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The macroeconomic effects of global supply chain reorientation

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Abstract

Policymakers around the world are introducing legislation seeking to encourage the local production of key inputs to reduce risks from excessive dependencies on foreign suppliers. We utilise a global dynamic general equilibrium model to analyse the macroeconomic effects of supply chain reorientation through localisation policies, such as reshoring and friend-shoring production, via a novel non-tariff mechanism. Focusing on the euro area, we find that localisation policies are inflationary, imply transition costs and generally have a negative long-run effect on aggregate domestic output. The size (and sign) of the impact depends on whether these policies are implemented unilaterally or as part of a global shift, and the extent to which they reduce domestic competition and productivity. Untargeted localisation policies do not necessarily improve macroeconomic resilience against shocks that proxy supply chain disruptions. Sensitivity to regional shocks increases, while resilience to global shocks is unaffected. We provide some recommendations for policymakers considering implementing a localisation agenda.

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Keywords: Friendshoring; General equilibrium; Reshoring; Strategic autonomy.

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Non-technical summary

The COVID-19 pandemic and heightened geopolitical tensions, from events such as Brexit, US/China trade tensions and beyond all the Russian invasion of Ukraine, have increased concerns over the smooth functioning and security of global supply chains. Policymakers around the world are reconsidering the trade-off between efficiency and resilience inherent in global supply chains. Many have introduced legislation seeking to encourage the local production of key inputs to reduce risks emanating from excessive dependencies on external suppliers. Despite the importance attached to achieving this policy goal, the macroeconomic implications of global supply chains reorientation remain little explored.

We analyse the macroeconomic effects of global supply chain reorientation through localisation policies, such as partially reshoring production and partially friend-shoring production towards "trusted partners", using a global dynamic general equilibrium model. We model three regions of the global economy: the euro area, the United States, and the rest of the world. The regional economies are linked with each other through bilateral trade and participation in international financial markets, with bloc-specific calibration. To analyse reshoring, we gradually reduce, over a period of 10 years, the share of euro area imports used as inputs in domestic production and replace these imports with locally produced goods. To analyse friendshoring, we gradually reduce the share of euro area imports from the rest of the world and replace them by imports from trusted partners, in this case the U.S.

Our approach has several advantages. First, it allows for a comprehensive treatment of cross-border macroeconomic interdependences and spillovers between the different regions. Second, it permits an analysis of non-tariff mechanisms, which are so far dominating the localisation agenda. Finally, we are able to assess three key aspects of localisation policies: transition dynamics, long-run effects, and implications for resilience. The main disadvantages compared to trade models are less granularity in modelling cross-border linkages and less flexibility in delineating the trade blocks.

We find that localisation policies are inflationary and imply transition costs in the short to medium run. The long-term impacts of localisation policies on aggregate domestic output are generally negative. The size (and sign) of these impacts depends on whether these policies are implemented unilaterally or as a part of a global shift and the extent to which they lead to a reduction in domestic competition and productivity. Once domestic producers are not exposed to foreign competition, they have greater ability to increase prices. For goods where the quality of local production is not as high as the foreign competition, as is the case for chips, reshoring would also lead to lower productivity. These negative effects would likely offset any positive impact from moving production back home, resulting in permanently lower domestic aggregate output.

A key motivation for reorientating supply chains is to boost economic resilience. We analyse whether this is the case by comparing the response of the status quo and a reshored European economy to adverse regional and global shocks. We find that untargeted localisation policies do not necessarily improve macroeconomic resilience against shocks that proxy supply chain disruptions. Sensitivity of the reshored economy to regional shocks increases, while its resilience to global shocks improves only marginally.

Based on these results, we provide some recommendations for policymakers considering implementing the localisation agenda. While the Open Strategic Autonomy

agenda is rooted in concerns over and beyond economics, European policymakers need to consider ways to reduce the costs of this adjustment. First, free trade should remain Europe's driving economic principle and any localisation policies should focus only on essential goods. Second, maintaining effective state-aid rules may limit the negative impact of reshoring on domestic competition. Third, localisation policies should focus on goods that are not too far from the technological frontier to limit negative impacts on productivity. Finally, policymakers should seek greater ties with regions that are not potential competitors for the same type of goods.

"European strategic autonomy is goal number one for our generation."
Charles Michel, President of the European Council

1 Introduction

The COVID-19 pandemic and heightened geopolitical tensions, from events such as Brexit, US/China trade tensions and beyond all the Russian invasion of the Ukraine, have increased concerns over the smooth functioning and security of global supply chains. European policymakers, like many others around the world, have introduced legislation to spur the local production of key manufacturing inputs and reduce "excessive dependencies" on external suppliers. These initiatives seek to help Europe achieve *Open Strategic Autonomy*, a key policy objective of the von der Leyen European Commission.[1] Broadly speaking, this term refers to the European Union (EU)'s ability to protect its interests and adopt its preferred economic, defence and foreign policy without depending heavily on other foreign states.

Despite the importance attached to achieving this policy goal, the macroeconomic implications remain little explored, especially outside international trade models. While arguments about comparative advantage, the potential forgone benefits of international specialisation and industry- and product-specific disruptions (such as the shortage of semi-conductors) are familiar, there is relatively less analysis on the macroeconomic response to value chain shocks in the context of localisation policies. The response of output, employment and inflation are important considerations from a policy perspective.

The policy scale of such effects are staggering, with supply chain disruptions in 2021 estimated to have reduced euro area GDP by around two percent and doubled the rate of inflation (Celasun et al., 2022). This is despite an enormous fiscal response to the pandemic and post-invasion energy crisis.[2] Following a decade of persistently low inflation, central banks are unwinding (and reversing) quantitative easing programmes and raising interest rates to curb price rises and ensure inflation expectations remain anchored.

To address these issues, we first analyse the macroeconomic effects of several types of localisation policies, before examining the extent to which these policies achieve their aim of increasing macroeconomic resilience. We simulate the effect of (partially) reshoring production back to Europe and friend-shoring towards "trusted partners" using a global macroeconomic model.[3] This global general equilibrium perspective is crucial as

[1] In Appendix A, we discuss a specific piece of legislation that illustrates the concept of Open Strategic Autonomy, the European Chips Act. This legislation aims to ensure the supply of a key strategic intermediate good, semiconductors. In the United States, the Inflation Reduction Act provides tax incentives and subsidies to increase the share of renewable energy in the US energy mix and catalyse investments in domestic renewable capacity. These legislative initiatives underscore the shift towards an emphasis on the domestic, or in the case of the EU, the regional production of some essential goods.

[2] European countries have already allocated just over €700 billion in supports since the energy crisis erupted (Sgaravatti et al., 2022), led by Germany, with supports equivalent to almost 7.5% of GDP.

[3] We use the euro area and Europe interchangeably throughout. There is no established criteria as to what constitutes a "successful" reshoring. For example, while reshoring production

geopolitical trends point towards a bloc arrangement of competing economies, such as a "West versus the Rest".

Our model covers three regions: the euro area (EA), the rest of the world (RW) and the United States (US). The regional economies are linked with each other through bilateral trade and participation in international financial markets, with bloc-specific calibration. We model localisation policies by replacing intermediate-good imports with domestic production (reshoring) and increasing the share of imports from trusted partners (friend-shoring). This approach has several advantages. First, it allows for a comprehensive treatment of cross-border macroeconomic interdependences and spillovers between the different regions in a general equilibrium framework. Second, it permits an analysis of non-tariff mechanisms, which are so far dominating the localisation agenda. Finally, we are able to assess three key aspects of localisation policies: transition dynamics, long-run effects, and implications for resilience. In particular, the dynamic effects are crucial for policymakers to understand the transition path to a more localised economy. The main disadvantages compared to trade models are less granularity in modelling cross-border linkages and less flexibility in delineating the trade blocks.

We start by analysing the effects of the EA unilaterally reshoring part of its production. We model this as a permanent reduction in European preference for imported inputs in the production of goods for export, in favour of locally-produced inputs. This substitution proxies the intended goal of some already-legislated reshoring policies, such as the European Chips Act (discussed below) and changes in firms' strategies such as "China Plus One" supply chains.[4]

We find that unilateral reshoring results in lower aggregate economic output and higher inflation over the medium term while the economy adjusts. Increased costs and prices result in a (real effective) exchange rate appreciation that worsens external competitiveness and leads to a shift in resources from tradable to non-tradable production. In the long run, the size (and sign) of the impact on domestic aggregate output depends on the extent to which reshoring results in a rise in local firm price markups (from increased market power) and a fall in local firm productivity (from the use of lower-quality local inputs). We find that the adverse impacts of plausible domestic markup and productivity shock resulting from reshoring would likely more than offset the positive impact from moving production back home, resulting in permanently lower domestic aggregate output.

If all regions of the world engage in reshoring, which we model as a reduction in preferences for imported inputs used for export good production in all regions simultaneously, the economic drop in Europe is somewhat larger during the initial adjustment but the transition is faster.

A key motivation for reorientating supply chains is to boost economic resilience. We analyse whether this is the case by comparing the response of the status quo and a reshored European economy to regional and global shocks to export firm price markups. These shocks proxy the current supply chain disruptions that, at least partly, motivated the increased focus on boosting resilience. We find that untargeted (partial) reshoring

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may itself mechanically lead to larger domestic output, the effect on national income is more complex and not examined in this analysis.

[4] Evenett and Fritz (2021) survey policies that governments have used to reduce import dependence. These include changing tariffs/border barriers, local production subsidies, and limits on foreign ownership or outright bans.

does not necessarily achieve this goal. The reshored economy has almost the same sensitivity to global shocks and substantially increased exposure to local shocks. This is in line with small economies (as aggregate output is lower in the reshored economy, it is smaller in terms of share of global output) generally being less resilient to shocks.

Finally, we examine the macroeconomic effects of friend-shoring, whereby supply chains linkages with "like-minded" trade partners are increased via an increase in preferences for imported inputs from such regions. Implementing this policy unilaterally leads to a permanent reduction in aggregate output. When there is reciprocation, whereby the US increases their reliance on European supply chains, the need to produce more exports boosts aggregate output via tradable sector production. This is following a transition period of reduced economic output and assuming that there are no long-run negative impacts from reduced competition or productivity. Friend-shoring is also beneficial over the long run if the rest of the world retaliates by pursuing similar friend-shoring policies with their allies.

Related literature: Our analysis sits within the broad literature examining the role of global supply chains as a mechanism for the propagation and amplification of shocks (Carvalho et al., 2021). In particular, our work relates to papers examining the potential for countries to reduce their integration in global supply chains to increase resilience to international shocks. Rodrik (1998) and Giovanni and Levchenko (2009) find that greater openness increases an economy's exposure to external shocks. In contrast, Caselli et al. (2020) show that international trade reduced volatility in most countries and Bonadio et al. (2021) demonstrate that reduced reliance on foreign inputs does not mitigate pandemic-induced contractions in labour supply. D'Aguanno et al. (2021) find no evidence of a relationship between global value chain integration and macroeconomic volatility.

