Industrial Policy Wars and Inequality: Who Loses and When?*

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Abstract

How does an industrial policy war affect worker inequality? How does this effect change over time? We develop a model to study how industrial policy affects the dynamics of the joint distribution of firms and workers, in the open economy. The model features two skill classes of workers, in addition to multiple sectors with varying skill intensities in production. Heterogeneous firms make decisions to offshore their production of inputs, in addition to export participation. Different industrial policy shocks generate alternative transmission channels in the model; after interacting with the dynamic decisions of firms and households, they can alter a country's comparative advantage over time. While most industrial policies can serve to benefit the locally protected skill class of workers, these effects may take time to eventuate. Similarly, the costs these policy actions impose on the non-protected worker class may diminish over time.

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1 Introduction

Folks who live in factory towns and in rural communities who have lost jobs are wondering if those jobs will ever come back. All of this is happening at a time when many of the biggest corporations continue to make record profits, while wages have not kept up pace.

–Harris Campaign, Pittsburgh PA, September 25th 2024

Recent years have seen political discussions surrounding inequality and industrial policy become increasingly inter-connected. Significant industrial legislative actions have come in response to global shocks, that particularly bring crucial inter-temporal considerations to the forefront. Some of these shocks have been transitory, such as the pandemic, or uncertain in severity or duration, such as as the war in Ukraine. As world leaders wield industrial policy tools and take aim at foreign lands, such as tariffs to "steal" offshored jobs as proposed by the Trump Campaign in September 2024, one thing is clear.[1] The effects of job losses, or higher living costs from supply chain congestion, have a real impact on workers, which varies across the distribution of skills, assets and income. In this paper, we ask the question how the recent wave of industrial policy wars has affected heterogeneous households of workers and how these effects vary over time.

We build a dynamic laboratory with two-countries, two-sectors and two skill classes of labor to answer this question quantitatively. This setting allows us to study comparative advantage (Bernard et al., 2007) in a temporal context (as in Lechthaler and Mileva, 2021). Our model features three key ingredients, which facilitate the study of this issue. Firstly, we depart from the standard assumption of a single sector with a representative household, to incorporate four different types of workers in each country, divided-up across sectors and skill classes. Secondly, we account for rich heterogeneity on the supply-side of the economy, with heterogeneous firms that make exporting and offshoring choices and endogenous entry. Thirdly, governments in each country have four policy instruments at their disposal — an import tariff, a barrier to offshoring, a subsidy to the cost of production and another to the cost of entry (as in Juhász et al. (2022)). These three ingredients approximate the main stakeholders in the current state of global policy; the general equilibrium structure of the model allows us to study their interaction.

[1] See Reuters report Reid and Slattery (2024), published September 25th 2024.

We discipline the parameters of the model with data pertaining to the distribution of firms in the global economy, as well as broad differences between the U.S. and Chinese (North and South) factor markets. Stark differences in the factor endowments give scope for asymmetric responses of worker inequality to economic shocks, across the two countries. Armed with the calibrated model, we quantify the impact of each instrument on the macroeconomy and welfare of each type of worker, both in the long run and along the transition path.

We begin by exploring the properties of the transition dynamics of our model. Our simulations begin from the deterministic steady state, where we fix each policy instrument to zero; we then implement a temporary shock to each. Each industrial policy delivers starkly different transition behavior. For instance, an increase in the US import tariff acts as a demand shifter, making the imported varieties from China more expensive. Such a change not only has a direct impact on Chinese exporters but also alters the relative price of goods between the two countries, causing an appreciation of the real exchange rate. This then feeds-back as a general equilibrium effect, impacting the dynamic choices of exporting and offshoring amongst U.S. firms. Production subsidies, on the other hand, operate through a quite different channel. An increase in the U.S. domestic production subsidy makes it more profitable for firms to produce locally, causing a reduction in the number of exporters and offshoring firms. With the expansion of domestic production, the demand for labor goes up for all types of households but varies according to the sector and worker's skill class. This then drives the relocation of workers across sectors and changes a country's comparative advantage in the long run.

The Heckscher-Ohlin framework, plus the dynamic export and offshoring decisions of firms, generates rich scope for wage dynamics across different types of households. Interestingly, although all policy instruments are protectionist in nature, some may alter a country's comparative advantage as if the country is experiencing an episode of liberalization. The key driver of this result is the integration of the two countries through firms' offshoring behavior. Take production subsidy as an example, such a policy would reshore the low-skill task back to the domestic market, but more so in the sector that has a comparative advantage. This implies the wages in this sector increase more compared to the other sector, driving worker to relocate toward this sector over time. This resembles the classic finding that trade liberalization can cause an expansion in the sector in which a country has a comparative advantage.

