermediate Goods}^{\text{AE}}_{j,t-4}}{\text{Total Intermediate Goods}_{j,t-4}}, \quad \text{IIS}^{\text{EM}}_{j,t-4} = \frac{\text{Imported Intermediate Goods}^{\text{EM}}_{j,t-4}}{\text{Total Intermediate Goods}_{j,t-4}},$$

and using the same equation, we can measure the impact of imported intermediate goods share for each country/region. Since we aim to compare the relative flattening effects of imports from each region, we standardize each variable around their mean before adding in regressions (leaving out the scaling effects).

Table 2 presents the results. The previous estimation result from total imported intermediate goods shares is shown in column (1). The estimated coefficients from columns (2), (3), and (4) provide the striking difference in the role of integration to the EU, AEs, and EMEs on the UK Phillips curve, respectively. Column (4) shows that the coefficient of the interaction term is negative and statistically significant, implying a role for imported intermediate goods shares from EMEs. To state differently, we find that increased integration of the UK sectors to the EMEs led to a diminished response of UK inflation to the output gap between 2000 and 2014. On the other hand, columns (2) and (3) suggest that we cannot precisely estimate the role of integration to the EU or AEs on the UK Phillips curve.

To report the economic significance of the results, recall that $\text{IIS}^{EME}_{j,t-4}$ is standardized; thus, the coefficient for the output gap (0.0389) denotes the Phillips curve coefficient for the mean level of integration to the EMEs. The coefficient of the interaction term (-0.0421) implies that one standard deviation increase in the share of imported intermediate goods from EMEs in UK sectors reduces the correlation between the inflation and the output gap to near 0. Furthermore, we apply back-of-the-envelope calculations to understand the importance of rising imported intermediate goods dependence on the EMEs on the value of the UK Phillips curve slope. Using the coefficients from column (4), we find that the Phillips curve coefficient reduced by 64% between 2000 and 2014 due to rising $\text{IIS}^{EME}_{j,t-4}$, after controlling for aggregate time-varying sector-specific time-invariant effects.

Our findings provide new evidence on the reasons behind the fall in response of inflation to

Table 2: GVCs and the UK Phillips Curve: The Source Matters

	(1) Total	(2) EU	(3) AEs	(4) EMEs	(5) EMEs vs. AEs
$\widetilde{y}_{jt}$	0.0426***	0.0418***	0.0432***	0.0389***	0.0354***
	(0.0128)	(0.0133)	(0.0137)	(0.0104)	(0.0116)
$\text{IIS}_{j,t-4}$	-0.103				
	(0.399)				
$\widetilde{y}_{jt} \times \text{IIS}_{j,t-4}$	-0.00765				
	(0.0216)				
$\text{IIS}^{\text{EU}}_{j,t-4}$		-0.144			
		(0.541)			
$\widetilde{y}_{jt} \times \text{IIS}^{\text{EU}}_{j,t-4}$		-0.00290			
		(0.0190)			
$\text{IIS}^{\text{AE}}_{j,t-4}$			-0.401		-0.752*
			(0.416)		(0.435)
$\widetilde{y}_{jt} \times \text{IIS}^{\text{AE}}_{j,t-4}$			-0.00127		0.0414*
			(0.0187)		(0.0211)
$\text{IIS}^{\text{EME}}_{j,t-4}$				0.389	0.583***
				(0.234)	(0.196)
$\widetilde{y}_{jt} \times \text{IIS}^{\text{EME}}_{j,t-4}$				-0.0421**	-0.0732***
				(0.0172)	(0.0243)
Industry FE	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y
No of Obs.	2030	2030	2030	2030	2030
R^2	0.244	0.244	0.245	0.249	0.255

Note: Results are from Equation (22). Columns (1)-(4) use $\text{IIS}_{j,t-4}$, $\text{IIS}^{EU}_{j,t-4}$, $\text{IIS}^{\text{AE}}_{j,t-4}$, $\text{IIS}^{\text{EME}}_{j,t-4}$, respectively. Column (5) includes both $\text{IIS}^{\text{AE}}_{j,t-4}$ and $\text{IIS}^{\text{EME}}_{j,t-4}$ in the regression. Driscoll-Kraay standard errors are in parenthesis with a lag of 8. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

the fluctuations in domestic demand in the UK. Different from previous studies that emphasize the importance of trade integration on inflation dynamics, here we argue that the regional direction of the integration affects inflation and economic activity relationships. Comparing integration with EMEs versus other regions shows that the source of imports is essential for understanding the UK's inflation-activity relationship. We next examine the role of each channel we discussed in our model in deriving our results. Namely, we disentangle the role of first the slope and second the terms of trade.

3.2 Robustness Checks

Including Lags. We first aim to isolate the impact of the increased use of imported intermediates in production on the link between inflation and the output gap. To do so, we use lags of our GVC measurement in our regressions. Furthermore, we calculate the two- and three-year moving average in IIS^{EM}_{jt} to smooth short-run relative price fluctuations.

Table 3 presents the results with a baseline specification (column (1)), using the lag of our GVC measurement $IIS^{EM}_{j,t-4}$ (column (2)), two-year moving average and three-year moving average. The interaction terms from each column suggest that integration to the EMEs flattens the slope of the UK's Phillips curve consistently with the theoretical results presented in section 2.

Table 3: Further Controls on Medium-term Impacts

	(1) Two-Year Moving Average	(2) Three-Year Moving Average
$\widetilde{y}_{jt}$	0.0358*	0.0324
	(0.0206)	(0.0205)
$\overline{\text{IIS}}_{j,t-8\to t-4}$	-0.0617	
	(0.293)	
$\widetilde{y}_{jt} \times \overline{\text{IIS}}_{j,t-8\to t-4}$	-0.0363*	
	(0.0204)	
$\overline{\text{IIS}}_{j,t-12\to t-4}$		-0.135
		(0.324)
$\widetilde{y}_{jt} \times \overline{\text{IIS}}_{j,t-12,t-4}$		-0.0412*
		(0.0209)
Industry FE	Y	Y
Time FE	Y	Y
No of Obs.	1877	1720
R^2	0.549	0.561

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Instrumental Variable Analysis. Following the trade literature, we assess the potential endogeneity problem due to including the $\text{IIS}_{j,t-4}$ variable in Equation (22) which can affect the interpretation of its role on the flattening of the Phillips curve. In particular, we follow Autor et al. (2013) and argue that import increases might not be due to the increased competitiveness or higher productivity in the source country but also be caused by increasing demand in the importer country. Since higher import demand is correlated with higher inflation, estimations would suffer from endogeneity, and an OLS estimation would understate the actual impact.

We follow Autor et al. (2013) and estimate the following structural equation and the first stage of the IV specification,

$$\pi_{jt} = \beta_1 \, \widetilde{y}_{jt} + \beta_2 \, \text{IIS}_{j,t-4} + \beta_3 \, \widetilde{y}_{jt} \times \text{IIS}_{j,t-4} + \beta_4 \left(\frac{1}{4} \sum_{k=1}^{4} \pi_{j,t-k} \right) + \delta_j + \delta_t + \epsilon_{jt} \tag{23}$$

$$\text{IIS}_{j,t-4} = \alpha \, \text{IIS}^{Others}_{j,t-4} + \delta_j + \delta_t + \eta_{jt} \; , \tag{24}$$

where we use the imports of 8 other developed countries from EMEs and China separately to calculate $\text{IIS}^{Others}_{j,t-4} = \frac{\text{Imported Intermediate Goods}^{Others}_{j,t-4}}{\text{Total Intermediate Goods}_{j,t-4}}$.[8] Here, the identification assumption is that the import demand shocks at the sector level between the UK and 8 other developed countries are independent.[9] Table 4 shows that the flattening effect of integration with both EMEs (columns (1) and (2)) and China (columns (1) and (2)) are robust to IV estimation. The coefficients on interaction terms are slightly higher (in absolute terms) and statistically significant at 5%.

[8] These include Australia, Denmark, Finland, Germany, Japan, Spain, Switzerland, United States. The correlation between the instrument and the endogenous regressor is 0.85.

[9] The results are robust to using G7 countries or only the U.S. for instrumenting the UK's imports.

Table 4: Instrumental Variable Analysis

	(1) OLS	(2) IV	(3) OLS	(4) IV
$\widetilde{y}_{jt}$	0.0389***	0.0408***	0.0397***	0.0383***
	(0.0104)	(0.0118)	(0.0103)	(0.0102)
$\mathrm{IIS}^{\mathrm{EM}}_{j,t-4}$	0.389	0.379		
	(0.234)	(0.708)		
$\widetilde{y}_{jt} \times \mathrm{IIS}^{\mathrm{EM}}_{j,t-4}$	-0.0421**	-0.0456***		
	(0.0172)	(0.0161)		
$\mathrm{IIS}^{\mathrm{CH}}_{j,t-4}$			0.356**	0.540**
			(0.146)	(0.242)
$\widetilde{y}_{jt} \times \mathrm{IIS}^{\mathrm{CH}}_{jt-4}$			-0.0464***	-0.0470***
			(0.0141)	(0.0128)
First-stage Fstat		1048.6		520.7
Industry FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
No of Obs.	2030	2030	2030	2030
R^2	0.249	0.248	0.250	0.251

Standard errors in parentheses

Driscoll-Kraay standard errors are in parentheses with a lag of 8

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4 Dissecting the mechanism: Why EMEs?

Our empirical evidence establishes that GVC integration with EMEs systematically affects the sectoral inflation-output gap relationship. However, the reduced-form analysis does not identify the mechanism behind this result. In particular, the data alone do not reveal why integration with EMEs—rather than with other advanced economies–drives the results we find. We argue that two features of the UK's GVC integration patterns are central to understanding this asymmetry: (i) the source dimension, since integration to EMEs inputs have increased significantly in our sample period, and (ii) the sectoral dimension, as the rise in EME integration has been disproportionately concentrated in capital goods industries. To assess whether these characteristics can jointly account for our empirical findings, we develop a quantitative two-country model of GVCs and use counterfactual exercises to evaluate how sectoral and source-specific integration shape the inflation-output relationship.

4.1 A New-Keynesian Model with Global Value Chains

In this section, we introduce a two-country, multi-sector New Keynesian model with sectoral linkages. The two countries, Home (H) and Foreign (F), are populated by a continuum of infinitely lived households with a fraction of n and $1 - n$ of the total world population, respectively. Relative to the static model in section 2, this model extends the setup to allow for dynamics and general equilibrium.[10]

In each country, there is a continuum of firms indexed by $i \in [0, 1]$ and each firm belongs to a sec-

[10] The modeling choices are standard. For instance Comin and Johnson (2020) presents a similar small open economy model with Rotemberg price adjustments instead of Calvo. We differ from them by presenting a two-country structure that accounts for the endogenous changes in terms of trade.

tor, $s \in 1, ..., S$. Firms produce differentiated products which can be sold domestically or exported for consumption and production. Our model incorporates GVCs through trade in intermediate inputs. In each sector, monopolistically competitive firms produce their output using labor and intermediate goods as inputs. Each period, producers choose how much intermediate input they want to buy from each sector and then they decide whether to buy home or foreign-produced intermediates. Similarly, we assume that aggregate consumption is a composite of sectoral consumption goods and each of these goods is a CES aggregate of home and foreign-produced goods. Thus, there is trade in final goods as well. Changes in global value chains are captured through transitory changes in tariffs for imported intermediate inputs and final goods. For brevity, we present the equations only for the Home economy. The Foreign economy has a symmetric setup.