The onset of the COVID-19 pandemic and the severe supply chain issues seen in many countries has fostered a narrative that countries and regions could be better off reducing their exposure to foreign shocks which propagate into their economies through trade in intermediate goods. Baldwin and Freeman (2021) provide a comprehensive discussion of proposals to reduce exposure, such as decoupling from GVC's through greater use of domestic inputs, shortening value chains and through further diversification of input sources. Additionally, the strong retaliation of the European Union, the United States, and their allies against Russia following the invasion of Ukraine suggests that a more fragmented international system could replace previous norms of ever more open markets and increasing globalisation. In particular, strategic geopolitical rivalries may decrease the weight on economic gains from trade. This dynamic along with factors such as natural disasters, climate-change induced volatility and terrorism mean that supply chain disruptions could be a new normal (Grossman et al., 2021).

Our work contributes to the literature providing general equilibrium analyses of protectionist policies, in particular those using global macroeconomic models to quantify trade changes. Faruqee et al. (2008) analyse the effect of a rise in protectionism in response to rising global trade imbalances. They find that imposing import tariffs do not help reduce these imbalances. Lindé and Pescatori (2019) find that although the macroeconomic costs of a trade war are substantial, a fully symmetric retaliation is the best response. Cappariello et al. (2020) consider a rich input-output structure and demonstrate that closer integration amplifies the adverse effects of protectionist trade

policies. Other papers to analyse trade policy issues using the EAGLE model framework include Pisani and Vergara Caffarelli (2018), Bolt et al. (2019) and Jacquinot et al. (2022).

Several recent studies have also examined the economic effects of a global decoupling. Góes and Bekkers (2022) find that Europe could suffer substantial welfare losses from a split into a two-bloc world along geopolitical lines. The size of the effect depends crucially on the extent to which this decoupling reduces the cross-border diffusion of ideas and therefore innovation. A common finding is that distortions to trade from geopolitical fragmentation generally entail higher prices and lower welfare (Javorcik et al., 2022; Felbermayr et al., 2023; Attinasi et al., 2023; Campos et al., 2023).[5] Meanwhile, Shocks and Chains (2020) find that greater localisation increases vulnerability to (external and domestic) shocks.

We contribute to this literature in a number of ways. We modify a general equilibrium model of the global economy to enable us to analyse the transmission of localisation policies. Importantly, we focus a non-tariff mechanism of supply chain reorientation. This is because policies to promote localisation, such as the Inflation Reduction Act, do not include tariffs as part of the package. We believe that modelling this issue in a manner that does not mechanically increase import prices offers novel insights on the endogenous reaction of prices to localisation policies.

We then use this framework to assess three key aspects of localisation policies: the transition dynamics, the long-term effects (comparative statics) and the implications for economic resilience. The literature is silent on this latter aspect, in particular. However, we believe analysing the short- and medium-term adjustment following the enactment of localisation policies is crucial from a policy perspective. Overall, our paper contains a careful analysis of the key aspects of the fragmentation debate, such as the second-round effects of localisation on domestic competition and efficiency as well as the impact on resilience to domestic and global shocks.

The outline of the paper is as follows. Section 3 provides a brief overview of the model, the modifications to examine global supply chain reorientation and some key details on the calibration. We present the results of our reshoring, resilience and friend-shoring simulations in Sections 4, 5 and 6 respectively. Finally, in Section 7, we summarise our findings and discuss their policy implications.

2 Model overview

3 Model overview

We conduct our analysis using an extended version of the EAGLE, a dynamic general equilibrium model.[6] This framework permits the implementation of counterfactual

[5] There is, however, substantial cross-country heterogeneity in terms of impact, with small open economies (SOEs) reliant on global value chains more affected. Clancy et al. (2023) analyse spillovers to SOEs from the localisation policies of (much) larger trade partners and examine the use of fiscal policy instruments to reshore production. See Aiyar et al. (2023) and Ioannou et al. (2023) for comprehensive discussions of the wider economic implications of the changing geopolitical environment.

[6] Although we use a macroeconomic model to analyse what is, fundamentally, a trade (or industrial) policy question, our approach offers distinct advantages in identifying key transmission

exercises and avoids issues of causal identification faced by empirical studies. Here we only provide an overview of the model, with the reader referred to Gomes et al. (2012) for details on the original model, (Brzoza-Brzezina et al., 2014) for the import content of exports component and Clancy et al. (2016) for government imports.[7]

We model three regions of the global economy: the Euro Area (EA), the United States (US) and the Rest of the World (RW). The structure of each regional economy is symmetric and linked with each other through bilateral trade and participation in international financial markets, with bloc-specific calibration. This allows for a comprehensive treatment of cross-border macroeconomic interdependences and spillovers between the different regions. We include a number of real and nominal rigidities in order to match the sluggish reaction of prices and wages found in macroeconomic data. We display the structure of the model in Figure 1.

Each economy features both Ricardian and liquidity-constrained households, firms, and monetary and fiscal authorities. The (infinitely-lived) households consume final goods, allocate time between work and leisure and offer imperfectly substitutable labour services to domestic firms. They use their market power to set wages with a markup over the marginal rate of substitution between labour and consumption. Households own domestic firms and the domestic capital stock, which it rents to domestic firms in a fully-competitive market.

Firms produce non-tradable final goods, tradeable and non-tradeable intermediate goods, and provide intermediation services. Non-tradable final goods are produced by perfectly competitive firms and include consumption goods, investment goods and public goods. Tradable goods are an aggregate of domestically produced and imported goods. Final goods are produced using domestic tradable and non-tradable intermediate goods and imported goods, combined according to a constant elasticity of substitution technology. Different varieties of intermediate goods are imperfect substitutes, produced under monopolistic competition. This market power allows firms to set nominal prices with a markup over marginal costs. Each intermediate good is produced using domestic and (internationally-immobile) labour and capital that are combined according to a Cobb–Douglas technology. Intermediate goods are sold both in the domestic and in the export market. Importantly for our analysis, this implies that there are five types of imports in the model: imports of intermediate goods for private consumption and investment, for government consumption and investment and for exports.

The monetary authority sets the national short-term nominal interest rate according to a standard Taylor-type rule, by reacting to increases in consumer inflation and real output. Fiscal policy is conducted at the regional level. In the extended

mechanisms and policy levers. Given the macroeconomic focus, our model contains a rich representation of price dynamics and fiscal and monetary authorities. In contrast, trade models, while possessing great depth at the sectoral / product level, do not capture these aspects well. Yet they are crucial for economic policy makers tasked with managing the business cycle fluctuations and structural changes that may arise from localisation policies. See Hunt et al. (2020) and Smith et al. (2020) for discussions of the relative strengths and weaknesses of trade and macroeconomic models in assessing large economic shocks.

[7] Further extensions of the EAGLE have added search and matching frictions in the labour market (Jacquinot et al., 2018), financial frictions in (country-specific) banking sectors (Bokan et al., 2018) and import tariffs (Jacquinot et al., 2022).

version of the model that we use, each region sets government consumption and investment expenditures (contributing to domestic capital stock) with an explicit imported component. On the revenue side, the government (exogenously) sets labour income taxes and social contributions, capital income taxes and consumption taxes. Public debt is stabilised through a fiscal rule that induces an endogenous adjustment through lump-sum taxes.

3.1 Supply chain reorientation

Our analysis focuses on intermediate-good imports (IM), as the introduction of localisation policies are in response to recent disruptions to global supply chains. These are a composite of imports from the other regions of the world, with the quantity and price of bilateral imports a function of preference shares and the elasticity of substitution from different trading partners. Intermediate-good imports are then combined with domestic tradable inputs (HT), produced using domestic (and internationally-immobile) capital (K) and labour (N).[8] Depending on demand, which is a function of preferences and relative prices, these goods are either packaged with locally-produced non-tradables as final goods for private and public consumption and investment (C, G and I, respectively) or exported (EX) for use in other countries' production.
More formally, exports in our model are a combination of locally-produced tradable inputs and intermediate imports (Armington, 1969):

$$X_t(h) = \left[\nu_X^{\frac{1}{\mu_X}} HT_t^X(h)^{\frac{\mu_X - 1}{\mu_X}} + (1-\nu_X)^{\frac{1}{\mu_X}} IM_t^X(h)^{\frac{\mu_X - 1}{\mu_X}} \right]^{\frac{\mu_X}{\mu_X - 1}}. \tag{1}$$

Importantly for our analysis, ν_X represents the weight of local goods in the export good bundle and μ_X represents the intertemporal elasticity of substitution between local and foreign tradable goods (e.g. intermediate imports). In order to examine the macroeconomic effect of *reshoring*, we introduce *time-varying* weights of local inputs in the export good bundle. More specifically, we modify the parameter ν_X to become an AR(1) process:

$$\nu_{X,t} = (1-\rho_{\nu_X})\overline{\nu_X} + \rho_{\nu_X}\nu_{X,t-1} + \epsilon_{\nu_X}, \tag{2}$$

allowing us to simulate permanent (or temporary) changes in these weights. One can think of these weights as preferences, formed due to historical linkages, shared language / culture, geographical distance, quality of products and ease of procurement (such as the existence and/or extent of non-tariff barriers) for example.[9] By increasing $\overline{\nu_X}$, for example, we permanently increase the home bias of export firms, causing them to use a greater proportion of local inputs in production. As we employ a general equilibrium framework, this change will affect costs, prices and demand for all other goods in the economy. We provide some more details on how this change propagates through the model system in Appendix B.

[8] For the EA and RW regions, "domestic" refers to within region. We use domestic, local and regional interchangeably throughout.

[9] Our use of these weights to pin down the steady-state (aggregate and bilateral) import content of exports means they represent a region's revealed (trade) preference.

We follow a similar procedure to analyse *friend-shoring*. The import content of exports are a composite of imports from all regions of the world:

$$IM_t^X(h) = \left[\sum_{CO \neq H} \left(\nu_{IM^X}^{H,CO} \right)^{\frac{1}{\mu_{IM^X}}} \left(IM_t^{X,H,CO}(h) \left(1 - \gamma_{IM^X}^{H,CO}(h) \right) \right)^{\frac{\mu_{IM^X}-1}{\mu_{IM^X}}} \right]^{\frac{\mu_{IM^X}}{\mu_{IM^X}-1}}, \quad (3)$$

where ν_{IM^X} represents the share of imports from each region in total imports (and therefore must sum to one), μ_{IM^X} is the intertemporal elasticity of substitution between imports from different trading partners and $\gamma_{IM^X}^{H,CO}$ are (quadratic) adjustment costs on bilateral imports of export goods of firm h. By making the parameter $\nu_{IM^X}^{H,CO}$ an AR(1) process, we can examine the effect of changing bilateral trade relations:

$$\nu_{IM_t^X}^{H,CO} = (1 - \rho_{\nu_{IM_t^X}^{H,CO}}) \overline{\nu_{IM_t^X}^{H,CO}} + \rho_{\nu_{IM_t^X}^{H,CO}} \nu_{IM_{t-1}^X}^{H,CO} + \epsilon_{\nu_{IM_t^X}^{H,CO}}. \quad (4)$$

Modelling localisation policies this way means we do not consider the immediate reshoring of production capacities (e.g. the setting up of a new production plant for semiconductors). Instead, we assume reshoring occurs at first using existing capital and labour. These factors then endogenously adjust over time. Our approach is a close proxy current OSA policies, which seek to gradually ramp up regional production of key goods rather than actively poach capacity from other jurisdictions. Our modelling approach also implies that the private sector fully agrees with the decision to localise production. There are many mechanisms for firms to reach such a consensus, such as through The European Forum for Manufacturing. Of course, governments have often resorted to moral suasion to encourage desired behavioural changes (Ongena et al., 2019).[10]

Our approach has several advantages. First, it permits an analysis of non-tariff mechanisms of localisation policies. We do not exogenously change relative prices by imposing tariffs or applying iceberg costs for exporters. As such, our approach better approximates current policies which, so far, mainly rely on moral suasion or quotas on import content in domestic production. Second, we capture not only long-term effects, but also transition dynamics resulting from localisation policies. Finally, we can take into account reactions of fiscal and monetary policy. Considering the substantial transition costs we uncover, policymakers require a framework that can assess how other policy instruments at their disposal can help facilitate a localisation agenda.