Our results show that temporal considerations are crucial when evaluating the welfare effects of different policies. We note two main points here. The first is that, of the eight policy instruments we study (four in each country), all except one have the capacity to bolster the utility of the local protected worker skill class, at *some* point along the transition path. However, these effects often take time to materialize, for instance with the Northern subsidy to entry. A fraction of low-skill Northern workers see welfare gains, but only after around three years after the changes. This follows from the slow movement of the firm cross-section driving a delay in the associated benefits. The second point we emphasise about inequality dynamics and welfare is that, while these benefits to the protected class sometimes come at a cost to the other worker class, these costs can become more muted over time. For instance, some high skilled Northern workers suffer from the imposition of a tariff on Southern imports along the transition, however this cost almost completely washes-out when looking at overall lifetime utility.

Related Literature. Our paper is connected to several strands of literature. The first strand is the theoretical literature that incorporates heterogeneity in the analysis of international macroeconomic issues. While some papers focus exclusively on firm heterogeneity (Ghironi and Melitz, 2005; Auray and Eyquem, 2011; Hamano and Zanetti, 2017; Zlate, 2016; Di Giovanni et al., 2024, among others), others tend to focus solely on household heterogeneity (Auclert et al., 2021; De Ferra et al., 2020; Guo et al., 2023; Kekre and Lenel, 2024, among others). To the best of our knowledge, very few frameworks incorporate both firm heterogeneity and household heterogeneity. In this regard, our paper is closely related to Lechthaler and Mileva (2021). We embed trade-in-task (as in Grossman and Rossi-Hansberg, 2008) and dynamic offshoring (as in Zlate, 2016) into their framework and study the distributional implications of various industrial policies.

Our paper also relates to the strand of literature that focuses on the ”trade war” between China and the United States. Existing studies have presented various aspects of the impact of the US-China trade war, such as welfare (Amiti et al., 2019, 2020), the labor market (Benguria and Saffie, 2020), the trade balance (Tu et al., 2020; Ma and Meng, 2023) and others. However, only a few articles have explored the distributional aspect (Waugh, 2019; Fajgelbaum et al., 2020; Caliendo and Parro, 2022; Chor and Li, 2021, among others). Our contribution to this strand of literature is twofold. First, we study the impact of tariffs on heterogeneous households in a dynamic macro framework. Second, we compare the welfare implications of tariffs on households with other industrial policies and discuss how myopic policy-making might benefit certain households at the cost of others.

This paper is also related to the literature on the new economics of industrial policy (Juhász et al., 2023). While more recent studies have turned to the assessment of productivity effects and cross-sectoral spillovers (Aghion et al., 2015; Lane, 2022; Liu, 2019; Manelici and Pantea, 2021; Choi and Levchenko, 2021; Juhász et al., 2022), our paper not only studies how industrial policies might cause workers to reallocate across sectors but also explores on the welfare impacts on heterogeneous workers varying over different time horizons.

Our paper is also related to the macroeconomic impact of geoeconomic fragmentation. In recent years, a new body of literature has emerged on the macroeconomic implications of the potential decoupling between different geopolitical blocks (Bolhuis et al., 2023; Attinasi et al., 2023; Javorcik et al., 2024; Bekkers and Góes, 2022; Cerdeiro et al., 2021). While most of these studies focus on either trade or technology decoupling, this project aims to contribute to this literature by investigating the dynamic and distributional impacts of a broader set of industrial policies deployed by policymakers amidst geoeconomic tensions. In this regard, our framework is closely related to Ding et al. (2024). We embed the dynamic version of Bernard et al. (2007) (as in Lechthaler and Mileva, 2021) into their one-sector model and study the distributional and welfare consequences of industrial policy wars.

The rest of the paper is structured as follows: Section 2 presents the model. Section 3 presents the calibration. Section 4 studies the dynamic and distributional impacts of industrial policy wars in the two-country model. Section 5 concludes. The Appendix contains our computation method and additional figures and tables.

2 Model

The model consists of two countries, North (N) and South (S), all variables for the South are denoted with an asterisk. Each country has two sectors and produces two types of goods: good H and good L. The production of each good requires two types of labor: high-skilled labor and low-skilled labor. The production of good H requires relatively more high-skill labor than the production of good L. The North has a comparative advantage in producing good H because it has a relatively higher endowment of high-skill labor. Likewise, the South has a comparative advantage in producing L because it has a relatively higher endowment of low-skill labor. We assume that low-skill labor is more abundant than high-skill labor in both countries in order to generate a positive skill premium. The main micro-foundations in our framework are trade-in-tasks as in Grossman and Rossi-Hansberg (2008), comparative advantage as in Bernard et al. (2007), and dynamic offshoring as in Zlate (2016).