4.2 Model Setup

Preferences. Each period households optimally allocate their total expenditure across sectoral goods. The final consumption basket is a CES aggregate of finitely many sectoral goods $s \in \{1, 2, \ldots, S\}$ in each country,

$$C_t = \left[\sum_{s=1}^{S} \eta_s^{\frac{1}{\phi_C}} (C_{st})^{\frac{\phi_C - 1}{\phi_C}} \right]^{\frac{\phi_C}{\theta_C - 1}} , \tag{25}$$

where ϕ_C is elasticity of substitution between sectoral consumption goods and η_s is the share of sector s in total consumption with $\sum_{s=1}^{S} \eta_s = 1$. Sectoral goods themselves are also CES aggregates of Home (C_{Hst}) and Foreign (C_{Fst}) consumption goods such that,

$$C_{st} = \left[\alpha_s^{\frac{1}{\phi_{Cs}}} (C_{Hst})^{\frac{\phi_{Cs}-1}{\phi_{Cs}}} + (1 - \alpha_s)^{\frac{1}{\phi_{Cs}}} (C_{Fst})^{\frac{\phi_{Cs}-1}{\phi_{Cs}}} \right]^{\frac{\phi_{Cs}}{\phi_{Cs}-1}} , \tag{26}$$

where α_s represents the share of home-produced goods in sectoral consumption and ϕ_{Cs} is the elasticity of substitution between home and foreign-produced consumption goods which is allowed to be different across sectors. As in the static model, the share of imported goods in each sector is a function of relative country size, $1 - n$, and the degree of openness in final demand, v_{Cs}: $1 - \alpha_s = (1 - n)\, v_{Cs}$. When $\alpha_s > 0.5$, there is home bias in preferences in a given sector. Household expenditure minimization yields the following optimal demand for sectoral goods,

$$C_{st} = \eta_s \left(\frac{P_{st}}{P_t} \right)^{-\phi_C} C_t, \tag{27}$$

where the aggregate price index is $P_t = \left[\sum_{s=1}^{S} \eta_s P_{st}^{1-\phi_C} \right]^{\frac{1}{1-\phi_C}}$. Sectoral consumption is further allocated between home and foreign goods according to,

$$C_{Hst} = \alpha_s \left(\frac{P_{Hst}}{P_{st}} \right)^{-\phi_{Cs}} C_{st} \text{ and } C_{Fst} = (1 - \alpha_s) \left(\frac{(1 + \tau_{st}) P_{Fst}}{P_{st}} \right)^{-\phi_{Cs}} C_{st} , \tag{28}$$

where the sectoral price index is $P_{st} = \left[\alpha_s P_{Hst}^{1-\phi_{Cs}} + (1 - \alpha_s)((1 + \tau_{st}) P_{Fst})^{1-\phi_{Cs}} \right]^{\frac{1}{1-\phi_{Cs}}}$. Imported final goods are subject to tariffs τ_{st}, which creates a deviation from the law of one price. Households derive utility from consumption and disutility from supplying labor. The lifetime utility function of the representative household is given by

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{C_t^{1-\sigma}}{1-\sigma} - \Xi \frac{L_t^{1+\varphi}}{1+\varphi} \right\}, \tag{29}$$

where β is the discount factor and Ξ is a preference parameter. Households finance expenditure on consumption goods through labor income and profits from the ownership of firms. We assume that the international asset markets are complete in the sense that households trade state-contingent securities that are denominated in the home currency to buy consumption goods. Additionally, we assume that only bonds that are issued by home are traded internationally. The period budget constraint of the home household is

$$P_t C_t + \sum Q_{t,t+1} B_{Ht,t+1} \leq B_{Ht-1,t} + W_t L_t + D_t + T_t \ , \tag{30}$$

where P_t is the CPI, W_t is the nominal wage and D_t are firm profits. $B_{Ht,t+1}$ denotes the home households holding of nominal state-contingent internationally traded bonds which deliver one unit of home currency in period $t+1$ if a particular state occurs. $Q_{t,t+1}$ is the price of such bond at time t. The government provides lump-sum transfers T_t to the household, which consists of rebating the revenues from tariffs. Solving the household's problem yields a standard Euler equation, intra-temporal equation and Backus-Smith condition.

Firms. The supply side of the economy consists of perfectly competitive sectoral producers at the retail level and monopolistically competitive firms at the wholesale level. Infinitely many competitive firms aggregate firm-level domestic varieties $Y_{Hst}(i)$ into sectoral goods Y_{Hst} using the following technology,

$$Y_{Hst} = \left[\int_0^1 Y_{Hst}^{\frac{\epsilon_s}{\epsilon_s - 1}}(i) di \right]^{\frac{\epsilon_s - 1}{\epsilon_s}}, \tag{31}$$

where ϵ_s is the elasticity of substitution between varieties within a sector. The solution to this aggregation problem implies the following demand for varieties,

$$Y_{Hst}(i) = \left(\frac{P_{Hst}(i)}{P_{Hst}} \right)^{-\epsilon_s} Y_{Hst} \ . \tag{32}$$

Firms use labor and intermediate inputs to produce a unit of output. The production function is given by,

$$Y_{Hst}(i) = A_t A_{st} L_{st}(i)^{\delta_s} M_{st}(i)^{1-\delta_s} \ , \tag{33}$$

where L_{st} denotes firm i's labor demand and δ_s denotes the share of labor in production. Aggregate and sectoral productivity assumed to follow an AR(1) process and are represented by A_t and A_{st}

respectively.[11] Each firm i uses intermediate good, $M_{st}(i)$, which is a CES aggregate of sectoral goods,

$$M_{st}(i) = \left[\sum_{s'=1}^{S} \chi_{ss'}^{\frac{1}{\theta_M}} \left(M_{ss't}(i) \right)^{\frac{\theta_M - 1}{\theta_M}} \right]^{\frac{\theta_M}{\theta_M - 1}}, \tag{36}$$

where $M_{ss't}$ is the intermediate good demand of sector s from sector s' at time t, and $\chi_{ss'}$ is the share of sector s' in total intermediate good expenditure of sector s with $\sum_{s'=1}^{S} \chi_{ss'} = 1$. The elasticity of substitution across sectoral intermediate goods is denoted by θ_M. Firms' sectoral input demand is a CES aggregate of domestic and foreign intermediate goods as in the consumption case,

$$M_{ss't}(i) = \left[\mu_{ss'}^{\frac{1}{\phi_{Ms}}} \left(M_{Hss't}(i) \right)^{\frac{\phi_{Ms} - 1}{\phi_{Ms}}} + (1 - \mu_{ss'})^{\frac{1}{\phi_{Ms}}} \left(M_{Fss't}(i) \right)^{\frac{\phi_{Ms} - 1}{\phi_{Ms}}} \right]^{\frac{\phi_{Ms}}{\phi_{Ms} - 1}}, \tag{37}$$

where $M_{Hss't}(i)$ and $M_{Fss't}(i)$ denote domestic and foreign intermediate good demand of sector s from sector s' at time t, respectively. There exists sectoral home bias at the intermediate level denoted by $\mu_{ss'}$, and ϕ_{Ms} denotes the elasticity of substitution between home and foreign-produced intermediate goods which is allowed to be different across sectors. Similar to consumption preference structure, we assume that the share of imported intermediate goods is a function of relative country size and the degree of openness in intermediate goods in a sector.

Every period, firms choose the labor and intermediate inputs to minimize their costs. Optimal input demands are,

$$L_{st} = \delta_s \left(\frac{MC_{st}}{W_t} \right) Y_{Hst} \text{ and } M_{st} = (1 - \delta_s) \left(\frac{MC_{st}}{P_{st}^M} \right) Y_{Hst},$$

where MC_{st} is sectoral marginal cost (will be defined below) and P_{st}^M is the intermediate input price index for sector s. Firms also optimally choose sectoral intermediate goods as,

$$M_{ss't} = \chi_{ss'} \left(\frac{P_{ss't}^M}{P_{st}^M} \right)^{-\theta_M} M_{st},$$

where intermediate input price index is $P_{st}^M = \left[\sum_{s'=1}^{S} \chi_{ss'} \left(P_{ss't}^M \right)^{1-\theta_M} \right]^{\frac{1}{1-\theta_M}}$, and the demand for home and foreign sectoral inputs is given by,

$$M_{Hss't} = \mu_{ss'} \left(\frac{P_{Hs't}}{P_{ss't}^M} \right)^{-\phi_{Ms}} M_{ss't} \text{ and } M_{Fss't} = (1 - \mu_{ss'}) \left(\frac{(1 + \tau_{s't}) P_{Fs't}}{P_{ss't}^M} \right)^{-\phi_{Ms}} M_{ss't},$$

where sectoral intermediates price index is a weighted average of home and foreign sectoral output prices $P_{ss't}^M = \left[\mu_{ss'} P_{Hs't}^{1-\phi_{Ms}} + (1 - \mu_{ss'}) ((1 + \tau_{s't}) P_{Fs't})^{1-\phi_{Ms}} \right]^{\frac{1}{1-\phi_{Ms}}}$. Note that imported intermediate goods are also subject to tariffs. Using firms' demand for factors of production, we can derive the

[11] The law of motion for aggregate and sectoral productivity are

$$\log A_t = (1 - \rho_A) \log \overline{A} + \rho_A \log A_{t-1} + \varepsilon_{At}, \tag{34}$$
$$\log A_{st} = (1 - \rho_{As}) \log \overline{A_s} + \rho_{As} \log A_{st-1} + \varepsilon_{Ast}, \tag{35}$$

where ε_{At} and $\varepsilon_{A_s t}$ are i.i.d. innovations.

sectoral nominal marginal cost,

$$MC_{st} = \frac{1}{A_t A_{st}} \left(\frac{W_t}{\delta_s} \right)^{\delta_s} \left(\frac{P^M_{st}}{1-\delta_s} \right)^{1-\delta_s} . \tag{38}$$

Note that sectoral linkages through input-output relationships at the intermediate goods level imply a sectoral marginal cost that depends on other sectors' output prices.

Pricing. We assume that firms are subject to Calvo-type price rigidities such that a firm can update its price with a probability of $1-\theta_s$, where θ_s denotes the sector-specific price stickiness. Wholesalers can re-set its price, maximizes the present discounted future value of profits

$$\mathbb{E}_t \sum_{k=0}^{\infty} (\beta\theta_s)^k \left(\frac{C_{t+k}}{C_t} \right)^{-\sigma} \{P_{Hst}(i)Y_{Hst}(i) - MC_{st}(i)Y_{Hst}(i)\} \ , \tag{39}$$

subject to demand function (32). We assume that the law of one price holds such that the pre-tariff price of foreign goods in the units of home currency is $P_{Fst} = \mathcal{E}_t P^*_{Fst}$ and the pre-tariff price of home goods in the units of Foreign currency is $P^*_{Hst} = \frac{P_{Hst}}{\mathcal{E}_t}$.[12]

Government. The government rebates tax revenues lump-sum to the household and has a balanced budget in every period. Tax revenues consists of tariffs on imported intermediate and final goods such that,

$$T_t = \tau_{st} P_{Fst} \sum_{s=1}^{S} \left(C_{Fst} + \sum_{s'=1}^{S} M_{Fs'st} \right) . \tag{40}$$

Market Clearing. Labor is perfectly mobile across sectors but not across countries. Therefore, the labor market clearing conditions is,

$$L_t = \sum_{s=1}^{S} L_{st} \ . \tag{41}$$

Sectoral goods can be used domestically for consumption and for further production as intermediate inputs or they can be exported. Exports can be consumed by foreign consumers or used by foreign firms as inputs. Thus, we can write the market clearing conditions for Home and Foreign goods as,[13]

$$Y_{Hst} = C_{Hst} + \sum_{s'=1}^{S} M_{Hs'st} + \left(\frac{1-n}{n} \right) \left(C^*_{Hst} + \sum_{s'=1}^{S} M^*_{Hs'st} \right) , \tag{44}$$

[12] We acknowledge that imperfect exchange rate pass-through can be important to understand the fluctuations in international relative prices as explored by Devereux and Engel (2002). Nevertheless, we follow Galí and Monacelli (2005) and focus on producer currency pricing to single out the mechanism at play.