Our approach also has a number of limitations. First, we consider the import content of exports at the aggregate level and therefore do not distinguish between essential and non-essential goods. Second, our model includes just three regions, which are not fully aligned to current geopolitical alliances. Moreover, there are many countries that may wish to avoid complete alignment with a single geopolitical bloc (Afzal et al., 2023). Finally, our framework does not have a decision on where firms are located. As such, we cannot endogenously capture the impact of reshoring on local competition and productivity. As these are important considerations in the debate surrounding supply chain reorientation, we analyse these as separate scenarios. More specifically, to model the effect of reduced local competition, we introduce *time-varying* export good markups:

[10] Other, more distortionary, approaches to achieving supply chain reorientation may involve tax incentives, subsidies, non-tariff barriers or import restrictions. Examining the implications of alternative measures represent an interesting avenue for further research.

$$\theta_{X,t} = (1 - \rho_{\theta_X})\overline{\theta_X} + \rho_{\theta_X}\mu_{X,t-1} + \epsilon_{\theta_X} \tag{5}$$

that allow us to proxy the effect of local firms gaining more market power (i.e. a reduced elasticity of substitution for their brand, which facilitates the charging of a larger price markup over their marginal costs). This reflects the greater insulation of local firms from the threat of foreign competition.

Furthermore, we also examine the willingness and/or ability of a region to substitute foreign for local inputs. In particular, it seems likely that pursuing a localisation policy would hamper a region's ability to conduct such substitution. To analyse this aspect, we introduce *time-varying* elasticity of export-good substitution:

$$\mu_{X,t} = (1 - \rho_{\mu_X})\overline{\mu_X} + \rho_{\mu_X}\mu_{X,t-1} + \epsilon_{\mu_X} \tag{6}$$

that allows us to proxy the reduced knowledge of the other regions' goods or business contacts in these markets, for example, making substitution more difficult. A further advantage of this is that it is consistent with the philosophy behind localisation policies.

Finally, we consider the potential side effect of having to use lower quality goods in areas where Europe is not at the technology frontier. Returning to the example of semi-conductors, Europe is currently substantially behind the capability of advanced chip manufacturing in Taiwan. To examine this aspect, we implement a shock to the total factor productivity term in the local tradable good firm's production function:

$$Y^S_{T,t}(h) = max\left\{z_T K^D_t(h)^{\alpha_T} N^D_t(h)^{1-\alpha_T} - \psi_T, 0\right\} \tag{7}$$

where ψ_T are fixed costs and z_T are (permanent or temporary) sector-specific productivity shocks:

$$\log(z_T) = (1 - \rho_{z_T})\log(\overline{z_T}) + \rho_{z_T}\log(z_{T,t-1}) + \epsilon_{z_T}. \tag{8}$$

3.2 Calibration

To get a sense of the euro area's trade relationships in the model, we detail the key steady state ratios and bilateral trade partners in Table C8. The most important dimension of our analysis relates to international trade. It is clear that the euro area is by far the smallest and most open region. Arriola et al. (2020) note that countries that tend to rely more on foreign inputs and ship larger portions of their production to foreign markets are more exposed to global value chain disruptions. Unsurprisingly, given the relative size of the regions, the RW is the EA's largest trading partner for all types of imports. The value of parameters in the model (Tables C3-C6) are either based on region-specific empirical evidence, where available, or kept consistent with the original model which uses standard values, prevalent in the literature. See Gomes et al. (2012) and Clancy et al. (2016) for details.

It is worth highlighting that we follow the principle that the elasticity of substitution between tradable and non-tradable goods is substantially lower than the elasticity of substitution between different types of tradable goods. We set the (long-run) elasticity of substitution between tradable goods to 2.5 and the (long-run) elasticity of substitution between tradable and non-tradable goods to 0.5. These values come from Faruqee et al.

(2008) and are in line with the literature.[11] The elasticities of substitution between local tradable goods and imports (of 2.5) are closer to the macroeconomic literature than the trade literature, which often uses higher values (see, for example, Imbs and Mejean (2015)).

Regarding the focus of our study, the value for ν_X is greatest for the US (where only 15% of exports contain imported components) and lowest for the RW (where over one third of exports are composed of imported inputs). The EA lies closer to the middle of this range, with an import content of exports of around one fifth. The μ_X for each region is set at 1.5, meaning that intermediate imports used in the creation of exports are substitutes and not complements. This is the baseline calibration and we adjust this value (downwards) in some simulations. Finally, price and wage markups are generally larger in the EA, indicating a somewhat less competitive economy than the other regions. We assume, however, that nominal (price and wage) rigidities are the same across regions.

4 Reshoring

We first examine the effects of Europe attempting to reshore production, by reducing preferences for imports of intermediate goods used in the creation of exports from the other regions in favour of locally-produced inputs.

4.1 Unilateral reshoring

At first, we assume that these regions do not retaliate.[12] This means that we do not impose any exogenous shock (e.g. policy-related change) on their share of imports from Europe, which can of course endogenously react. This simplistic scenario allows us to explore the main mechanisms through which reshoring policies affect the economy, but without the additional complications resulting from simultaneous changes in the trade policies of the other regions. Later, we will examine more realistic simulations that feature retaliation and second-round effects on competition and productivity.

We scale the shocks to induce a permanent 1% decrease, relative to the initial steady state, in the EA's import content of exports to GDP. This transition occurs gradually, with almost all of the change complete after 10 years. As we solve our model using perfect foresight, all agents in the model are fully aware of the path the shock will take.[13] We display the results in Figure 2.

[11] Note that because of adjustment costs on bilateral imports, actual *short-run* elasticities in the model are smaller in line with the empirical evidence (Peter et al., 2020). Drozd et al. (2021) model a dynamic elasticity, that is low in the short run but high in the long run, by imposing a convex adjustment cost on trade shares. This represents an interesting avenue for future research.

[12] Martin and Vergote (2008) show that retaliation is a necessary feature of an efficient equilibrium in trade agreements. This is because governments do not, or cannot, compensate trade partners for terms-of-trade externalities. In our framework, retaliation, and recriprocation in friendshoring, is not endogenous and instead modelled as an exogenous policy decision.

[13] Our model is deterministic and is solved using a non-linear Newton–type algorithm in Dynare (see Adjemian et al. (2011) for details). Not having to linearise the model around a given steady state allows us to plot the transition dynamics between the initial and new steady state (i.e. post implementation of localisation policies).

The increase in preferences for local inputs in export goods leads to increased competition between these sectors for factor inputs, and a rise in production costs. Cost increases are passed through into prices, triggering an increase in inflation, a reduction in real interest rate and a real exchange rate appreciation.[14]

While the increase in costs is gradual, inflation responds faster. The response of monetary policy is crucial in shaping the macroeconomic dynamics. As the Central Bank responds (with a lag) to the pass through of higher costs to prices there is an almost immediate jump in the real effective exchange rate is almost immediate in anticipation of interest rate differentials across regions. The appreciated exchange rate initially dampens foreign demand for euro area exports and stimulates imports. This deteriorates the trade balance and lowers production in the tradable sector on impact. Therefore, reshoring production has some initial adjustment costs, with aggregate output decreasing because of the fall in tradable sector production.

However, the reduction in demand for intermediate imports in export goods causes foreign firms to reduce the price of these goods. As the reshoring is only partial, this represents a saving on local exporters' remaining intermediate imports. They eventually pass on these lower costs by reducing their prices. Gradually, as the shock (increasing demand for local inputs in exports) kicks in, tradable output and exports increase. Pricing rigidities and adjustment costs mean that investment only gradually increases to facilitate the expansion in tradable-sector output. In contrast, non-tradable output rises on impact, as the real interest rate decrease drives a rise in consumption (that has a larger home bias than investment).

4.2 Firm market power

Greater economic openness exposes local firms to foreign competition. However, efforts to boost the local production of semiconductors, for example, would reduce existing producers exposure to foreign competition. The large setup costs involved in this industry, as well as relaxations in EU state-aid rules aimed at facilitating greater public support for existing firms, make it more difficult for new entrants. By signalling a clear increase in preference for local intermediate inputs in export goods, localisation policies could (unintentionally) encourage firms in supported sectors to increase their price markups.[15]

We now amend our simplified unilateral reshoring scenario to include an additional (permanent) shock to EA tradable-good firms' market power. In the absence of any evidence of what the size of this increase in market power would likely be, we scale this shock to induce a 0.5% increase in (tradable-good) price markups. The shock is purely for illustrative purposes, to help us examine the transmission channels of this additional effect. As before, the shock occurs gradually and is almost fully absorbed after 10 years. We display the results (red line) in Figure 3.

A decrease in local competition due to reshoring would see aggregate production decrease. The greater market power of tradable firms allows them to increase their

[14] We define the exchange rate as the local currency price of one unit of foreign currency. Therefore, a reduction in the exchange rate means an appreciation of the home currency.

[15] An increase in price markups could also capture other salient aspects of international trade not captured in our model, such as reduced gains from technological and knowledge spillovers from reduced trade linkages.

prices, reducing demand for, and therefore reduce their output of, these goodsto recover profits. There is a substantial rise in inflation. The persistent drop in tradables production is sufficiently large, and not offset by a corresponding rise in non-tradable output (due to the reduced relative price of these goods), to result in a decrease in aggregate production.

The larger fall in tradables production also decreases demand for factor inputs, with marginal costs lower over the medium term. The decline in domestic demand means that tradable production are now directed towards exports, with lower cost of imports (from foreign firms reducing prices in response to the reshoring shock) key to facilitating a reduction in export prices. Investment declines in line with production in the more capital-intensive tradable sector. The rise in inflation reduces the real interest rate, spurring consumption, while the exchange rate appreciation and improvement in the terms of trade result in an increase in imports.

4.3 Firm productivity

Reshoring production weakens the interaction of the domestic economy with global supply chains. Openness affects growth positively, as economies that are more open have a greater ability to absorb technological advances generated elsewhere (Barro and Sala-i Martin, 1997). Global value chains have important implications for productivity and innovation.[16] Increased competition from foreign suppliers can induce improvements in domestic firms. Firms can have potential gains through specialising in their most productive tasks and from utilising a wider array of new varieties and higher quality foreign goods, services and intangible inputs. Further to these effects, engagement with global firms provides an opportunity for knowledge spillovers to local firms (Criscuolo et al., 2017). Reshoring could potentially weaken all of these transmission channels, resulting in the use of lower quality locally-produced inputs.

We next amend our simplified unilateral reshoring scenario to include an additional (permanent) shock to tradable-good firms' productivity. Again, in the absence of evidence of how big this shock might be, we induce a 0.5% decrease in (tradable-good) productivity for illustrative purposes. As before, the shock occurs gradually and is almost fully absorbed after 10 years. We display the results (red line) in Figure 4.