Our goal here is not to exactly model all kinds of policies, but hope that the analysis of the popular industrial policies (Juhász et al., 2022) will give us a basic understanding of how they would impact workers from different classes. To this end, we embed the following instruments into our framework: (i) Ad valorem tariff ($\tau^i_{IM}, \tau^{i*}_{IM}$), (ii) Domestic production subsidy (s^i_D, s^{i*}_D), (iii) Entry subsidy (s^i_E, s^{i*}_E), and (iv) Iceberg friction on offshoring (τ^i_V, τ^{i*}_V). Throughout this paper, we will keep the following notation convention: subscript usually indicates time (t) and status (entrant-E, domestic-D, export-X and offshoring-V); supscript usually indicates for sector ($i = H, L$) and skill class (h, l). With a slight abuse of notation, H and L also represent the total number of high-skill and low-skill labor.

2.1 Households

Following Lechthaler and Mileva (2021), households are defined by the skill class and the sector that they work in. Each member of a household belongs to the same skill class and works in the same sector. Due to the structure of our model, this implies that in each country there are four types of households: high-skill households employed in sector H and sector L, low-skill households employed in sector H and sector L.

For the purpose of exposition, here we focus on the household of high-skill workers (indicated by h) employed in sector i that maximize the present discounted value of utility derived from consumption

$$\max \mathbb{E}_t \left[\sum_{k=0}^{\infty} \beta^k \ln(C^{ih}_{t+k}) H^i_{t+k} \right]$$

where $\beta \in (0, 1)$ is the subjective discount factor, C^{ih}_{t+k} is the consumption per worker of the aggregate consumption bundle and H^i_{t+k} is the number of workers in the household. The household faces the following intertemporal budget constraints:

$$C^{ih}_t H^i_t + B^{ih}_{t+1} + \frac{\eta}{2}(B^{ih}_{t+1})^2 = (1 + r_t)\, B^{ih}_t + w^{ih}_t H^i_t + T_t H^i_t + \Pi_t H^i_t + T^{ih}_t$$

where B_t^{ih} are household holdings of domestic bonds, $\frac{\eta}{2}(B_{t+1}^{ih})^2$ is the cost of adjusting holdings of domestic bonds, r_t is the real interest rate, w_t^{ih} is the real wage for high-skill workers in sector i, Π_t is the transfer of a mutual fund to be explained in next subsection, and T_t is the lump-sum per worker transfer from the government. T_t^{ih} is the reimbursement of the cost of adjusting bond holdings to the households.

The high-skill household chooses C_t^{ih} and B_{t+1}^{ih}. The first-order conditions yield the following Euler equation:

$$1 + \eta B_{t+1}^{ih} = \beta(1 + r_{t+1})\mathbb{E}_t \left[\left(\frac{C_{t+1}^{ih}}{C_t^{ih}} \right)^{-1} \right]$$

The aggregate consumption bundle C_t is a Cobb-Douglas combination of the goods produced in two sectors:

$$C_t = (C_t^H)^{\gamma^H} (C_t^L)^{\gamma^L}$$

where γ^H is the share of good H in the consumption bundle for both North and South, and $\gamma^H + \gamma^L = 1$. We can then easily obtain the relative demand functions for each good from the expenditure minimization problem of the household:

$$C_t^H = \gamma^H \frac{P_t}{P_t^H} C_t, \quad C_t^L = \gamma^L \frac{P_t}{P_t^L} C_t$$

where $P_t = \left(\frac{P_t^H}{\gamma^H}\right)^{\gamma^H} \left(\frac{P_t^L}{\gamma^L}\right)^{\gamma^L}$ is the aggregate price index for one unit of aggregate consumption bundle C_t.

The consumption basket for the Northern households in sector i includes varieties produced by the Northern firms (some of which are offshoring firms), as well as goods produced by the Southern exporters, with the elasticity of substitution $\theta > 1$:

$$C_t^i = \left[\int_{z_{\min}}^{z_{V,t}^i} y_{D,t}^i(\omega)^{\frac{\theta-1}{\theta}} d\omega + \int_{z_{V,t}^i}^{\infty} y_{V,t}^i(\omega)^{\frac{\theta-1}{\theta}} d\omega + \int_{z_{X,t}^{i*}}^{\infty} y_{X,t}^{i*}(\omega)^{\frac{\theta-1}{\theta}} d\omega \right]^{\frac{\theta}{\theta-1}}$$

Each variety ω is produced by a different firm. As explained below, Northern firms with productivity above the offshoring cutoff $z_{V,t}^i$ will offshore the low-skilled tasks to the South and supply their corresponding varieties, whereas firms with productivity above $z_{\min}$ but below $z_{V,t}^i$ produce their varieties using domestic high-skilled and low-skilled labor tasks. The consumption-based price index for sector i in the North is then $P_t^i = \left(\int_{\omega \in \Omega_t} p_t^i(\omega)^{1-\theta} d\omega \right)^{\frac{1}{(1-\theta)}}$.