[13] Alternatively, one can model the integration of GVCs through 'lost' resources akin to an iceberg trade cost. This captures more technological features of trade. Whereas tariff revenues are rebated to the household, iceberg trade costs leads to a loss in resources for the country as a whole. The market clearing conditions would change to

$$Y_{Hst} = C_{Hst} + \sum_{s'=1}^{S} M_{Hs'st} + \left(\frac{1-n}{n} \right) (1+\tau^*_{st}) \left(C^*_{Hst} + \sum_{s'=1}^{S} M^*_{Hs'st} \right) , \tag{42}$$

$$Y_{Fst} = C^*_{Fst} + \sum_{s'=1}^{S} M^*_{Fs'st} + \left(\frac{n}{1-n} \right) (1+\tau_{st}) \left(C_{Fst} + \sum_{s'=1}^{S} M_{Fs'st} \right) . \tag{43}$$

The main difference is with tariffs is the income effect.

$$Y_{Fst} = C^*_{Fst} + \sum_{s'=1}^{S} M^*_{Fs'st} + \left(\frac{n}{1-n}\right)\left(C_{Fst} + \sum_{s'=1}^{S} M_{Fs'st}\right). \tag{45}$$

Similar to the consumption preference structure, we assume that the share of imported intermediate goods is a function of relative country size and the degree of openness in intermediate goods in a sector. The resource constraint states that goods produced in each country must be consumed as final goods, used in intermediate production, or lost due to iceberg costs.

Combining the household and government's budget constraints (30), (40), along with the Home goods market clearing condition (44), yields the Home country's budget constraint,

$$\sum Q_{t,t+1}B_{Ht,t+1} - B_{Ht-1,t} = P_{Ht}\left(Y_t - \sum_{s=1}^{S}\left[C_{Hst} + \sum_{s'=1}^{S} M_{Hs'st}\right]\right) - \left(\frac{1-n}{n}\right) P_{Ft}\left(\sum_{s=1}^{S}\left[C_{Fst} + \sum_{s'=1}^{S} M_{Fs'st}\right]\right),$$

where the left-hand-side is the (nominal) change in the state-contingent internationally traded assets and the right-hand-side captures the trade balance.

Monetary policy. Monetary policy authority sets the nominal interest rate following an inertial Taylor rule which targets CPI inflation,

$$\frac{I_t}{\bar{I}} = \left(\frac{I_{t-1}}{\bar{I}}\right)^{\Gamma_i}\left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\Gamma_\pi(1-\Gamma_i)} \exp(\varepsilon_{mt}), \tag{46}$$

where ε_{mt} is a monetary policy shock.

4.3 Calibration

The model is calibrated such that Home represents Advanced Economies, and Foreign represents Emerging Market Economies. Furthermore, we calibrate the model to a three-sector economy which consists of Capital Goods, Manufacturing, and Services. This keeps the model tractable whilst capturing the key features from the data. Table 5 shows the calibration of the model.

The three sectors differ in key features: sector size, labor share, position in the input-output linkage, and the home bias (for final and intermediate goods). The Capital Goods sector is the smallest sector in final consumption, has the smallest labor share, is the most upstream in the input-output network, and is imports relatively more intermediate inputs. The Services sector is the opposite. It is the largest sector in final consumption, has the largest labor share, is the most downstream in the input-output network, and imports little intermediate inputs. Manufacturing lies in between.

Table 5: Baseline Calibration

	Parameter	Value	Target/ Source
Households			
σ	Coefficient of relative risk aversion	1	Standard
Ξ	Relative disutility of hours	1	Mean hours worked at 0.33
φ	Inverse Frisch Elasticity	2	Standard
β	Discount factor	0.99	Standard
Firms			
ϕ_C	Elasticity of subst. across sectors in final consumption	0.9	Huo et al. (2025)
$(\phi_{Cs})_{s=1,2,3}$	Elasticity of subst. between Home and Foreign goods in final consumption	[2, 2, 2]	
$(\eta_s)_{s=1,2,3}$	Size of sector in final consumption	[0.05, 0.22, 0.73]	WIOD
$(\alpha_s)_{s=1,2,3}$	Home bias in final goods	[0.33, 0.54, 0.94]	WIOD
$(\delta_s)_{s=1,2,3}$	Labor share	[0.33, 0.31, 0.58]	WIOD
ϕ_M	Elasticity of subst. across sectors in intermediate inputs	0.9	Huo et al. (2025)
$(\phi_{Ms})_{s=1,2,3}$	Elasticity of subst. between Home and Foreign goods in intermediate inputs	[2, 2, 2]	
$(\chi_{ss'})_{s,s'=1,2,3}$	Input-output matrix	$\begin{pmatrix} 0.39, 0.04, 0.04 \\ 0.27, 0.51, 0.16 \\ 0.34, 0.45, 0.79 \end{pmatrix}$	WIOD
$(\mu_{ss'})_{s,s'=1,2,3}$	Home bias for each sector-by-input	$\begin{pmatrix} 0.24, 0.35, 0.30 \\ 0.70, 0.60, 0.69 \\ 0.90, 0.91, 0.91 \end{pmatrix}$	WIOD
$(\theta_s)_{s=1,2,3}$	Price stickiness	[0.75, 0.75, 0.75]	
$(\epsilon_s)_{s=1,2,3}$	Elasticity of substitution between firms within sectors	[6,6,6]	Gross markup of 1.2
Other Parameters			
n	Country size	0.5	
Γ_π	Taylor Rule Coefficient on Inflation	2	Standard
Γ_i	Taylor Rule Smoothing	0.7	Standard

4.4 Dissecting the channels: GVCs in the Model

How does GVC integration affect the link between inflation and domestic slack? In our empirical analysis, we measure GVCs as the imported intermediate inputs as a share of total intermediate inputs:

$$GVC_{st}(\tau) = \frac{n}{1-n} \frac{\sum_{s'=1}^{S} P_{Fs't} M_{Fss't}}{P_{st}^{M} M_{st}} = \frac{\sum_{s'=1}^{S} P_{Fs't}(\tau_{st})(1-\mu_{ss'}) \left(\frac{P_{Fs't}}{P_{ss't}^{M}}\right)^{-\phi_{Ms}} \chi_{ss'} \left(\frac{P_{ss't}^{M}}{P_{st}^{M}}\right)^{-\theta_M} M_{st}}{P_{st}^{M} M_{st}},$$

In the model, GVC integration is thus a function of both structural parameters and relative prices. The parameter $\mu_{ss'}$ governs the share of foreign intermediates in sector s, so a lower μ corresponds to deeper GVC integration. But the measure is not purely technological: it also responds to international relative prices, and therefore to terms-of-trade movements, whenever the elasticities of substitution ϕ_{Ms} (between home and foreign intermediates) and θ_M (across sectoral intermediates) differ from 1.

To see this clearly, consider the benchmark Cobb–Douglas case where $\phi_{Ms} = \theta_M = 1$. Then GVC integration simplifies to:

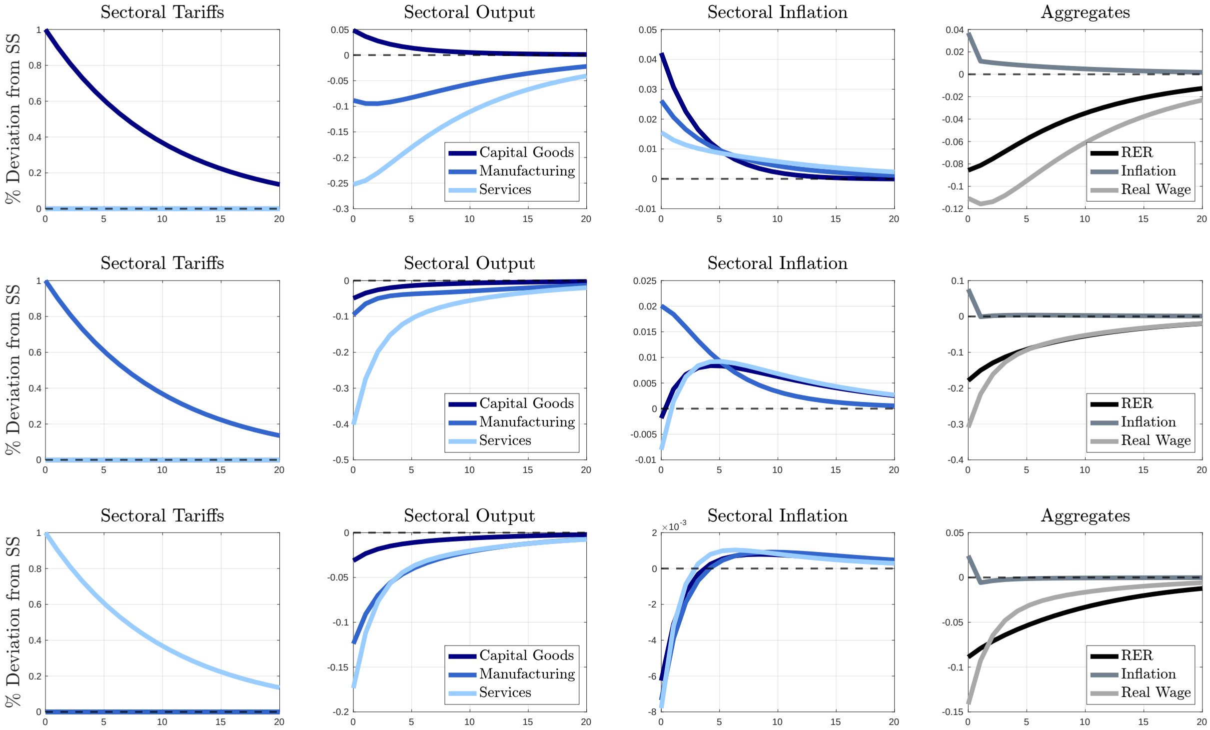
$$\frac{\sum_{s'=1}^{S} P_{Fs't} M_{Fss't}}{P_{st}^{M} M_{st}} = \sum_{s'=1}^{S} (1-\mu_{ss'})\, \chi_{ss'}.$$

so the empirical measure captures only openness in production, not relative-price movements. In practice, however, empirical estimates of the elasticity of substitution between home and foreign goods are rarely close to one (Feenstra (1994)), implying that measured GVC intensity varies with the terms of trade as well as with the underlying import share.This implies that our empirical measure of GVC integration reflects not only underlying openness in production but also fluctuations in relative prices.

Tariff shocks. To disentangle these forces and illuminate the mechanisms behind our empirical findings, we introduce a sector-specific tariff shock, τ_{st}, which raises the cost of foreign intermediates and mechanically reduces measured GVC integration. Figure 2 reports impulse responses to a 1% increase in sectoral tariffs. The first row presents the responses to a tariff shock in the Capital Goods sector, while the second and third rows show the corresponding responses for Manufacturing and Services. By lowering the foreign-input share, the tariff shock captures a sector-specific GVC fragmentation (or de-integration) exercise.

Across all cases, the aggregate responses are qualitatively similar: sectoral tariff increases raise aggregate inflation, depress output and real wages, and generate a real appreciation of Home relative to Foreign. However, transmission to sectoral variables differs substantially depending on the sector affected and the input–output linkages. As shown in the first row of Figure 2, a tariff shock to the capital goods sector raises its own inflation and output while reducing output in other sectors and increasing their inflation. In contrast, shocks to manufacturing (second row) or services sectors (third row) produce different patterns: manufacturing shocks generate trade-offs across sectors, lowering output and raising inflation, whereas services shocks act more like a negative demand shock, reducing both output and inflation broadly.