In this case, both tradable and non-tradable production are lower than in the unilateral scenario. Tradable production falls due to the less efficient use of inputs, with marginal costs rising rapidly. Firms pass higher costs through to prices and demand for exports falls. Although the REER appreciation is not as large as before, as the smaller fall in EA export prices means exports do not increase as much as in other simulations. A smaller improvement in the terms of trade reduces demand for consumption and therefore non-tradables.

[16] Trade in our model is motivated by the Armington assumption that countries produce unique goods and consumers have a love of variety. However, this setup is silent on potentially important implications of localisation policies, such as shift patterns of specialisation driving by comparative advantage. Given Arkolakis et al. (2012)'s equivalence result for different classes of quantitative trade models, it is unclear whether incorporating such changes in specialisation would affect our aggregate results. This represents an important avenue for future research.

4.4 Global reshoring

We also analyse whether imposing a similar shock in the other regions affects these results i.e. the RW and US all permanently decrease their import content of export goods by a similar amount (1% of GDP, relative to the initial steady state level). We display the results using the red line in Figure 5. Again, this change occurs gradually and takes roughly 10 years to implement. We abstract from analysing second round effects in this scenario, as this would require us making assumptions regarding differential impacts of decreased competition and productivity across the three regions. Of course, even if technically feasible, the use of multiple simultaneous region-specific shocks would raise important concerns over interpretation.

In this case, the positive effects of reshoring on EA aggregate output are smaller than for the unilateral scenario. The exchange rate depreciation facilitates a faster expansion in tradable production.[17] However, reshoring in all regions means that each economy becomes more closed. This implies a need for an increase tradeable output, facilitated by a decline in non-tradeable output. Demand for imports of re-export good collapses in every region. As a result, total EA exports decrease, despite the REER depreciation boosting exports of consumption and investment goods to both the US and RW.

4.5 Comparative statics

So far, we have concentrated on the adjustment to the shock over the first 10 years. We now provide an overview of how these scenarios compare to the initial steady state (i.e. what is the long-run efficiency of reshoring). We display the results in Table 1. In more optimistic cases, where there are no second-round effects from reshoring, the long-run effect on domestic aggregate output is positive as local production replaces imports. However, it is clear that reshoring has a net negative economic cost in the more realistic scenarios of reduced local competition and productivity.

5 Resilience

Having assessed the different types of policies countries may utilise to reorient supply chains, we now examine whether such a shift increases resilience. This is a stated aimed of localisation policies. We do this by simulating an economic contraction in the face of regional and global shocks and comparing the susceptibility of the economy with greater reshoring to the (baseline) economy with more diversified supply chains. The differences between the reshored and baseline economies are that the latter has an import content of exports to GDP that is a one-percentage point lower and an elasticity of substitution between foreign and local goods of 0.5 (instead of 1.5). These changes, which essentially result in a greater dependence on local firms, proxy some of the potential differences in economic structure post reshoring.[18]

[17] This depreciation is due to the reshoring-induced rise in costs and prices in the larger regions. As exchange rates are double weighted, changes in costs and prices in these larger economies have a greater impact.

[18] Drozd and Nosal (2012), for example, motivate low (short-run) elasticities of substitution using customer base search and matching frictions that endogenously segments markets.

We first analyse the differential impact of the regional shocks in the two economies. We proxy this through an increase in the markup of EA export firms that has a roughly 1% of GDP impact in the euro area (i.e. the markups of export firms in the other regions are unchanged) in the baseline economy. We then impose precisely the same sized shock on the reshored economy. We display the results in the left-hand panel of Figure 6. It is clear there are material differences in the regional shock absorption capacity of the reshored economy. Reshoring increases the susceptibility of the economy to regional disturbances, with aggregate output falling by around 25% more for the same-sized shock. A reduced ability to use inputs from the unaffected regions, coupled with the greater market power of local firms, worsen the tradable sector contraction in the reshored economy.

We next examine the differential impact of the global shocks in the two economies. We proxy the current supply chain disruptions by modelling this as a temporary increase in the markup of export firms in all three regions of the world. We scale the shock to get a roughly 1% of GDP impact in each region in the baseline economy, and then impose the same sized shock on the reshored economy. We display the results in right-hand panel of Figure 6. We find that there is essentially no difference in resilience to global shocks following reshoring. In this case, the higher costs of production (from the greater use of local inputs and the increase in tradable firm market power) limit the euro area's ability to supply the other regions with exports during their downturns.[19]

While we believe this is a useful first attempt at examining the implications of localisation policies on economic resilience, it is important to note some limitations of our approach. A key driver of localisation policies is the avoidance of a counterfactual where being overly dependent on an external supplier allows them puts the EA in a compromised situation. Our framework, with only three regions of the world and no distinction amongst imports of essential and non-essential goods (i.e. untargeted reshoring) does not permit such an investigation. Finally, as our model is deterministic, we cannot capture the effect of reduced susceptibility to foreign shocks that may better capture the trade-off facing policymakers.

6 Friend-shoring

We next examine the effects of reorientating supply chains towards "trusted partners", a policy described as "friend-shoring" by US Treasury Secretary Yellen. The US view this as a commitment to work with countries that "have strong adherence to a set of norms and values about how to operate in the global economy and about how to run the global economic system".

We model this as an increase in EA preferences for intermediate-good imports from the US, offset by a reduction in such imports from the RW. This means that total imports of these goods remain unchanged, and there is only a reorientation of the size of bilateral trade flows. We assume, at first, that preferences in the RW and US regions remain unchanged. As before, we scale the shock to induce a 1% change in (this case the bilateral) import content of exports-to-GDP ratio. We display the results in Figure 7.

[19] Although participation in global value chains increased firms' vulnerability to the COVID-19 shock, firms benefited from sourcing of core inputs from different countries (Lebastard et al., 2023).

We find that unilateral friend shoring induces limited losses in aggregate output. , largely due to the big increase in imports. This is because the relative price of imports from the US is lower than from the RW, and so this friendshoring boosts demand for imports. The biggest difference compared to reshoring is that production is not brought back home but redirected from one external region to another. It results in a persistent drop in tradable sector production, which is sufficiently large to negate the increase in non-tradable production. As before, lower import prices allow export prices to fall, boosting exports.

6.1 Reciprocation

We next examine the impact of friend-shoring if the US reciprocates i.e. the EA and US both increase their preference for imports of intermediate goods from each other. For now, we continue to assume that preferences in the RW bloc remain unchanged. We display the results in Figure 8.

The increase in US demand for EA intermediate-good imports increases competition for factor inputs in Europe (as there is the need to produce these export goods). The resulting rise in costs, prices and inflation, however, appreciates the real effective exchange rate and therefore makes imported components of export goods more attractive at the expense of local inputs. Exports increases due to the greater US demand for EA imports (despite the REER appreciation). This results in a persistent reduction in tradable output, contrary to reshoring scenarios. The reduced real interest rate again spurs consumption and investment, with the large rise in non-tradable production that more than offsets the reduction in tradeable output, boosting aggregate output.

This conclusion abstracts from possible second-round effects of reduced competition or productivity which may to some extent also be induced by friendshoring policies. As we saw in the reshoring analysis, such second-round effects would likely worsen the economic outcomes of friendshoring initiatives.

6.2 Retaliation

Until now, we have assumed that RW preferences remain unchanged. This could be because of the substantial heterogeneity in this bloc, with different country-specific responses effectively cancelling each other out for instance (and making a coordinated response more difficult). We next examine the impact of reciprocal friend-shoring between the two western blocs when the RW reduces bilateral trade ties in response. In our model, this is equivalent to the RW reshoring i.e. they reduce their preference for imports of EA and US intermediate-good imports. We display the results in Figure 9.

This scenario has very similar dynamics to the reciprocation scenario, but with a level shift in some variables boosting the impact on aggregate output. Reduced demand for EA exports from the RW eases some of the pressure (compared to the reciprocation scenario) on factor input costs, and therefore prices and inflation. The knock-on effect on the exchange rate somewhat dampens the increase in imports and consumption, allowing for the greater use of local inputs in exports. The need for greater tradable production means aggregate output increases by more than when there is only reciprocation.

Of course, as we saw with our reshoring simulations, this is likely an optimistic view of friend-shoring. As before, if localisation policies promote imports from a specific trade

partner, it makes sense that the same increase in firm market power and lower efficiency of intermediate imports would reduce the economic benefits of such a policy. These are important aspects to consider in any attempt to quantify the effect of friend-shoring, whereas our interest lies in exploring the transmission mechanism.

7 Conclusion

While the Open Strategic Autonomy agenda is rooted in concerns over and beyond economics, European policymakers need to consider ways to reduce the costs of this adjustment. It is essential to minimise the crowding out of resources (i.e. capital and labour) that pushes up costs and prices in our simulations. We consider reshoring as a gradual process, enacted over roughly 10 years. Although we do not capture this aspect in our framework, it stands to reason that limiting reshoring to vital goods that are most susceptible to supply chain disruptions could help in this regard.

Another important finding is that an increase in local tradable firm market power likely negates a positive effect of reshoring on domestic output. Therefore, policymakers should avoid excessively weakening Europe's long-established state aid rules, as reduced foreign competition will ultimately undermine localisation policies. It could also lead to demands for support in other industries, which are not the focus on reshoring initiatives.[20]

Our results also indicate that if locally produced inputs are inferior to their imported counterparts, the economic costs of reshoring are greater. As such, policymakers should focus localisation policies on goods where there is already an existing comparative advantage in production (or, at least, where the distance from the technological frontier is not too large). Either that, or, as we mentioned previously, the economic costs are considered a worthwhile trade-off for an increase in security of supply.

Finally, even if not specifically analysed in our model, it seems reasonable to recommend that policymakers seeking to friendshore should favour regions that are not potential competitors for goods. For example, the US has similar aims to Europe for increased production of semi-conductors. This competition may induce trade tensions in future. While the prospect of friend-shoring has increased following Russia's invasion of Ukraine, Europe could also decide to focus on increasing *intra*-regional trade. The increase in tariffs by the previous US administration demonstrates that trade relations can change rapidly.

In addition to addressing some of the limitations of our analysis that we mentioned throughout the paper, we believe there are several other interesting avenues for future research on this topic. For example, one could explore the welfare impacts of localisation policies. Our comparative static analysis shows that consumption increases in most reshoring scenarios. However, analysing the net welfare effect could bring some further insights and help us better understand the trade-offs implicit in reshoring and friend-shoring initiatives. Another important aspect, given our finding that localisation policies are inflationary, is the monetary policy response. In our simulations, all regions have the same calibrated values in their Taylor rules. Making these values region specific

[20] Experience with past initiatives, such as the Common Agricultural Policy, demonstrates that industries can become reliant on public support (Kazukauskas et al., 2013).

would allow one to analyse how monetary policy could affect the adjustment following localisation initiatives.