Figure 2: Impulse Response Functions to Sectoral Tariffs



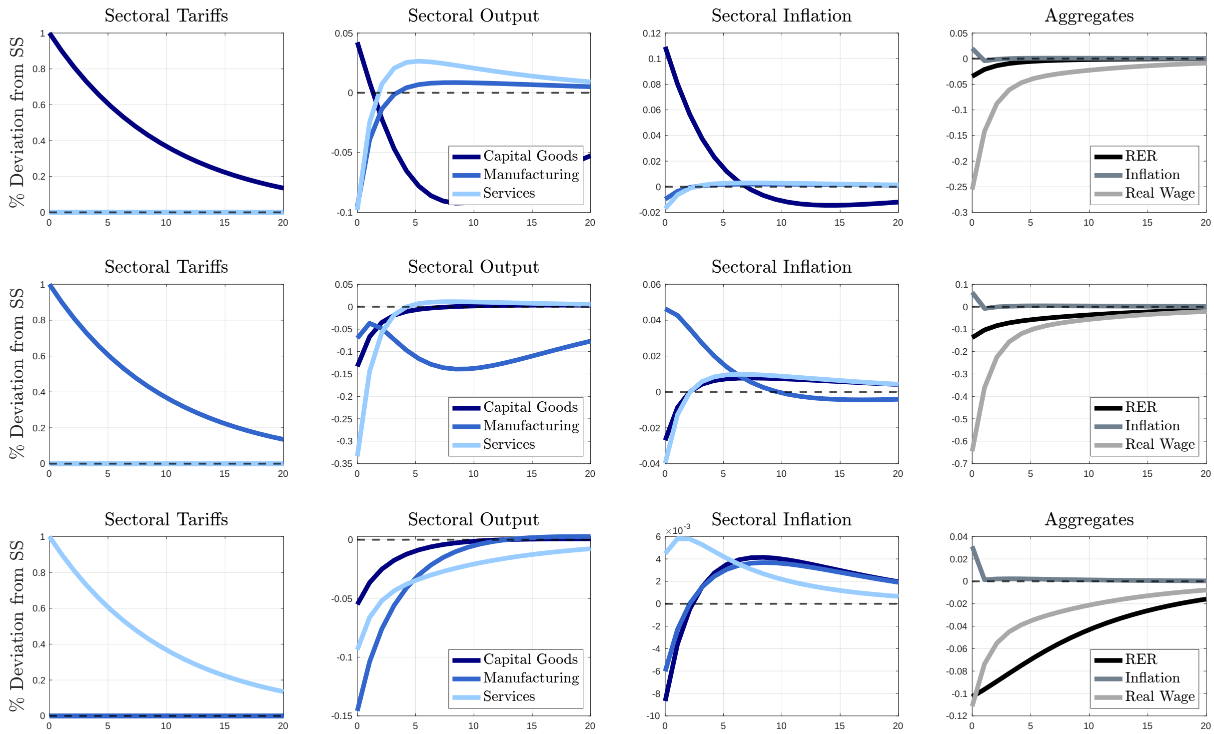
Notes: This figure shows the IRFs to a sectoral tariff shock. Row 1 shows the IRFs to a tariff shock in the capital goods sectors. Row 2 shows the IRFs to a tariff shock in the manufacturing sector. Row 3 shows the IRFs to a tariff shock in the services sector.

Counterfactual exercises. To understand the sources of these heterogeneous responses, we next conduct counterfactual exercises that isolate the roles of input-output linkages. In the model, firms' production choices are determined each period by how much labor they demand and, given this, how they allocate their intermediate input purchases across supplying sectors and between domestic and foreign sources. Three parameters govern the strength of these dynamics: (i) the sectoral labor share (δ_s); (ii) the input–output linkage matrix that determines how intensively each sector uses intermediates from every other sector ($\chi_{ss'}$); and (iii) the degree of openness in intermediate input demand, captured by the foreign share of intermediates ($1 - \mu_{ss'}$). Note that while the labor share varies substantially across sectors, changing these parameters do not change the qualitative results. The reason is that the labor share only scales the production technology. By contrast, input–output linkages and foreign-input dependence vary substantially across sectors—precisely along the dimensions highlighted in our empirical results, where EME exposure is concentrated in capital goods and where sectoral integration plays an important role. For this reason, our counterfactual exercises focus on $\chi_{ss'}$ and $\mu_{ss'}$, allowing us to isolate how differences in input–output structure and foreign-input dependence shape the propagation of sectoral GVCs shocks.

In Figure 3, we shut down firms' ability to source intermediates from other sectors and instead impose a "roundabout production" structure in which each sector can only use its own intermediates. This isolates the role played by input–output linkages in shaping the transmission of sector-specific GVC shocks.

Once inter-sectoral sourcing is eliminated, all GVC shocks generate a decline in output and inflation in the non-shocked sectors. This pattern reflects a pure income effect: de-integration raises the ef-

Figure 3: Counterfactual with no Input-Output Network



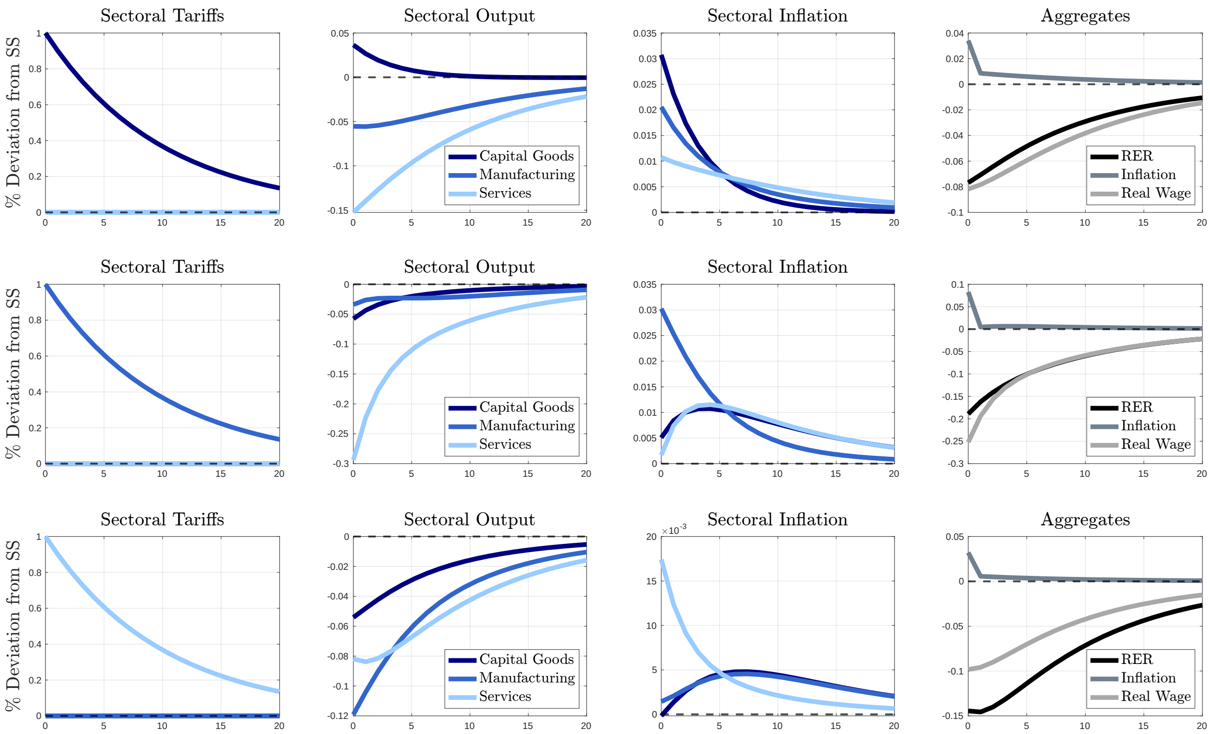
Notes: This figure shows the IRFs to a sectoral tariff shock. Row 1 shows the IRFs to a tariff shock in the capital goods sectors. Row 2 shows the IRFs to a tariff shock in the manufacturing sector. Row 3 shows the IRFs to a tariff shock in the services sector.

fective cost of imported intermediates, lowering real wages at Home and depressing demand in other sectors. In the benchmark economy, however, sectoral linkages re-route these shocks in markedly different ways. Capital-goods de-integration behaves like a positive demand disturbance for that sector, while services de-integration behaves like a negative demand shock. When input–output linkages are shut down, both instead transmit as standard negative supply shocks: for capital goods, output initially rises slightly but then falls, while for services the characteristic demand-like response disappears entirely—its inflation rises and output falls.

These differences make clear that the demand-side responses of the capital goods and services sectors in the benchmark model are largely a consequence of production-network structure. The underlying disturbance is a sector-specific tariff shock that raises production costs in the affected sector, pushing up its prices and reducing its output when demand is fixed. When firms lose the ability to substitute toward intermediates from other sectors, this negative supply shock becomes stronger and more localized, since sectors can no longer share or absorb the cost increase through the network. Intuitively, sectoral linkages flatten the sectoral Phillips curve of the shocked sector by allowing part of the cost increase to be absorbed elsewhere in the network. This dampens the standard supply-shock response and contributes to the more demand-like dynamics observed in the benchmark economy.

To further disentangle the forces behind the heterogeneous transmission of GVC shocks, we next examine the role of home bias in intermediate input sourcing. While the capital goods sector is highly open in the benchmark calibration, the services sector is unsurprisingly closed, relying overwhelmingly on domestic inputs. This asymmetry turns out to be central for understanding why the

Figure 4: Counterfactual with no Home Bias in Intermediate Inputs



Notes: This figure shows the IRFs to a sectoral tariff shock. Row 1 shows the IRFs to a tariff shock in the capital goods sectors. Row 2 shows the IRFs to a tariff shock in the manufacturing sector. Row 3 shows the IRFs to a tariff shock in the services sector.

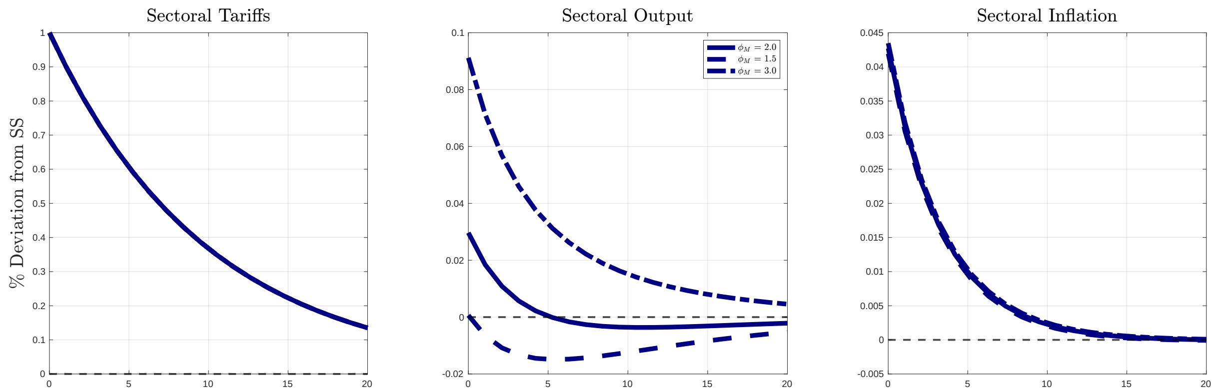
benchmark model generates a negative demand–type response for services, despite the tariff shock being a negative supply disturbance at the sectoral level.

Figure 4 shows the counterfactual in which we eliminate home bias in intermediate inputs, domestic and foreign inputs now enter symmetrically, while preserving the baseline input–output structure across sectors. Under this experiment, the GVC shock continues to transmit to the capital goods sector as a positive demand shock. By contrast, the services sector no longer displays the demand-like fall in inflation seen in the benchmark. Instead, its response reverts to the textbook negative supply shock pattern: inflation rises while output falls.

The mechanism is straightforward. In the benchmark economy, the high home bias in services insulates the sector from rising foreign input prices. Because imported intermediates represent only a small fraction of its total costs, the tariff shock has a limited impact on the service sector's marginal cost, while demand falls due to negative income effect and generate a decline in both services inflation and output. When we remove this asymmetry and make services more open, the shock feeds directly and more strongly into marginal cost. As a result, the negative supply component becomes dominant, and the sector behaves in line with a standard sectoral tariff shock.

We now turn to the final ingredient behind the distinctive transmission of GVC shocks to the capital goods sector: high openness combined with a high elasticity of substitution between domestic and foreign intermediates. In the model, a sector's intermediate input demand reflects both how exposed it is to foreign inputs and how easily firms can substitute away from imported inputs when their relative price rises. The capital goods sector is highly open in the benchmark calibration, and firms face an elasticity of substitution of 2 between domestic and foreign intermediates; a value sufficiently

Figure 5: Varying Elasticities of Substitution in Intermediate Inputs



Notes: This figure shows the IRFs to a tariff in the capital goods sector under three alternative values of the elasticity of substitution between Home and Foreign intermediate inputs.

high to generate strong substitution effects.