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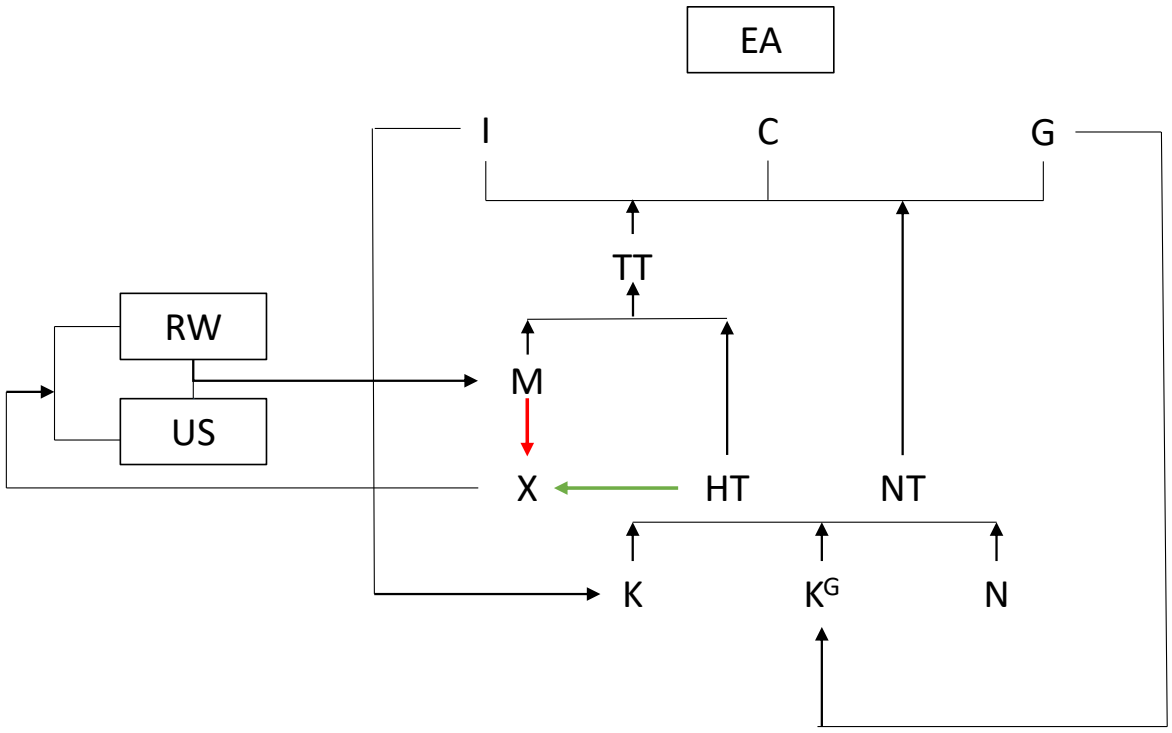
Tables and Figures

Table 1. Efficiency of reshoring (% differences in steady states)

	Unilateral	Mkt Power	Productivity	Global
GDP	0.5	-0.2	-0.3	0.2
Trad. output	0.5	-1.3	-1.0	0.8
Nontrad. output	0.5	0.7	0.2	-0.3
Consumption	1.4	1.5	0.7	-0.9
Investment	1.9	0.3	0.9	0.1
REER	-2.1	-2.3	-1.7	0.3
Imports	0.7	1.7	0.0	-4.9
Exports	1.0	2.7	-0.1	-1.7
Trad. marg. costs	0.7	0.2	1.6	-0.3
Inter. import prices	-2.1	-2.5	-1.7	0.6
Export prices	-2.5	-3.4	-1.6	-2.9

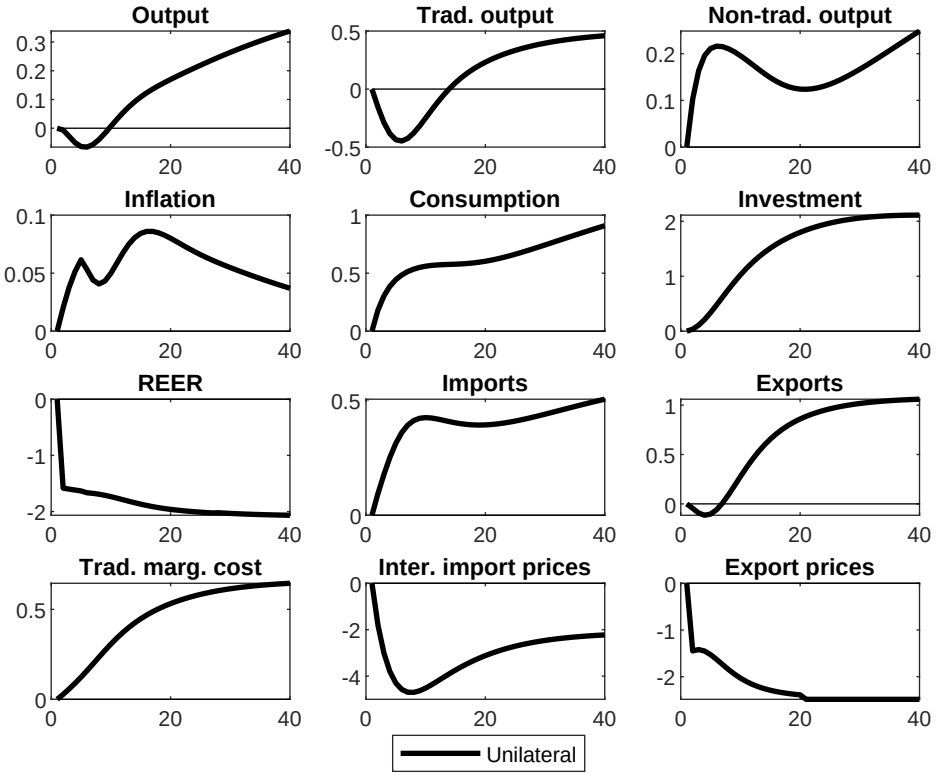
Notes: This table compares the steady-state values with unchanged trade linkages to those of an economy with a one percentage point reduction in the imports content of exports to GDP. "Unilateral" examines the case where the EA enacts this reshoring on its own and there is no retaliation by the other regions. "Mkt power" adds an increase in EA tradable firms' price markups to the unilateral scenario. "Productivity" adds a decrease in EA tradable firms' productivity to the unilateral scenario. "Global" sees all regions engage in reshoring.

Figure 1. **Model structure**



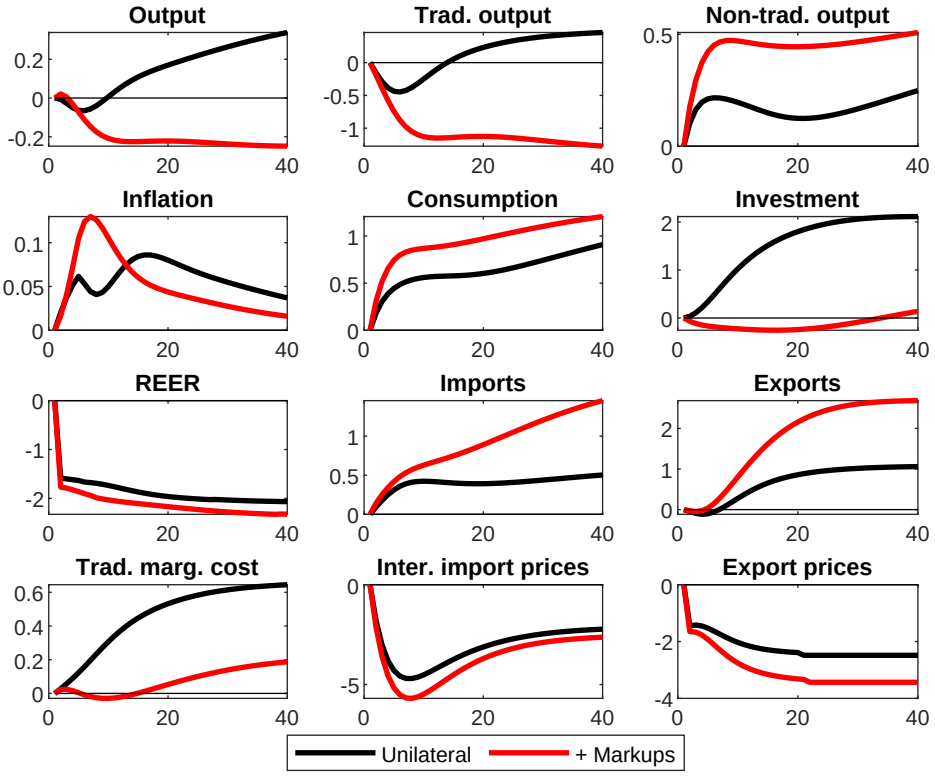
Notes: This figure shows the structure of our model. The red and green arrows indicate the *direct* channel through which a greater preference for domestically-produced inputs for export goods (and therefore a reduced preference for imported inputs) affects the macroeconomy. However, by affecting the relative price of all goods produced in the economy, and therefore their quantity demanded and supplied, there are considerable *indirect* effects captured by our general equilibrium framework. For conciseness, the figure focuses on the euro area (EA) economy. The structure of each regional economy is symmetric and linked with each other through bilateral trade and participation in international financial markets with a block-specific calibration. US represents the United States, while RW is the rest of the world. M denotes imports, X exports, K capital, N labour, NT non-tradeable goods, HT domestically produced tradeable goods and TT total tradeable goods.

Figure 2. **Unilateral reshoring**



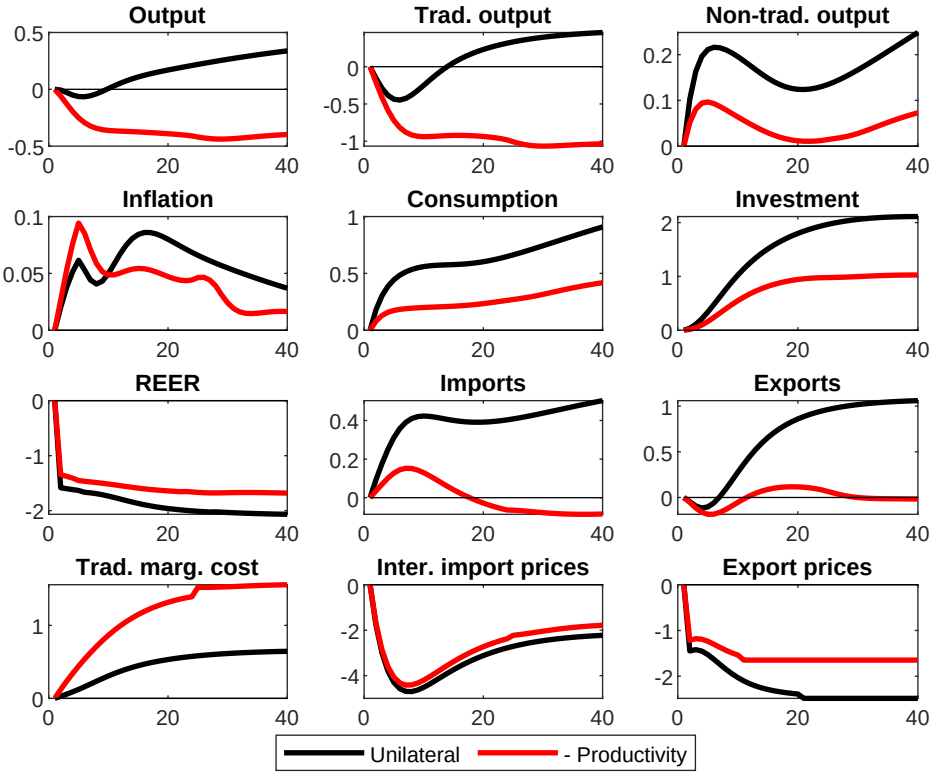
Notes: This figure shows the effect on the euro area (EA) of a permanent increase in EA-only ('unilateral') preferences for domestically-produced inputs for export goods. The plotted lines represent transition dynamics between the initial and new steady state. We scale the shock such that the import content of exports to GDP decreases by one percentage point in the long run, with almost all of this adjustment complete after 10 years.

Figure 3. **Unilateral reshoring, with increased tradable firm market power**



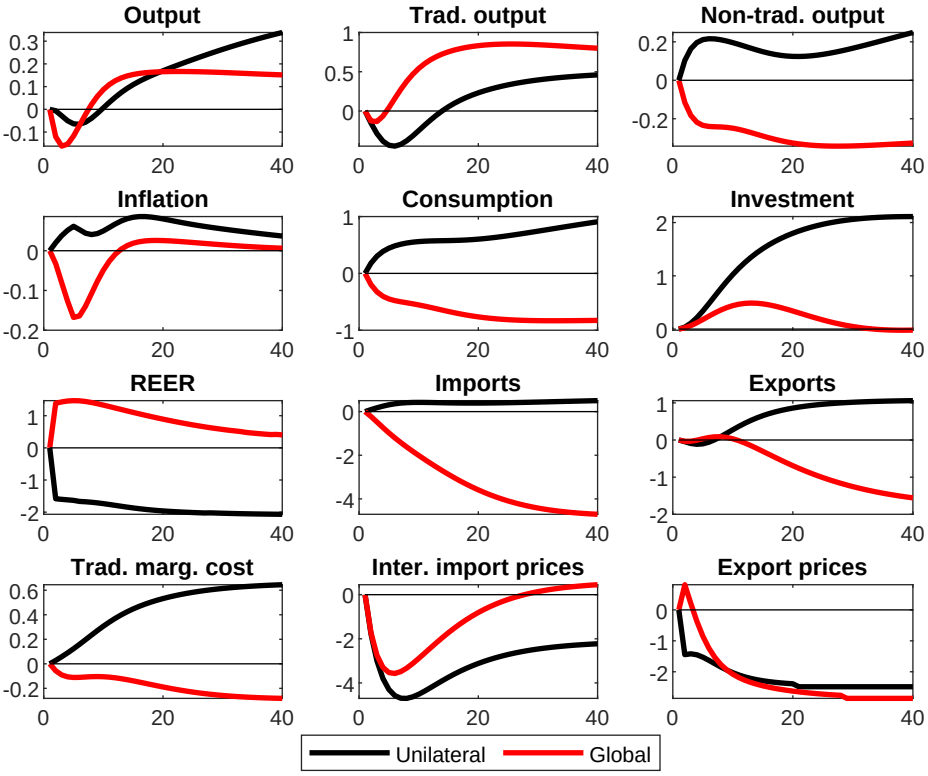
Notes: This figure shows the effect on the euro area (EA) of a permanent increase in EA-only ('unilateral') preferences for domestically-produced inputs for export goods and a permanent increase in EA tradable firms' market power. The plotted lines represent transition dynamics between the initial and new steady state. We scale the reshoring shock such that the import content of exports to GDP decreases by one percentage point in the long run, with almost all of this adjustment complete after 10 years. We scale the market power shock such that EA tradable firms' price markup increases by 0.5% in the long run, with almost all of this adjustment complete after 10 years.

Figure 4. **Unilateral reshoring, with reduced tradable firm productivity**



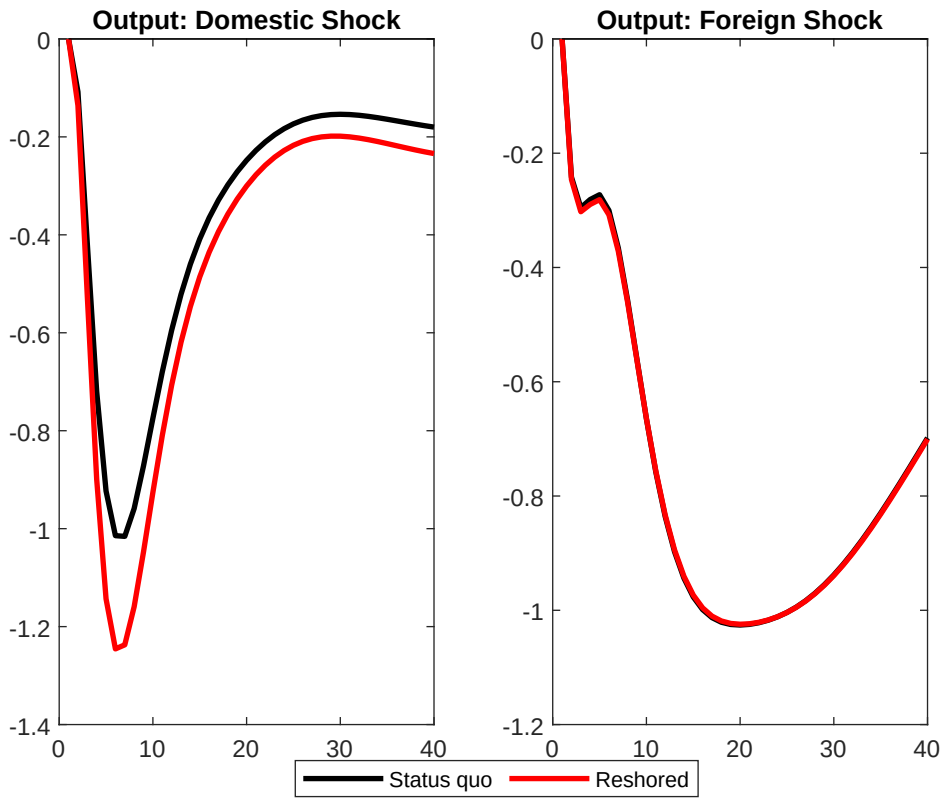
Notes: This figure shows the effect on the euro area (EA) of a permanent increase in EA-only ('unilateral') preferences for domestically-produced inputs for export goods and decreases EA tradable firms' productivity. The plotted lines represent transition dynamics between the initial and new steady state. We scale the reshoring shock such that the import content of exports to GDP decreases by one percentage point in the long run, with almost all of this adjustment complete after 10 years. We scale the productivity shock such that EA tradable firms' productivity decreases by 0.5% in the long run, with almost all of this adjustment complete after 10 years.

Figure 5. **Global reshoring**



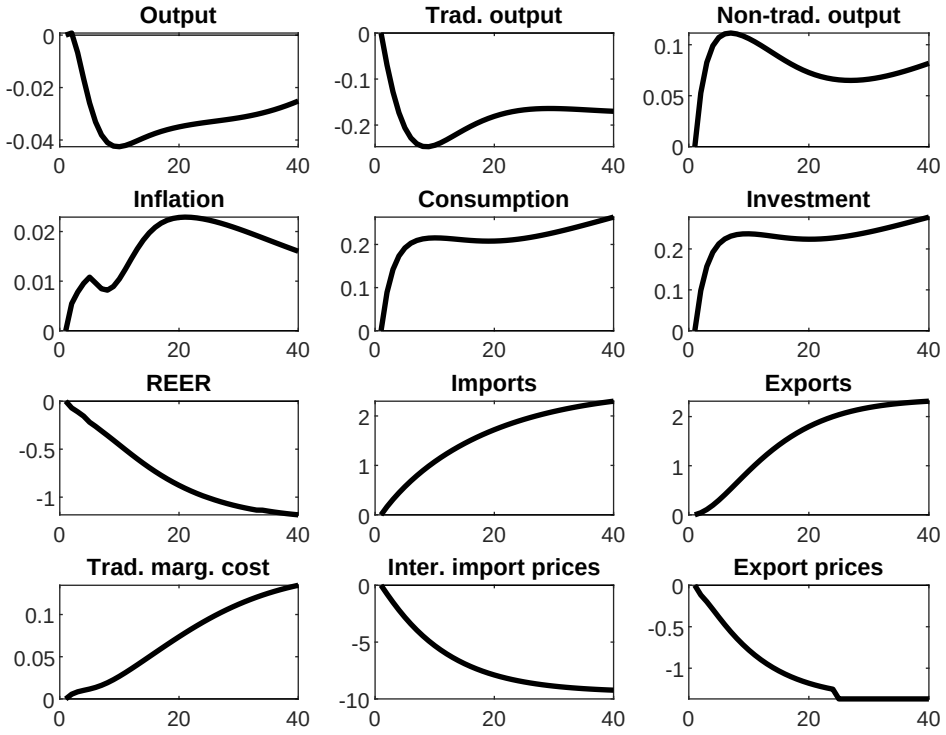
Notes: This figure shows the effect on the euro area (EA) of a permanent increase in EA-only ('unilateral') and all bloc ('global') preferences for domestically-produced inputs for export goods. The plotted lines represent transition dynamics between the initial and new steady state. We scale the shock such that the import content of exports to GDP decreases by one percentage point in the long run, with almost all of this adjustment complete after 10 years.

Figure 6. **Resilience to domestic and global (markup) shocks**



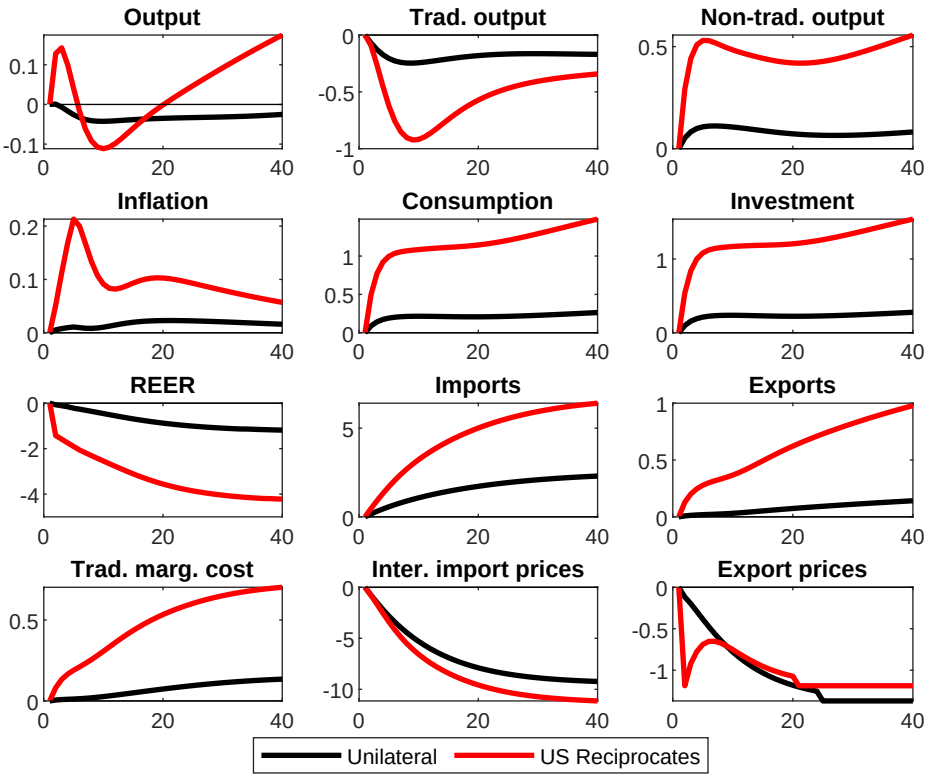
Notes: This figure shows the effect on euro area (EA) aggregate output of a temporary unanticipated increase in export firms' markups, scaled to induce a roughly 1% of GDP contraction on impact. The left-hand panel compares the effect of a shock to euro-area ("regional shock") export firms' markups between the status quo economy and an economy that has underwent reshoring (e.g. has a 1% of GDP lower import content of exports and a lower elasticity of substitution between foreign and domestic goods). The plotted lines represent transition dynamics between the initial and new steady state. We scale the markup shock to induce a 1% fall in GDP in the status-quo economy and then impose the same sized change in markups on the reshored economy. In the right-hand panel we use the same process for a shock to export firms' markups in the US and RW regions ("foreign shock").