To quantify this mechanism, Figure 5 reports the responses of the capital goods sector to a GVC shock under three alternative elasticities of substitution: a lower value (1.5), our benchmark (2), and a higher value (3). The results confirm that substitutability is crucial for the sector's output response. When substitution channel is relatively dampened (elasticity of 1.5), the rise in the relative price of imported intermediates behaves like a standard negative supply shock: costs increase, inflation rises, and the sector's output falls. As the elasticity increases, firms shift more aggressively towards domestic intermediates when foreign inputs become more expensive. Because the capital goods sector is very open, this substitution margin is quantitatively large. With the benchmark elasticity of 2, the substitution effect is strong enough to more than offset the direct cost-push component, leading to an increase in sectoral output alongside rising inflation, the positive demand type pattern observed in the baseline. Thus, the combination of high openness and strong substitutability is what allows the capital goods sector to exhibit a demand like expansion in response to a de-integration shock.

When these ingredients are weakened, the response reverts toward the conventional negative supply pattern, underscoring that the amplification is not mechanical but structurally driven by the sector's position in global production networks. It is worth noting that, when we eliminate the home bias in capital good sector, its output and inflation still rise as shown in Figure 4. The consumption of capital goods also has a very large import share, therefore eliminating home bias only in production is not sufficient to eliminate the strong substitution effect that also arises in consumption.

Our counterfactual exercises help explain why GVC integration with EMEs matter for inflation dynamics. EME integration rose primarily in capital goods sectors, which are significantly more open than services and manufacturing. In such a sector, changes in the price or availability of foreign intermediates trigger large reallocation of input demand and stronger movements in marginal cost. As a result, shocks to EME sourced inputs in capital goods transmit more forcefully to domestic inflation dynamics, often generating 'demand-like' output responses when substitutability between home and foreign inputs is high. This interaction of high openness and high substitutability gives capital goods sectors a distinct impact on the inflation-output-gap relationship consistent with the pattern uncovered in our empirical analysis.

5 Conclusion

This paper examines how global value chains shape inflation dynamics, with a focus on the role of EMEs. We first show that imported intermediates enter marginal cost directly, weakening the sensitivity of inflation to domestic slack. A larger imported input share flattens the Phillips curve mechanically by reducing the weight of domestic inputs. Second, we show that terms-of-trade movements by transmitting international relative-price fluctuations into domestic inflation affect the inflation, output gap relationship. We then bring this prediction to the data and document that greater dependence on EME-sourced intermediates is associated with a significantly weaker relationship between inflation and the output gap across a range of reduced-form specifications. Crucially, it is not global integration per se, but integration with EMEs in particular, that underpins the empirical results.

To interpret this result, we develop a two-country model with trade in intermediates and sectoral input–output linkages. EMEs have become integrated predominantly through capital goods supply chains, rather than through services or manufacturing. Counterfactual exercises show that capital goods differ systematically from other sectors: they are substantially more open, source a wider set of foreign intermediates, and exhibit stronger input-demand reallocation when foreign intermediate prices shift. As a result, shocks to EME-sourced inputs propagate more powerfully through marginal costs in capital goods.

These findings highlight that the macroeconomic consequences of GVCs depend not only on the extent of integration but on where in the production network that integration occurs. Because EME integration has been concentrated in capital goods, any prospective fragmentation or trade war will likewise have sector-specific consequences. Understanding these channels is central for evaluating how future changes in global production structures may shape inflation dynamics and the transmission of domestic policy.

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Appendices

A Data Appendix

A.1 Data Sources

Sectoral Data: Sectoral inflation is calculated as a four-quarter percent change in Producer Price Index (PPI) and Service Producer Price Index (SPPI) from ONS. Data has been available at a quarterly frequency since 1997. The sectoral output series, Index of Production (IoP), and Index of Services (IoS) are also from ONS. Data has been available at a quarterly frequency since 1995 (1997 for the service sectors). Sectoral output gap series is calculated as the deviation indexes from their HP-filtered trends separately.

World Input-Output Database (WIOD): We use the last version (2016) of the WIOD to calculate imports, exports, and imported intermediate good values for 56 sectors at an annual frequency from 2000 to 2014. However, the sectoral aggregation from WIOD does not match the aggregation level of sectoral price and output data from ONS. Therefore, we use many-to-many matching using the weights from the Blue Book GDP Source Catalogue.

Country Coverage: Following the IMF classification, we consider Brazil, Hungary, China, India, Indonesia, Mexico, Poland, Romania, Russia and Turkey as EMEs; Austria, Belgium, Czech Republic, Cyprus, Germany, Denmark, Spain, Estonia, Finland, France, Greece, Croatia, Hungary, Ireland, Italy, Lithuania, Latvia, Luxembourg, Malta, the Netherlands, Norway, Poland, Romania, Slovakia, Slovenia and Sweden as the EU and Australia, Canada, South Korea, Japan, U.S., Switzerland and the EU excluding Poland, Hungary and Romania as AEs.

Business cycle correlations: We use OECD country-level real GDP growth statistics to calculate business correlations between countries and the UK.

A.2 Additional Figures

Table A1: Sector Definitions

Sector	WIOT Industry Code	Industry Description
Capital Goods	C26-C30	Manufacture of electronics, electrical equipment, machinery, motor vehicles, other transport.
Manufacturing	C10-C25, C31-C33	Manufacture of food/beverage, textiles, wood and paper products, media, petroleum, chemicals, pharmaceuticals, rubber and plastics, metals, fabricated metals, mineral products, and repairs/installations.
Services	D35, E36-39, F, G45-G47, H49-H53, I, J58-J63, K64-K66, L68, M69-M75, N, O84, P85, Q, R, S, T, U	Utilities, Construction, Retail Trades, Transport, Postal, Hospitality, Media, Business and Tech, Miscellaneous Work, Public Administration, Defence, Education, etc.

A.3 The Role of Trade

Here we explore the role of openness in the flattening of the UK's Phillips curve. We begin by displaying the trade openness and total import share over time (Figure A2) since the 1950s. Trade openness almost doubled from the mid-1980s to 2000 and then further increased by 50% from 2000 to 2020. Analogously, the share of imports doubled between the 1950s and 2010, remaining stable after that.

Both measures from Figure A2 point to a significantly increasing integration of the UK economy in global markets. We argue that increasing trade openness makes the prices in the UK economy less dependent on domestic factors. Therefore, the relationship between inflation and domestic economic activity weakens. To test this argument, we follow Ball (2006) and estimate the following regression where we interact aggregate output gap with trade openness

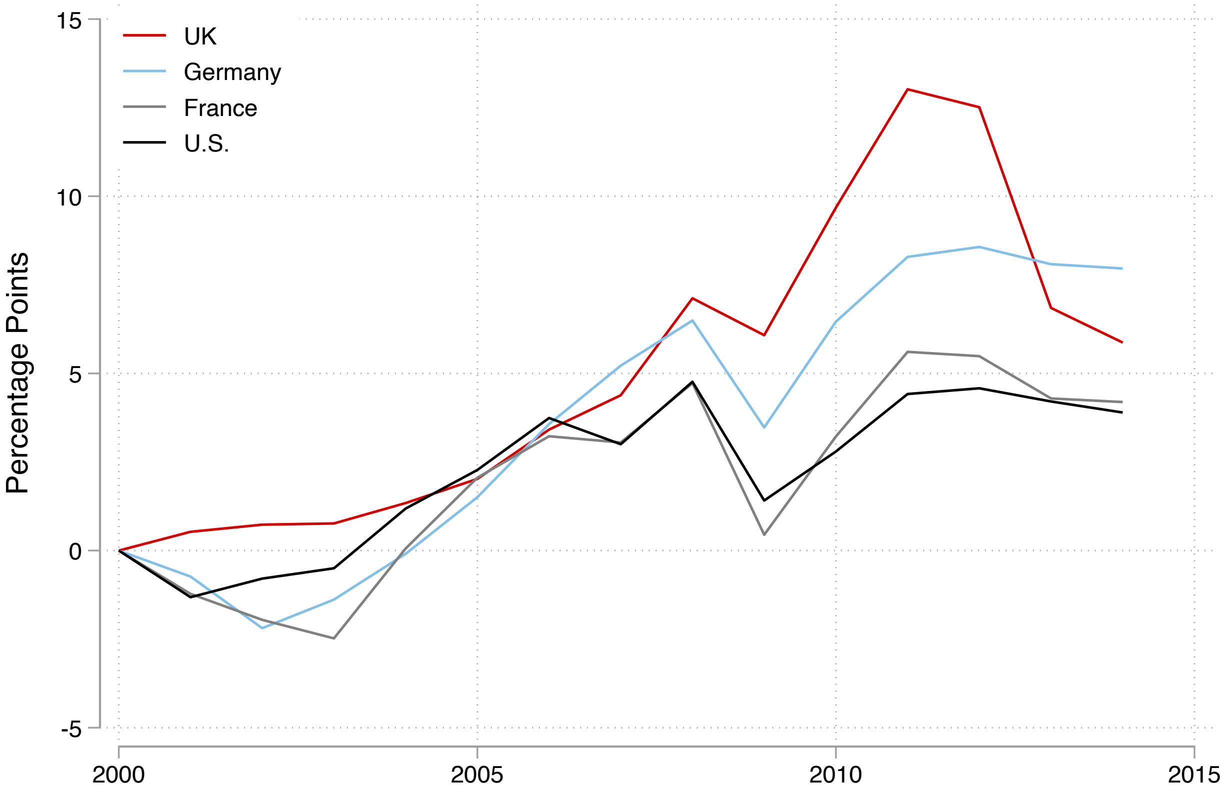
$$\pi_t = \beta_1 \left(y_t - y_t^*\right) + \beta_2 \text{Openness}_t + \beta_3 \left(y_t - y_t^*\right) \times \text{Openness}_t + \beta_4 \pi_t^M + \beta_5 \pi_t^{oil} + \beta_6 \left(\frac{1}{4} \sum_{j=1}^{4} \pi_{t-j}\right) + \varepsilon_t, \tag{A.1}$$

where $\text{Openness}_t = \frac{\text{Imports+Exports}}{\text{Real GDP}}$. This variable is standardized (around the mean) to ease the interpretation of the estimated coefficients. We are interested in the estimation of the interaction parameter, β_3.

Table A2 column (1) suggests that the coefficients attached to $(y_t - y_t^*) \times \text{Openness}_t$ is negative and statistically significant, supporting the argument that rising trade openness in the UK led to a flattening in the Phillips curve. Recall that, Openness_t is standardized, thus β_1 coefficient denotes the Phillips curve slope for the mean trade openness period (e.g., the mid-1990s) in our sample and the coefficient for the interaction term (β_3) represents the effect of a one standard deviation increase in trade openness on the slope of the Phillips curve.

As a robustness check, we control the role of the inflation targeting regime in 1992 and central bank independence in 1997. We include a dummy variable equal to 1 after 1992 ($Post_{1992}$) and another one after 1997 ($Post_{1997}$) to control separately for the possible effects of these two policies. Columns (2) and (3) show that the results remain qualitatively unchanged, implying that one standard deviation increase in the trade variable flattens the slope of the Phillips curve to roughly 0.1.

Figure A1: Change in IIS across other countries



Note: Source - WIOD. The figure shows the change in imported intermediate inputs as a share of total intermediate inputs for manufacturing sectors.

The results imply that openness may be an important driver behind the flattening of the UK Phillips curve.