Figure 7. **Unilateral EA friendshoring**



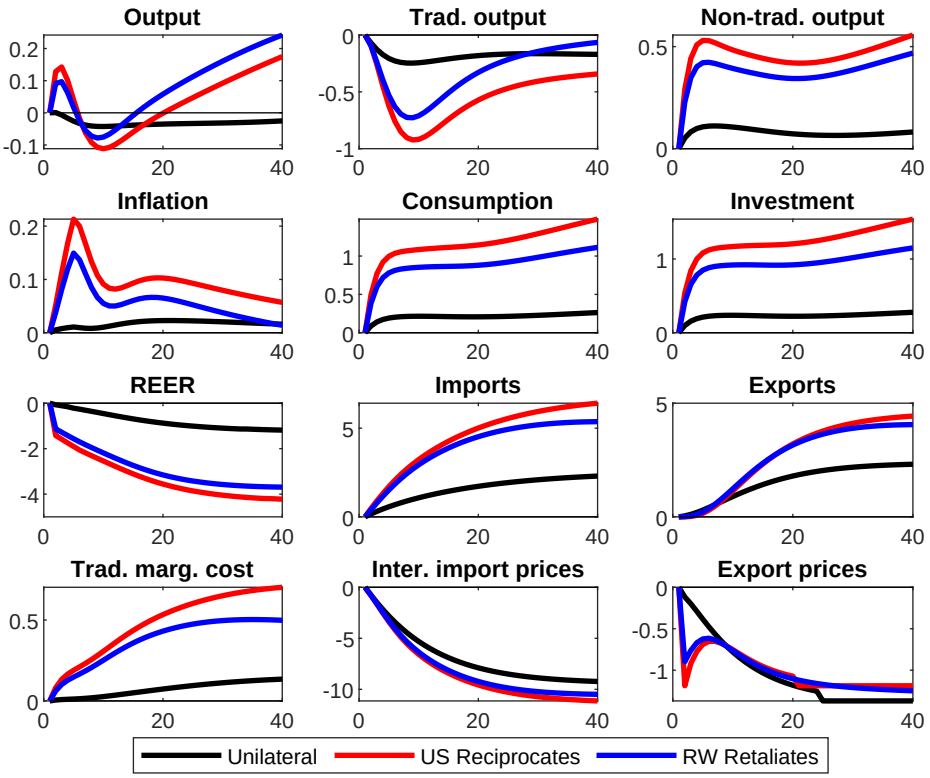
Notes: This figure shows the effect on the euro area (EA) of a permanent increase in EA preferences for intermediate-good imports from the United States (US) that is offset by a reduction in such imports from the rest of the world (RW). The plotted lines represent transition dynamics between the initial and new steady state. We scale the shock such that the import content of exports to GDP from the US increases by one percentage point in the long run and the RW component falls by the same amount, with almost all of this adjustment complete after 10 years. There is no change in the preferences of the other regions (i.e. the EA engages in friendshoring unilaterally).

Figure 8. **Reciprocated EA friendshoring**



Notes: This figure shows the effect on the euro area (EA) of a permanent increase in EA preferences for intermediate-good imports from the United States (US) that is offset by a reduction in such imports from the rest of the world (RW). The US reciprocates and increases their preferences for intermediate good imports from the EA (also offset by a reduction in imports from the RW). The plotted lines represent transition dynamics between the initial and new steady state. We scale the shocks such that the import content of exports to GDP in the EA and US from the RW decreases by one percentage point in the long run and the component from the other bloc increases by the same amount, with almost all of this adjustment complete after 10 years. There is no change in the preferences of the RW bloc (i.e. the US reciprocates EA friendshoring but there is no retaliation by the RW).

Figure 9. **Retaliation EA friendshoring**



Notes: This figure shows the effect on the euro area (EA) of a permanent increase in EA preferences for intermediate-good imports from the United States (US) that is offset by a reduction in such imports from the rest of the world (RW). The US reciprocates and increases their preferences for intermediate good imports from the EA (also offset by a reduction in imports from the RW). The RW retaliates by reducing their preferences for intermediate good imports from the EA and the US (i.e. they reshore production). The plotted lines represent transition dynamics between the initial and new steady state. We scale the shocks such that the import content of exports to GDP in the EA and US from the RW decreases by one percentage point in the long run and the component from the other bloc increases by the same amount, with almost all of this adjustment complete after 10 years. Over the same period the import content of exports in the RW decreases by one percentage point.

A The European Chips Act

Public policy choices emphasising security considerations over cost minimisation, foreshadowing a less-integrated global economy with shorter (or renationalised) supply chains, are already apparent in the sectors providing critical intermediate inputs. As an essential component of electronic devices, semiconductors are vital for the global economy. Post-pandemic shortages forced production slowdowns in many parts of the world and exposed global reliance on a small number of producers in a small number of countries. These few and geographically-concentrated production locations must operate at close to full capacity in order to cover the very high capital investment costs, leaving little capacity to accommodate demand volatility. European policymakers have identified securing the supply of the most advanced chips as an economic and geopolitical priority, with industrial automation equipment highly dependent on their supply. As an example of the disruption due to the global chips shortage, Europe produced over 11 million less cars in 2021, a substantial shock that brought production back to 1975 levels (Commission, 2022).

The European Chips Act aims to double Europe's semiconductor global market share, to 20% from less than 10% currently, by 2030. This requires the mobilisation of substantial public and private investment in this industry. Given the high entry barriers and the capital intensity of the sector, the European Commission (EC) will allow greater than usually permitted (under state aid rules) public support for chips manufacturing. Through the Important Project of Common European Interest on Microelectronics and Communication Technologies, approval of state aid is possible for facilities where the economic benefit outweighs the potentially negative impact on trade and competition. The legislation also contains mechanisms for greater cooperation and coordination amongst EU member states to provide early warnings of, and react to, supply chain bottlenecks.

However, Europe is not alone in seeking to enhance the resilience of its semiconductor supply. In China, a series of initiatives, such as "Made in China 2025", will

provide substantial financing to boost this industry. Planned public support, through tax incentives and investment, is orders of magnitude larger in South Korea and Taiwan, the global leaders in the production of the most advanced semiconductor chips. In the US, the CHIPs and Science Act has a similar set of aims to the European Chips Act and goes a step further by explicitly stating a partial motivation is to "counter China".

This legislation marks an important turning point in European Industrial Policy.[21] After decades of emphasis on reducing costs and maintaining competition, policymakers are beginning to reconsider the efficiency versus resilience trade off. Since strategic autonomy as a whole is too broad a concept to analyse, we use the European Chips Act as a proxy for the types of initiatives that policymakers may implement to meet this objective.

B Appendix: Locally-produced intermediate inputs

We concentrate our analysis on intermediate-good imports, because recent disruptions to global supply chains are seen as a driver of reshoring policies.[22] These are a composite of imports from all regions of the world:

$$IM_t^X(h) = \left[\sum_{CO \neq H} \left(\nu_{IM^X}^{H,CO} \right)^{\frac{1}{\mu_{IM^X}}} \left(IM_t^{X,H,CO}(h) \left(1 - \gamma_{IM^X}^{H,CO}(h) \right) \right)^{\frac{\mu_{IM^X}-1}{\mu_{IM^X}}} \right]^{\frac{\mu_{IM^X}}{\mu_{IM^X}-1}}, \quad \text{(B9)}$$

where μ_{IM^X} is the intertemporal elasticity of substitution between imports from different trading partners, ν_{IM^X} represents the share of imports from each region in total imports and $\gamma_{IM^X}^{H,CO}$ are (quadratic) adjustment costs on bilateral imports of export

[21] Of course, such a change is not necessarily an improvement. See Tagliapietra et al. (2023) for a critique of the Net Zero Industry Act, which is essentially the EU's response to the US Inflation Reduction Act.

[22] Here we only provide the aspects of the model most directly related to our analysis. We refer the interested reader to Gomes et al. (2012) for details on the original EAGLE model, (Brzoza-Brzezina et al., 2014) for the import content of exports component and Clancy et al. (2016) for the fiscal extension. These papers also provide detailed discussion on the calibration choices documented in Appendix C.

goods of firm h. Intermediate-good imports are then combined with local (i.e. regional) tradable inputs, produced using regional capital K_t and labour L_t subject to productivity shocks z_T and fixed costs ψ_T:

$$Y_{T,t}^S(h) = max\left\{z_T K_t^D(h)^{\alpha_T} N_t^D(h)^{1-\alpha_T} - \psi_T, 0\right\} \tag{B10}$$

to produce exports goods:

$$X_t(h) = \left[\nu_X^{\frac{1}{\mu_X}} HT_t^X(h)^{\frac{\mu_X-1}{\mu_X}} + (1-\nu_X)^{\frac{1}{\mu_X}} IM_t^X(h)^{\frac{\mu_X-1}{\mu_X}}\right]^{\frac{\mu_X}{\mu_X-1}} \tag{B11}$$

that are in turn used as inputs in other countries' production of (public and private) consumption, investment and export goods. Importantly for our analysis, ν_X represents the weight of local goods in the export good bundle and μ_X represents the intertemporal elasticity of substitution between local and foreign tradable goods. The marginal cost of producing regional intermediate tradable goods are:

$$MC_{T,t} = \frac{1}{z_{T,t} K_{G,t}^{\alpha_G} (\alpha_T)^{\alpha_T} (1-\alpha_T)^{1-\alpha_T}} \left(R_t^K\right)^{\alpha_T} \left((1+\tau_t^{W_f}) W_t\right)^{1-\alpha_T} \tag{B12}$$

where α_T is the capital share in the tradable sector, α_G determines the productivity of public capital $K_{G,t}$, $\tau_t^{W_f}$ accounts for labour taxes paid by firms, W_t are wages and R_t^K is the rental cost of capital. The marginal cost of producing export goods is therefore:

$$MC_{X,t} = \left[\nu_{X,t}[MC_{T,t}]^{1-\mu_X} + 1 - \nu_{X,t}[P_{IM^X,t}]^{1-\mu_{X,t}}\right]^{\frac{1}{1-\mu_{X,t}}} \tag{B13}$$

where the aggregate price (which is equal to the marginal cost) of imports is:

$$P_{IM,^X t} = \left[\sum_{CO \neq H} \nu_{IM^X}^{H,CO} \left(\frac{P_{IM,t}^{H,CO}}{\gamma_{IM^X}^{H,CO,\dagger}(h)}\right)^{1-\mu_{IM^X}}\right]^{\frac{1}{1-\mu_{IM^X}}}, \tag{B14}$$

where $P_{IM,t}^{H,CO}$ is the price of imports by region H from region CO and $\gamma_{IM^X}^{H,CO,\dagger}$ is the derivative of bilateral import adjustment costs. Demand for local tradables is then:

$$HT_t^X(h) = \nu_X \left(\frac{MC_{T,t}}{MC_{X,t}} \right)^{-\mu_X} X_t(h) \tag{B15}$$

while for imports it is:

$$IM_t^X(h) = (1 - \nu_X) \left(\frac{P_{IM^X,t}}{MC_{X,t}} \right)^{-\mu_X} X_t(h). \tag{B16}$$

Export firms can discriminate between markets, albeit subject to foreign demand, and use their monopoly power to set their prices with a markup over marginal costs:

$$\frac{\tilde{P}_{X,t}}{P_{X,t}} = \frac{\theta_X}{\theta_X - 1} \frac{f_{X,t}}{g_{X,t}} \tag{B17}$$

$$f_{X,t} = X_t MC_{X,t} + \beta \xi_X E_t \left[\frac{\Lambda_{I,t+1}}{\Lambda_I, t} \left(\frac{\Pi_{X,t+1}}{\Pi_{X,t+1}^{\chi_X} \bar{\Pi}^{(1-\chi_X)}} \right)^{\theta_X} f_{X,t+1} \right] \tag{B18}$$

$$g_{X,t} = P_{X,t} X_t + \beta \xi_X E_t \left[\frac{\Lambda_{I,t+1}}{\Lambda_I, t} \left(\frac{\Pi_{X,t+1}}{\Pi_{X,t+1}^{\chi_X} \bar{\Pi}^{(1-\chi_X)}} \right)^{\theta_X - 1} g_{X,t+1} \right] \tag{B19}$$

where θ_X is the elasticity of substitution between different export brands and the ratio $f_{X,t}/g_{X,t}$ reflects the fact that only a fraction of export firms can change their prices in every period (i.e. some firms may be stuck with the same price for a number of periods). In this staggered framework (Calvo, 1983) prices evolve according to:

$$P_{X,t} = \left[\Xi_X \left(\Pi_{X,t-1}^{\chi,X} \bar{\Pi}^{1-\Xi_X} P_{X,t-1} \right)^{1-\theta_X} + (1 - \chi_X) \left(\tilde{P}_{X,t} \right)^{1-\theta_X} \right]^{\frac{1}{1-\theta_X}}.^{23} \tag{B20}$$

Importantly, adjusting the share of local inputs in export goods will affect prices and quantities all along the supply chain. As an illustration, consider the effect of a change in preferences for local intermediate inputs on demand for (final) consumption goods. These are a bundle comprised of tradables and non-tradable intermediates:

[23] There is an analogous process for the pricing for tradable and non-tradable goods.

$$Q_t^C = \left[\nu_C^{\frac{1}{\mu_C}} \left(TT_t^C \right)^{\frac{\mu_C - 1}{\mu_C}} + (1 - \nu_C)^{\frac{1}{\mu_C}} \left(NT_t^C \right)^{\frac{\mu_C - 1}{\mu_C}} \right]^{\frac{\mu_C}{\mu_C - 1}}. \tag{B21}$$

with tradables themselves a bundle of locally-produced and imported consumption goods:

$$TT_t^C = \left[\nu_{TC}^{\frac{1}{\mu_{TC}}} \left(HT_t^C \right)^{\frac{\mu_{TC} - 1}{\mu_{TC}}} + (1 - \nu_{TC})^{\frac{1}{\mu_{TC}}} \left(IM_t^C \right)^{\frac{\mu_{TC} - 1}{\mu_{TC}}} \right]^{\frac{\mu_{TC}}{\mu_{TC} - 1}}. \tag{B22}$$

Demand for local tradables used for consumption goods is:

$$HT_t^C = \nu_{TC} \left(\frac{P_{HT,t}}{P_{TTC,t}} \right)^{-\mu_{TC}} TT_t^C \tag{B23}$$

with a price of:

$$P_{TT^C,t} = \left[\nu_{TC} [P_{HT,t}]^{1-\mu_{TC}} + 1 - \nu_{TC} [P_{IM^C,t}]^{1-\mu_{TC}} \right]^{\frac{1}{1-\mu_{TC}}} \tag{B24}$$

that in turn affects the price of final consumption goods:

$$P_{C,t} = \left[\nu_C [P_{TT^C,t}]^{1-\mu_C} + 1 - \nu_C [P_{NT^C,t}]^{1-\mu_C} \right]^{\frac{1}{1-\mu_C}}. \tag{B25}$$

Market clearing for locally-produced tradables:

$$Y_{T,t}(h) = HT_t^C(h) + HT_t^I(h) + HT_t^{GC}(h) + HT_t^{GI}(h) + \sum_{CO \neq H} HT_t^{X,H,CO}(h) \tag{B26}$$

therefore implies that a change in preference for local inputs in export goods will affect demand for tradable and final consumption goods by changing $P_{HT,t}$.

C Model calibration

Table C2. Key steady-state ratios (as a % of GDP)

	EA	RW	US
Domestic demand			
Private consumption	58.5	58.6	65.9
Public consumption	20.5	16.6	14.7
Private investment	17.0	21.0	15.0
Public investment	4.0	4.0	4.0
Trade			
Total imports	27.9	11.3	17.1
Private consumption goods	14.0	2.6	6.9
Public consumption goods	1.2	1.0	0.9
Private investment goods	8.6	4.1	7.2
Public investment goods	0.4	0.4	0.4
Import content of exports	3.7	3.2	1.8
Bilateral trade			
Imported consumption goods	14.0	2.6	6.9
From REA	-	1.1	1.3
From RW	13.2	-	5.6
From US	0.7	1.5	-
Imported investment goods	8.6	4.1	7.2
From REA	-	1.4	1.2
From RW	5.7	-	6.0
From US	2.8	2.7	-
Imported goods for re-exports	3.7	3.2	1.8
	0.0	0.0	0.0
From REA	-	1.3	0.4
From RW	3.2	-	1.4
From US	0.4	1.9	-
Size of region (% of world GDP)	20.0	31.0	49.0

Notes: Euro area (EA), rest of the world (RW) and the United States of America (US). Rounding may affect totals.

Table C3. Household and firm behaviour

	EA	RW	US
Households			
Subjective discount factor	$1.03^{\frac{1}{4}}$	$1.03^{\frac{1}{4}}$	$1.03^{\frac{1}{4}}$
Depreciation rate (private capital)	0.025	0.025	0.025
Int. elasticity of substitution	1.00	1.00	1.00
Habit formation	0.70	0.70	0.70
Frisch elasticity of labour (inverse)	2.00	2.00	2.00
Intermediate goods firms			
Tradable - bias toward capital	0.30	0.30	0.30
Non-tradable - bias toward capital	0.30	0.30	0.30
Final consumption goods			
Subst. btw. local and imported	2.50	2.50	2.50
Subst. imported	2.50	2.50	2.50
Bias toward local tradables	0.28	0.90	0.62
Subst. btw. tradable and non-tradable	0.50	0.50	0.50
Bias toward tradables	0.35	0.35	0.35
Final investment goods			
Subst. btw. local and imported	2.50	2.50	2.50
Subst. imported	2.50	2.50	2.50
Bias toward local tradables	0.31	0.79	0.29
Subst. btw. tradable and non-tradable	0.50	0.50	0.50
Bias toward tradable	0.75	0.75	0.75
Export goods			
Subst. btw. local and imported	1.50	1.50	1.50
Subst. imported	2.50	2.50	2.50
Bias toward local tradables	0.80	0.65	0.85

Notes: Euro area (EA), rest of the world (RW) and the United States of America (US). In the absence of detailed data on the source of government imports, we assume that preferences (e.g. bias for local tradables) are the same as for the private sector. Rounding may affect totals.

Table C4. Government behaviour

	EA	RW	US
Consumption Expenditure			
Domestic consumption goods (% of GDP)	20.5	16.6	14.7
Imported consumption goods (% of GDP)	1.2	0.9	1.0
Quasi-share of govt cons.	0.75	0.80	0.80
Complementarity of consumption	0.29	0.33	0.33
Subst. btw. local and imported	2.50	2.50	2.50
Subst. imported	2.50	2.50	2.50
Bias toward local	0.73	0.74	0.66
Subst. btw. tradable and non-tradable	0.50	0.50	0.50
Bias toward tradable	0.80	0.80	0.80
Investment expenditure			
Domestic investment goods (% of GDP)	4.0	4.0	4.0
Imported investment goods (% of GDP)	0.4	0.4	0.4
Subst. btw. local and imported	2.50	2.50	2.50
Subst. imported	2.50	2.50	2.50
Bias toward local	0.54	0.54	0.46
Subst. btw. tradable and non-tradable	0.50	0.50	0.50
Bias toward tradable	0.80	0.80	0.80
Depreciation rate (public capital)	0.025	0.025	0.025
Taxation			
Consumption tax rate	0.183	0.077	0.077
Labour income tax rate	0.122	0.154	0.154
Capital tax rate	0.19	0.16	0.16
SSC rate paid by firms	0.219	0.071	0.071
SSC rate paid by households	0.118	0.071	0.071
Fiscal rule			
Target public debt (% of annual GDP)	60.0	60.0	60.0
Sensitivity of lump-sum taxes to debt	0.1	0.1	0.1

Table C5. Monetary policy

	EA	RW	US
Inflation target	1.02	1.02	1.02
Interest rate inertia	0,87	0.87	0.87
Sensitivity to inflation gap	1.70	1.70	1.70
Sensitivity to output growth	0.10	0.10	0.10

Table C6. Real and nominal rigidities

	EA	RW	US
Real rigidities			
Investment adjustment	6.00	4.00	4.00
Import adjustment (cons.)	5.00	5.00	5.00
Import adjustment (inv.)	5.00	5.00	5.00
Import adjustment (inter.)	5.00	5.00	5.00
Nominal rigidities			
Wage stickiness	0.75	0.75	0.75
Wage indexation	0.75	0.75	0.75
Price stickiness (local)	0.75	0.75	0.75
Price indexation (local)	0.50	0.50	0.50
Price stickiness (imported)	0.75	0.75	0.75
Price indexation (imported)	0.50	0.50	0.50
Price stickiness (services)	0.75	0.75	0.75
Price indexation (services)	0.50	0.50	0.50

Table C7. Price and wage markups (implied elas. of substitution)

	EA	RW	US
Tradables	1.30 (4.3)	1.20 (6.0)	1.20 (6.0)
Non-tradables	1.50 (3.0)	1.30 (4.3)	1.30 (4.3)
Exports	1.30 (4.3)	1.20 (6.0)	1.20 (6.0)
Wages	1.30 (4.3)	1.16 (7.3)	1.16 (7.3)

Table C8. Bilateral trade relations (% of category total)

	EA	RW	US
Imported consumption goods			
From REA	-	42.3	18.8
From RW	94.3	-	5.6
From US	5.7	57.7	-
Imported investment goods			
From REA	-	34.1	16.7
From RW	66.3	-	83.3
From US	33.7	65.9	-

Notes: Euro area (EA), rest of the world (RW) and the United States of America (US). Rounding may affect totals.