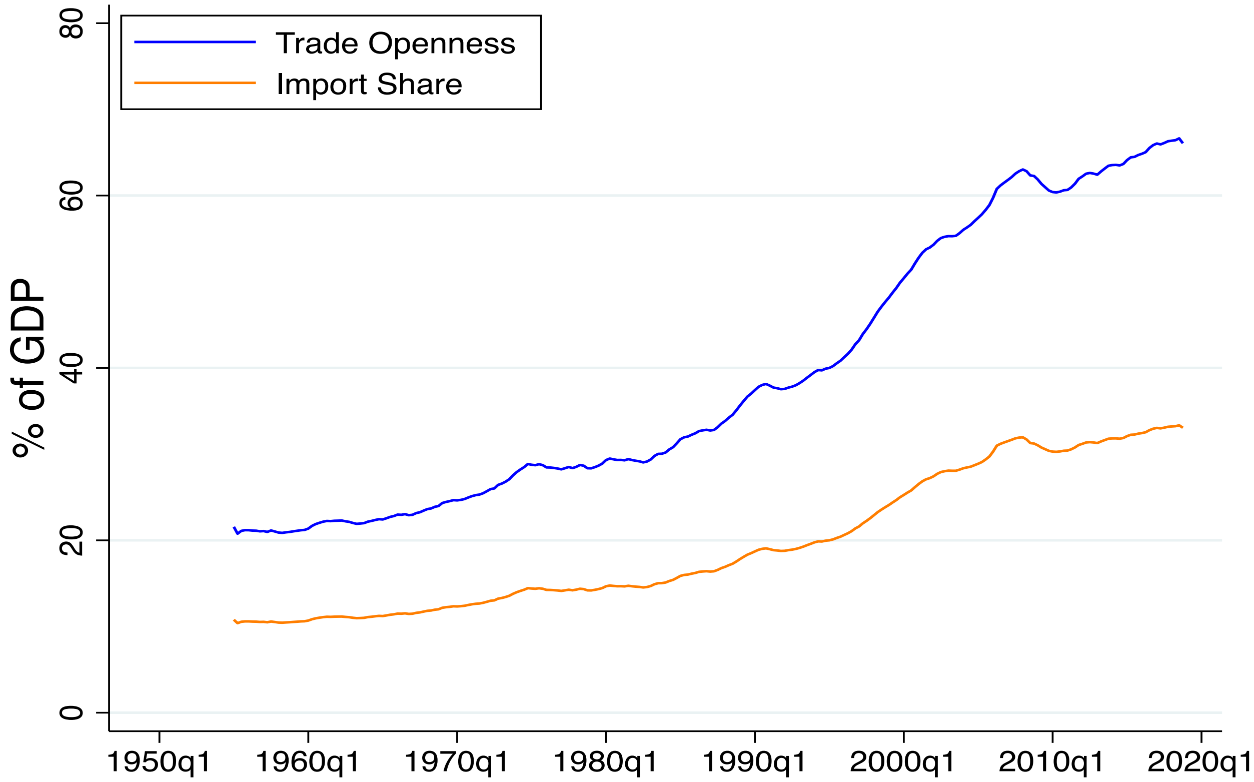
A.4 Indirect Effects

We examine the sensitivity of our results to the indirect effects of the rise in imported intermediate goods in production on the UK Phillips curve. The benchmark results documented the "direct" effects of the GVCs on the Phillips curve. However, a growing literature shows how a shock to one industry can propagate to other industries through sectoral linkages and generate more amplified effects on the aggregate economy. This subsection examines the role of amplified (direct+indirect) effects using input-output tables.

Let's redefine the variable IIS_{jt} from our estimations as the direct effects of the GVCs on industry j. Previous results showed that the inflation and output gap relationship is weaker in industries with higher imported intermediate goods dependence. This result also implies that the rigidity in output prices of an industry j will also be experienced by other industries that use goods/services from industry j as intermediate goods. Thus, the direct effects of IIS_{jt} to industry j propagates indirectly to its buyers. We define "Indirect effects" following Acemoglu et al. (2016) as

$$\text{IIS}_{jt}^{Ind} = \sum_{g} \omega_{gj} IIS_{gt}, \tag{A.2}$$

Figure A2: Trade openness



Note: Trade Openness: $\frac{\text{Imports+Exports}}{\text{Real GDP}}$ and Import Share: $\frac{\text{Imports}}{\text{Real GDP}}$ using ONS data.

which is equal to the weighted average of directly imported intermediate good shares (IIS_{gt}) across all industries, indexed by g, that *supply* goods to the industry j. The weights ω_{gj} are defined as

$$\omega_{gj} = \frac{\mu_{gj}}{\sum_{g'} \mu_{g'j}}, \tag{A.3}$$

where μ_{gj} is the value of inputs used by industry j from industry g, and calculated using 2000 ONS UK input-output tables. The weight ω_{gj} in Equation (A.3) is the share of inputs from industry g in total inputs used by industry j.

We also note that the imported intermediate good dependence of industry j affects other industries (g). Then, an affected industry g would further affect industry j and so on. To take into account the full chain of effects, we use the Leontief inverse of the linkages from weights of Equation (A.3) following Acemoglu et al. (2016). Thus, the total effects from GVC integration are measured using Leontief inverse matrices of weights such that

$$\text{IIS}_{jt}^{Total} = \sum_{g} \omega_{gj}^{L} \text{IIS}_{gt}, \tag{A.4}$$

where ω_{gj}^{L} are the weights adjusted by Leontief inverses.

The intuition for the indirect effects is that when an industry j's suppliers experience a high imported intermediate good dependence from abroad, then the industry j's inputs would be further

Table A2: Trade and the UK Phillips Curve
(1980Q1-2017Q1)

π_t	(1)	(2)	(3)
$\widetilde{y}_t$	0.427***	0.426***	0.429***
	(0.0934)	(0.0936)	(0.0952)
Openness_t	0.00983	0.0804	0.238
	(0.0563)	(0.120)	(0.212)
$\widetilde{y}_t \times \text{Openness}_t$	-0.315***	-0.316***	-0.319***
	(0.0870)	(0.0883)	(0.0892)
π_t^{oil}	0.0104*	0.0104*	0.0107*
	(0.00593)	(0.00589)	(0.00588)
π_t^M	0.0498***	0.0500***	0.0489***
	(0.0179)	(0.0173)	(0.0176)
$\frac{1}{4}\sum_{j=1}^{4}\pi_{t-j}$	0.913***	0.918***	0.924***
	(0.0241)	(0.0274)	(0.0272)
Observations	149	149	149
R^2	0.9674	0.9675	0.9677
$Post_{1992}$	No	Yes	No
$Post_{1997}$	No	No	Yes

Note: Newey-West standard errors in parentheses with a lag of 18.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Aggregate price and output data are from the Office for National Statistics (ONS). We calculate the aggregate output gap using the HP filtering method. Aggregate import and export variables are also from the ONS, and imported intermediate good value is from the WIOD.

dependent on imported goods and services. Therefore, we argue that this channel would further weaken the sensitivity of "output" prices against a change in economic activity as the input costs would be dependent abroad.

Note that Equation (A.4) generates a general formula to calculate the total effects of imported intermediate goods share. Thus, we focus on generating total effects for our two main results separately: Role of EMEs and low business cycle correlation countries.[14]

Table (A3) presents the results from the estimation of specification (22) using both direct and total effects. Comparison of the interaction terms between columns (1) and (2), and (3) and (4) cannot confirm the amplification of the GVCs' role through sectoral linkages. The interaction terms are negative and significant in each specification, but the coefficients are not different when total effects through sectoral linkages are used. Thus, the results suggest no evidence of the role of sectoral linkages amplifying the previous results.

[14] We calculate $\text{IIS}_{jt}^{EM,Total} = \sum_g \omega_{gj}^L IIS_{gt}$ and $\text{IIS}_{jt}^{BClow,Total} = \sum_g \omega_{gj}^L IIS_{gt}$ separately and use in our regressions.

Table A3: Indirect Effects

	(EMEs)		(Low BC Corr.)	
	(1)	(2)	(3)	(4)
	Direct	Total	Direct	Total
$\widetilde{y}_{jt}$	0.0483**	0.0490**	0.430***	0.0443***
	(0.02130)	(0.02140)	(0.01013)	(0.00994)
IIS_{jt}^{EM}	0.216			
	(0.2993)			
$\widetilde{y}_{jt} \times \text{IIS}_{jt}^{EM}$	-0.0429**			
	(0.0163)			
$\text{IIS}_{jt}^{EM,Total}$		0.231		
		(0.2939)		
$\widetilde{y}_{jt} \times \text{IIS}_{jt}^{EM,Total}$		-0.0410**		
		(0.0159)		
IIS_{jt}^{BClow}			0.552***	
			(0.18623)	
$\widetilde{y}_{jt} \times \text{IIS}_{jt}^{BClow}$			-0.0258**	
			(0.01145)	
$\text{IIS}_{jt}^{BClow,Total}$				0.563***
				(0.18868)
$\widetilde{y}_{jt} \times \text{IIS}_{jt}^{BClow,Total}$				-0.0269**
				(0.01139)
Average of Lags	0.379***	0.379***	0.364***	0.364***
	(0.1093)	(0.1092)	(0.0445)	(0.0447)
Industry FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
No of Obs.	2158	2158	2158	2158
R^2	0.537	0.537	0.561	0.561

Driscoll-Kraay standard errors are in parenthesis with a lag of 8.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

B Model Appendix

B.1 Derivation of Model Equations

Proof of Proposition 1. The marginal cost can be written as

$$\begin{aligned}\log MC &= \delta \log W + (1-\delta)\log P^M - \log A,\\ \log MC^* &= \delta^* \log W^* + (1-\delta^*)\log P^{M*} - \log A^*.\end{aligned}$$

The input price index can be written as

$$\begin{aligned}\log P^M &= \mu \log P_H + (1-\mu)\log P_F,\\ \log P^{M*} &= \mu^* \log P_F^* + (1-\mu^*)\log P_H^*,\end{aligned}$$

Combining the last two expressions yield

$$\begin{aligned}\log MC &= \delta \log W + (1-\delta)(\mu \log P_H + (1-\mu)\log P_F) - \log A,\\ \log MC^* &= \delta^* \log W^* + (1-\delta^*)(\mu \log P_F^* + (1-\mu)\log P_H^*) - \log A^*,\end{aligned}$$

Under producer currency pricing, we have

$$\begin{aligned}\log P_F &= \log P_F^* + \log \mathcal{E},\\ \log P_H &= \log P_H^* + \log \mathcal{E},\end{aligned}$$

where $\mathcal{E}$ is the nominal exchange rate (units of foreign currency in home currency). Plugging in PCP yields

$$\begin{aligned}\log MC &= \delta \log W + (1-\delta)(\mu \log P_H + (1-\mu)\log P_F^* + (1-\mu)\log \mathcal{E}) - \log A,\\ \log MC^* &= \delta \log W^* + (1-\delta)(\mu^* \log P_F^* + (1-\mu^*)\log P_H - (1-\mu)\log \mathcal{E}) - \log A^*.\end{aligned}$$

In matrix notation, we can write the previous equation as

$$\log \mathbf{MC} = \boldsymbol{\delta} \cdot \log \mathbf{W} + \Omega \log \mathbf{p} + (\mathbf{1}-\boldsymbol{\delta}) \cdot \begin{pmatrix} 1-\mu \\ -(1-\mu^*) \end{pmatrix} \log \mathcal{E} - \log \mathbf{A}, \tag{B.1}$$

where $\log \boldsymbol{MC} = \begin{pmatrix} \log MC \\ \log MC^* \end{pmatrix}$. With nominal rigidities, domestic inflation is given by

$$d \log \mathbf{p} = \Theta \cdot d \log \mathbf{MC}, \tag{B.2}$$

where $\Theta = diag(1-\theta, 1-\theta^*)$. Plugging in this expression to a differenced version of (B.1), we get

$$d \log \mathbf{MC} = \boldsymbol{\delta} \cdot d \log \mathbf{W} + \Omega\Theta d \log \mathbf{MC} + (\mathbf{1}-\boldsymbol{\delta}) \cdot \begin{pmatrix} 1-\mu \\ -(1-\mu^*) \end{pmatrix} d \log \mathcal{E} - d \log \mathbf{A}.$$

Rearranging for marginal cost yields

$$d\log \mathbf{MC} = (1-\Omega\Theta)^{-1}\left(\delta \cdot d\log \mathbf{W} + (\mathbf{1}-\delta)\cdot \begin{pmatrix} 1-\mu \\ -(1-\mu^*) \end{pmatrix} d\log \mathcal{E} - d\log \mathbf{A}\right),$$

where the term $(I-\Omega\Theta)^{-1}$ captures the 'adjusted' Leontief inverse as in Rubbo (2023) - the production network structure of the economy, suitably adjusted for nominal rigidities. Plugging the previous equation into (B.2) yields

$$d\log \mathbf{p} = \Theta(1-\Omega\Theta)^{-1}\left(\delta \cdot d\log \mathbf{W} + (\mathbf{1}-\delta)\cdot \begin{pmatrix} 1-\mu \\ -(1-\mu^*) \end{pmatrix} d\log \mathcal{E} - d\log \mathbf{A}\right). \tag{B.3}$$

CPI inflation can be written as

$$d\log \mathbf{P} = \Phi d\log \mathbf{p} + \begin{pmatrix} 1-\alpha \\ -(1-\alpha^*) \end{pmatrix} d\log \mathcal{E}, \tag{B.4}$$

where

$$\log \mathbf{P} = \begin{pmatrix} \log P \\ \log P^* \end{pmatrix}, \qquad \Phi = \begin{pmatrix} \alpha & 1-\alpha \\ 1-\alpha^* & \alpha^* \end{pmatrix}.$$

Market clearing. Now we write the Phillips Curve in terms of output gaps between home and foreign countries. Market clearing ensures that

$$Y_H = C_H + M_H + \frac{1-n}{n}\left(C_H^* + M_H^*\right), \tag{B.5}$$

$$Y_F^* = C_F^* + M_F^* + \frac{n}{1-n}\left(C_F + M_F\right). \tag{B.6}$$

We assume that there is balanced trade in final and intermediate goods [15]

$$nP_F(C_F + M_F) = (1-n)P_H(C_H^* + M_H^*), \tag{B.7}$$

and this allows us to write the market clearing (B.5) as

$$Y_H^{VA} \equiv Y_H - M_H - \frac{P_F}{P_H}M_F = C_H + \frac{P_F}{P_H}C_F, \tag{B.8}$$

where we define the value-added output as gross output less intermediate goods, both domestic and imported. We can then rewrite the previous equation to get the real consumption in terms of real value-added

$$P_H Y_H^{VA} = P_H C_H + P_F C_F = PC \iff C = \frac{P_H}{P} Y_H^{VA}, \tag{B.9}$$

[15] Imposing this condition implies that the country size parameter no longer appears in the derivation below. However, the share parameters α and μ capture an equivalent notion.

Similarly, we can write foreign consumption in terms of foreign value-added

$$Y_F^{*VA} \equiv Y_F^* - M_F^* - \frac{P_H^*}{P_F^*} M_H^* = C_F^* + \frac{P_H^*}{P_F^*} C_H^*, \tag{B.10}$$

where the relative price follows from PCP. As above, we can rewrite the previous equation as

$$P_F^* Y_F^{*VA} = P_F^* C_F^* + P_H^* C_H^* = P^* C^* \iff C^* = \frac{P_F^*}{P^*} Y_F^{*VA}. \tag{B.11}$$

From the intra-temporal equation, we have

$$\begin{aligned} d\log W &= d\log P + \sigma d\log C + \varphi d\log L \\ &= \sigma d\log Y_H^{VA} + \varphi d\log L + \sigma(d\log P_H - d\log P), \end{aligned}$$

where the last equality follows (B.8). Similarly for the foreign economy,

$$d\log W^* - d\log P^* = \sigma d\log Y_F^{*VA} + \varphi d\log L^* + \sigma(d\log P_F^* - d\log P^*).$$

Now we write the previous two expressions in terms of the output gap. Using the definition of the output gap, we have

$$\begin{aligned} d\log W - d\log P &= \sigma(\tilde{y}_H + y_H^{nat}) + \varphi d\log L + \sigma(d\log P_H - d\log P) \\ &= \sigma\tilde{y}_H + \sigma y_H^{nat} + \varphi d\log L + \sigma(d\log P_H - d\log P). \end{aligned} \tag{B.12}$$

Part of the right-hand side is equal to

$$\begin{aligned} \sigma y_H^{nat} + \varphi d\log L &= \sigma y_H^{nat} + \varphi(d\log L - d\log L^{nat}) + \varphi d\log L^{nat} \\ &= \sigma y_H^{nat} + \varphi\tilde{y}_H + \varphi d\log L^{nat}, \end{aligned}$$

where the last equation follows from the equation $Y = AL$, since labor is the only factor of production. Continuing, we have

$$\begin{aligned} \sigma y_H^{nat} + \varphi d\log L &= \sigma(d\log L^{nat} + d\log A) + \varphi\tilde{y}_H + \varphi d\log L^{nat} \\ &= \varphi\tilde{y}_H + \sigma d\log A + (\sigma+\varphi) d\log L^{nat}. \end{aligned}$$

By Lemma 6 of Rubbo (2020)

$$d\log L^{nat} = \frac{1-\sigma}{\sigma+\varphi} d\log A, \tag{B.13}$$

hence

$$\begin{aligned} \sigma y_H^{nat} + \varphi d\log L &= \varphi\tilde{y}_H + \sigma d\log A + (\sigma+\varphi)\frac{1-\sigma}{\sigma+\varphi} d\log A \\ &= \varphi\tilde{y}_H + d\log A. \end{aligned} \tag{B.14}$$

Plugging the last equation into (B.12), we get

$$d\log W - d\log P + (\sigma+\varphi)\tilde{y}_H + d\log A + \sigma(d\log P_H - d\log P). \tag{B.15}$$

A similar expression can be derived for the foreign economy. Hence, in matrix form, we have

$$d\log \mathbf{W} - d\log \mathbf{P} = (\sigma+\varphi)\tilde{y} + d\log A + \sigma(d\log \mathbf{P} - d\log \mathbf{p}), \tag{B.16}$$

where $\tilde{y} = \begin{pmatrix} \tilde{y}_H \\ \tilde{y}_F^* \end{pmatrix}$. The last term of the previous equation is

$$\sigma(d\log \mathbf{P} - d\log \mathbf{p}) = \left(\sigma(I-\Phi)d\log \mathbf{p} - \begin{pmatrix} 1-\alpha \\ -(1-\alpha^*) \end{pmatrix} d\log \mathcal{E}\right). \tag{B.17}$$

Hence we can rewrite (B.16) as

$$d\log \mathbf{W} - d\log \mathbf{P} = (\sigma+\varphi)\tilde{y} + d\log \mathbf{A} + \sigma(I-\Phi)d\log \mathbf{p} - \sigma \begin{pmatrix} 1-\alpha \\ -(1-\alpha^*) \end{pmatrix} d\log \mathcal{E}. \tag{B.18}$$

Using (B.4), we can also write

$$d\log \mathbf{W} - d\log \mathbf{P} = d\log \mathbf{W} - \Phi d\log \mathbf{p} - \begin{pmatrix} 1-\alpha \\ -(1-\alpha^*) \end{pmatrix} d\log \mathcal{E}. \tag{B.19}$$

Plug in for $d\log \mathbf{p}$ using (B.3), we get

$$\begin{aligned} d\log \mathbf{W} - d\log \mathbf{P} = {} & d\log \mathbf{W} - \Phi\Theta(I-\Omega\Theta)^{-1} \\ & \left[\delta \cdot d\log \mathbf{W} + (1-\delta)\cdot \begin{pmatrix} 1-\mu \\ -(1-\mu^*) \end{pmatrix} d\log \mathcal{E} - d\log \mathbf{A}\right] \\ & - \begin{pmatrix} 1-\alpha \\ -(1-\alpha^*) \end{pmatrix} d\log \mathcal{E}. \end{aligned} \tag{B.20}$$

Expand and collect

$$\begin{aligned} d\log \mathbf{W} - d\log \mathbf{P} = {} & \left[I - \Phi\Theta(I-\Omega\Theta)^{-1}\delta\right] d\log \mathbf{W} + \Phi\Theta(I-\Omega\Theta)^{-1} d\log \mathbf{A} \\ & - \left[\Phi\Omega(I-\Omega\Theta)^{-1}(\mathbf{1}-\delta)\cdot \begin{pmatrix} 1-\mu \\ -(1-\mu^*) \end{pmatrix} + \begin{pmatrix} 1-\alpha \\ -(1-\alpha^*) \end{pmatrix}\right] d\log \mathcal{E}. \end{aligned} \tag{B.21}$$

Combine (B.18) and (B.21)

$$\begin{aligned} (\sigma+\varphi)\tilde{y} + \sigma(I-\Phi)d\log \mathbf{p} - \sigma \begin{pmatrix} 1-\alpha \\ -(1-\alpha^*) \end{pmatrix} d\log \mathcal{E} = {} & \left[I - \Phi\Theta(I-\Omega\Theta)^{-1}\delta\right] d\log \mathbf{W} \\ & + \Phi\Theta(I-\Omega\Theta)^{-1} d\log \mathbf{A} \\ & - \left[\Phi\Theta(I-\Omega\Theta)^{-1}(\mathbf{1}-\delta)\cdot \begin{pmatrix} 1-\mu \\ -(1-\mu^*) \end{pmatrix} + \begin{pmatrix} 1-\alpha \\ -(1-\alpha^*) \end{pmatrix}\right] d\log \mathcal{E}. \end{aligned} \tag{B.22}$$

Collect terms

$$
\begin{aligned}
&(\sigma+\varphi)\widetilde{y}+\left[I-\Phi\Theta(I-\Omega\Theta)^{-1}\right]d\log\mathbf{A}\\
&+\left[\Phi\Theta(I-\Omega\Theta)^{-1}(\mathbf{1}-\delta)\cdot\begin{pmatrix}1-\mu\\-(1-\mu^*)\end{pmatrix}+(1-\sigma)\begin{pmatrix}1-\alpha\\-(1-\alpha^*)\end{pmatrix}\right]d\log\mathcal{E}\\
&+\sigma(I-\Phi)d\log\mathbf{p}=[I-\Phi\Theta(I-\Omega\Theta)^{-1}\delta]d\log\mathbf{W}.
\end{aligned}
\tag{B.23}
$$

Plug in for $d\log\mathbf{p}$ using (B.3)

$$
\begin{aligned}
&(\sigma+\varphi)\widetilde{y}+[I-\Phi\Theta(I-\Omega\Theta)^{-1}]d\log\mathbf{A}\\
&+\left[\Phi\Theta(I-\Omega\Theta)^{-1}(\mathbf{1}-\delta)\cdot\begin{pmatrix}1-\mu\\-(1-\mu^*)\end{pmatrix}+(1-\sigma)\begin{pmatrix}1-\alpha\\-(1-\alpha^*)\end{pmatrix}\right.\\
&\left.+\sigma(I-\Phi)\Theta(I-\Omega\Theta)^{-1}(\mathbf{1}-\delta)\cdot\begin{pmatrix}1-\mu\\-(1-\mu^*)\end{pmatrix}\right]d\log\mathcal{E}\\
&=\left[I-\Phi\Theta(I-\Omega\Theta)^{-1}\delta-\sigma(I-\Phi)\Theta(I-\Omega\Theta)^{-1}\delta\right]d\log\mathbf{W}.
\end{aligned}
\tag{B.24}
$$

Collect terms

$$
\begin{aligned}
&(\sigma+\varphi)\widetilde{y}+\left[I-\Phi\Theta(I-\Omega\Theta)^{-1}-\sigma(I-\Phi)\Theta(I-\Omega\Theta)\right]d\log\mathbf{A}\\
&+\left[\Phi\Theta(I-\Omega\Theta)^{-1}(\mathbf{1}-\delta)\cdot\begin{pmatrix}1-\mu\\-(1-\mu^*)\end{pmatrix}+(1-\sigma)\begin{pmatrix}1-\alpha\\-(1-\alpha^*)\end{pmatrix}\right.\\
&\left.+\sigma(I-\Phi)\Theta(I-\Omega\Theta)^{-1}(\mathbf{1}-\delta)\cdot\begin{pmatrix}1-\mu\\-(1-\mu^*)\end{pmatrix}\right]d\log\mathcal{E}\\
&=\left[I-\Phi\Theta(I-\Omega\Theta)^{-1}\delta-\sigma(I-\Phi)\Theta(I-\Omega\Theta)^{-1}\delta\right]d\log\mathbf{W}.
\end{aligned}
\tag{B.25}
$$

Simplify

$$
\begin{aligned}
(\sigma+\varphi)\widetilde{y}+\left[I-((1-\sigma)I+\sigma\Phi)\Theta(I-\Omega\Theta)^{-1}\right]d\log\mathbf{A}&\\
+\left[((1-\sigma)I-\sigma\Phi)\Theta(I-\Omega\Theta)^{-1}(\mathbf{1}-\delta)\cdot\begin{pmatrix}1-\mu\\-(1-\mu^*)\end{pmatrix}+(1-\sigma)\begin{pmatrix}1-\alpha\\-(1-\alpha^*)\end{pmatrix}\right]d\log\mathcal{E}&\\
=[I-((1+\sigma)\Phi-\sigma I)\Theta(I-\Omega\Theta)^{-1}\delta]d\log\mathbf{W}.&
\end{aligned}
\tag{B.26}
$$

Rearrange for $d\log\mathbf{W}$

$$
\begin{aligned}
d\log\mathbf{W}=[I-((1+\sigma)I+\sigma\Phi)\Theta(I-\Omega\Theta)^{-1}\delta]^{-1}&\\
[(\sigma+\varphi)\widetilde{y}+[I-[(1-\sigma)I+\sigma\Phi]\Theta(I-\Omega\Theta)^{-1}]d\log\bar{A}&\\
+\left[((1-\sigma)I-\sigma\Phi)\Theta(I-\Omega\Theta)^{-1}(\mathbf{1}-\delta)\cdot\begin{pmatrix}1-\mu\\-(1-\mu^*)\end{pmatrix}+(1-\sigma)\begin{pmatrix}1-\alpha\\-(1-\alpha^*)\end{pmatrix}\right]d\log\mathcal{E}.&
\end{aligned}
\tag{B.27}
$$

Plug back into (B.3)

$$
\begin{aligned}
d\log \mathbf{p} = \Theta(I-\Omega\Theta)^{-1}\delta \Bigg(& [I-((1+\sigma)\Phi-\sigma I)\Theta(I-\Omega\Theta)^{-1}\delta]^{-1} \\
& \Bigg\{ (\sigma+\varphi)\widetilde{y} + \left[I-((1-\sigma)I+\sigma\Phi)\Theta(I-\Omega\Theta)^{-1}\right] d\log \mathbf{A} \\
+ \left[((1-\sigma)I-\sigma\Phi)\Theta(I-\Omega\Theta)^{-1}(1-\delta)\begin{pmatrix} 1-\mu \\ -(1-\mu^*)\end{pmatrix} + (1-\sigma)\begin{pmatrix} 1-\alpha \\ -(1-\alpha^*)\end{pmatrix}\right] d\log \mathcal{E} \Bigg\}\Bigg) & \\
+\Theta(I-\Omega\Theta)^{-1}\left[(\mathbf{1}-\boldsymbol{\delta})\cdot\begin{pmatrix} 1-\mu \\ -(1-\mu^*)\end{pmatrix} d\log\mathcal{E} - d\log \mathbf{A}\right]. &
\end{aligned}
\tag{B.28}
$$

Collect terms

$$
\begin{aligned}
& d\log \mathbf{p} = \Theta(I-\Omega\Theta)^{-1}\boldsymbol{\delta} \\
& \left[I-((1+\sigma)\Phi-\sigma I)\Theta(I-\Omega\Theta)^{-1}\delta\right]^{-1}(\sigma+\varphi)\widetilde{y} \\
& + \Bigg[\Theta(I-\Omega\Theta)^{-1}\delta[I-((1+\sigma)\Phi-\sigma I)\Omega(I-\Omega\Theta)^{-1}\delta]^{-1}[I-((1-\sigma)I+\sigma\Phi)\Theta(I-\Omega\Theta)^{-1}] \\
& - \Theta(I-\Omega\Theta)^{-1}\Bigg] d\log \mathbf{A} \\
& + \Bigg[\Theta(I-\Omega\Theta)^{-1}\delta[I-((1+\sigma)\Phi-\sigma I)\Theta(I-\Omega\Theta)^{-1}\delta]^{-1} \\
& \left\{((1+\sigma)I-\sigma\Phi)\Theta(I-\Omega\Theta)^{-1}(1-\delta)\begin{pmatrix} 1-\mu \\ -(1-\mu^*)\end{pmatrix} + (1-\sigma)\begin{pmatrix} 1-\alpha \\ -(1-\alpha^*)\end{pmatrix}\right\} \\
& + \Theta(I-\Omega\Theta)^{-1}(\mathbf{1}-\boldsymbol{\delta})\cdot\begin{pmatrix} 1-\mu \\ -(1-\mu^*)\end{pmatrix}\Bigg] d\log\mathcal{E}.
\end{aligned}
\tag{B.29}
$$

Use (B.4) to get CPI Phillips Curves

$$
\begin{aligned}
d\log \mathbf{P} &= \Phi\Theta(I-\Omega\Theta)^{-1}\delta\left[I-((1+\sigma)\Phi-\sigma I)\Theta(I-\Omega\Theta)^{-1}\delta\right]^{-1}(\sigma+\varphi)\widetilde{y} \\
&+\Phi\Bigg[\Theta(I-\Omega\Theta)^{-1}\delta[I-((1+\sigma)\Phi-\sigma I)\Omega(I-\Omega\Theta)^{-1}\delta]^{-1}[I-((1-\sigma)I+\sigma\Phi)\Theta(I-\Omega\Theta)^{-1}] \\
&-\Theta(I-\Omega\Theta)^{-1}\Bigg]d\log \mathbf{A} \\
&+\Phi\Bigg[\Theta(I-\Omega\Theta)^{-1}\delta[I-((1+\sigma)\Phi-\sigma I)\Theta(I-\Omega\Theta)^{-1}\delta]^{-1} \\
&\left\{((1+\sigma)I-\sigma\Phi)\Theta(I-\Omega\Theta)^{-1}(\mathbf{1}-\delta)\cdot\begin{pmatrix}1-\mu\\-(1-\mu^*)\end{pmatrix}+(1-\sigma)\begin{pmatrix}1-\alpha\\-(1-\alpha^*)\end{pmatrix}\right\} \\
&+\Theta(I-\Omega\Theta)^{-1}(\mathbf{1}-\delta)\cdot\begin{pmatrix}1-\mu\\-(1-\mu^*)\end{pmatrix}\begin{pmatrix}1-\alpha\\-(1-\alpha^*)\end{pmatrix}\Bigg]d\log\mathcal{E},
\end{aligned}
\tag{B.30}
$$

where

$$
\begin{aligned}
\mathcal{K} &= \Phi\Theta(I-\Omega\Theta)^{-1}\delta\left[I-((1+\sigma)\Phi-\sigma I)\Theta(I-\Omega\Theta)^{-1}\delta\right]^{-1}(\sigma+\varphi), \\
\mathcal{G} &= \Phi\Bigg[\Theta(I-\Omega\Theta)^{-1}\delta[I-((1+\sigma)\Phi-\sigma I)\Omega(I-\Omega\Theta)^{-1}\delta]^{-1} \\
&\quad [I-((1-\sigma)I+\sigma\Phi)\Theta(I-\Omega\Theta)^{-1}]-\Theta(I-\Omega\Theta)^{-1}\Bigg],
\end{aligned}
$$

and

$$
\begin{aligned}
\mathcal{H} &= \Phi\Bigg[\Theta(I-\Omega\Theta)^{-1}\delta[I-((1+\sigma)\Phi-\sigma I)\Theta(I-\Omega\Theta)^{-1}\delta]^{-1} \\
&\left\{((1+\sigma)I-\sigma\Phi)\Theta(I-\Omega\Theta)^{-1}(1-\delta)\begin{pmatrix}1-\mu\\-(1-\mu^*)\end{pmatrix}+(1-\sigma)\begin{pmatrix}1-\alpha\\-(1-\alpha^*)\end{pmatrix}\right\} \\
&+\Theta(I-\Omega\Theta)^{-1}(\mathbf{1}-\delta)\cdot\begin{pmatrix}1-\mu\\-(1-\mu^*)\end{pmatrix}+\begin{pmatrix}1-\alpha\\-(1-\alpha^*)\end{pmatrix}\Bigg].
\end{aligned}
$$

B.2 Quantitative Model - Additional Equations

First-order conditions to the home household's utility maximization problem yields

$$\Xi\, C_t^{\sigma}\, L_t^{\varphi} \;=\; \frac{W_t}{P_t}, \tag{B.31}$$

and

$$Q_{t,t+1} = \beta \mathbb{E}_t \left[\left(\frac{C_{t+1}}{C_t} \right)^{-\sigma} \left(\frac{P_t}{P_{t+1}} \right) \right]. \tag{B.32}$$

Let the return on the nominal state contingent bond is equal to $(1+i_t) = 1/Q_{t,t+1}$. We then have the usual Euler equation

$$\frac{1}{1+i_t} = \beta \mathbb{E}_t \left[\left(\frac{C_{t+1}}{C_t} \right)^{-\sigma} \left(\frac{P_t}{P_{t+1}} \right) \right]. \tag{B.33}$$

The foreign household's intertemporal decision yields similar expressions

$$\Xi\, (C_t^*)^{\sigma}\, (L_t^*)^{\varphi} \;=\; \frac{W_t^*}{P_t^*}, \tag{B.34}$$

$$\frac{1}{1+i_t^*} = \beta \mathbb{E}_t \left[\left(\frac{C_{t+1}^*}{C_t^*} \right)^{-\sigma} \left(\frac{P_t^*}{P_{t+1}^*} \right) \right], \tag{B.35}$$

$$\frac{1}{1+i_t} = \beta \mathbb{E}_t \left[\left(\frac{C_{t+1}}{C_t} \right)^{-\sigma} \left(\frac{P_t}{P_{t+1}} \right) \left(\frac{\chi_{t+1}}{\chi_t} \right) \right] \tag{B.36}$$

and

$$Q_{t,t+1} = \beta \mathbb{E}_t \left[\left(\frac{C_{t+1}^*}{C_t^*} \right)^{-\sigma} \left(\frac{S_t\, P_t^*}{S_{t+1}\, P_{t+1}^*} \right) \right], \tag{B.37}$$

where S_t is the nominal exchange rate defined as the home currency price of foreign currency.

Households' choice on internationally traded bonds, Equations (B.32) and (B.37), yield the international risk-sharing condition

$$\mathcal{Q}_t = \Psi \left(\frac{C_t}{C_t^*} \right)^{\sigma}, \tag{B.38}$$

where $\mathcal{Q}_t = \frac{\mathcal{E}_t P_t^*}{P_t}$ is the real exchange rate and $\Psi = \mathcal{Q}_0 \left(\frac{C_0}{C_0^*} \right)^{\sigma}$ is a constant.

The FOC to this problem implies the following nonlinear relationship between firms' reset prices and marginal cost

$$P_{Hst} = \frac{\epsilon_s}{\epsilon_s - 1} \frac{\mathbb{E}_t \sum\limits_{k=0}^{\infty} \beta^k C_{t+k}^{-\sigma} \theta_s^k MC_{st+k} P_{Hst+k}^{\epsilon_s} Y_{Hst+k}}{E_t \sum\limits_{k=0}^{\infty} \beta^k C_{t+k}^{-\sigma} \theta_s^k P_{Hst+k}^{\epsilon_s} Y_{Hst+k}},$$

where $P_{Hst}^{\#}$ is the reset price.