The household's demand for each individual good variety ω is $c_t^i = \left(p_t^i / P_t^i\right)^{-\theta} C_t^i$. For analytical convenience, we define $\rho_t^i \equiv p_t^i / P_t$ and $\psi_t^i \equiv P_t^i / P_t$ as the relative prices for variety and for the sector bundles, respectively. Then we can rewrite the demand function for varieties and sectoral bundles as $c_t^i = \left(\rho_t^i / \psi_t^i\right)^{-\theta} C_t^i$ and $C_t^i = (\gamma^i / \psi_t^i) C_t$.

2.2 Workers

Similar to Lechthaler and Mileva (2021), we assume that incumbent workers are immobile across sectors in response to industrial policy shocks. The choice of occupation is only available for new workers upon entering the job market, but not for the incumbent workers. In other words, incumbent workers have to stay in their sector for employment but retire at an exogenous rate s. The occupation choice for new workers depends on the wage differential across sectors.

For simplification, we also assume each retiring high-skill worker is replaced by a new high-skill worker, and similarly for the low-skill worker. Thus the total number of high-skill workers and low-skill workers is exogenously given and remains constant over time:

$$sH = \sum_{i=H,L} H_{E,t}^i, \quad sL = \sum_{i=H,L} L_{E,t}^i$$

where H and L are the exogenous endowment of high-skill and low-skill workers in the North, and $H_{E,t}^i, L_{E,t}^i$ are the new entrants of high-skill and low-skill workers in sector i.

Based on the evidence of non-pecuniary preference toward jobs, We denote sector preference for high-skill workers with ε^h and low-skill workers with ε^l. If $\varepsilon > 0$, it means the worker prefers sector H, and if $\varepsilon < 0$ means the worker prefers sector L. For new entering workers, they draw their relative sector preference from a random distribution with C.D.F $J(\varepsilon^j), j = h, l$. An entering high-skill worker will choose to enter sector H if

$$V_t^{Hh} + \varepsilon_t^h > V_t^{Lh}$$

where $V_t^{ih} = \mathbb{E}_t \left[\ln(C_t^{ih}) + \beta(1-s)V_{t+1}^{ih}\right]$ stands for the present discounted value of consumption utility of a high-skill worker in the sector i. The equation above defines a threshold value $\bar{\varepsilon}_t^h$, for which a worker is indifferent between the two sectors ($\bar{\varepsilon}_t^h = V_t^{Lh} - V_t^{Hh}$) and the share of new high-skill workers that choose sector H is $1 - J(\bar{\varepsilon}_t^h)$ while the rest of the workers enter into sector L.

Given the assumption that workers are immobile across sectors, the law of motion for high-skill and low-skill workers in sector i are:

$$H^i_t = (1-s)H^i_{t-1} + H^i_{E,t}$$
$$L^i_t = (1-s)L^i_{t-1} + L^i_{E,t}$$

2.3 Production

The structure of firms' production and offshoring decisions is based on Zlate (2016), with the main difference being that there are two types of labor in this setting. Both sectors are producing final goods.[2] Firms are all final-good producers with heterogeneity in their productivities, each producing a different variety of final goods. Production of the final good in sector i requires two tasks – y^{ih} and y^{il}. Task y^{ih} uses high-skill labor only and task y^{il} uses low-skill labor only. The production function is assumed to take the following form: $y^i_t(z) = \left[y^{ih}_t(z)\right]^{\alpha^i} \left[y^{il}_t(z)\right]^{1-\alpha^i}$.[3]

The high-skilled and low-skilled endowment of a given sector in each country is set up in a way that delivers a cost relationship so that some firms in the North have incentives to offshore the low-skilled task in order to utilize cost advantage of performing the low-skilled task in the South, while some firms in the South have incentives to offshore the high-skilled tasks to the North. Each task is subject to its source country's aggregate productivity. Each firm has a different relative productivity z with which it transforms the two tasks into the final output. The productivity differences across firms translate into differences in the unit cost of production. Every period, firms choose to produce each task either domestically or offshore.

Production Location Choice: Domestic vs Offshoring

For a firm in sector i of the North, if it decides to produce both tasks domestically, then $y^{ih}_t(z) = zZ_t h^i_t(z)$ and $y^{il}_t(z) = zZ_t l^i_t(z)$. If the firm instead decides to offshore the low-skilled task, $y^{ih}_t(z) = zZ_t h^i_t(z)$ but $y^{il}_t(z) = zZ^*_t l^{i*}_t(z)$; For sector i, offshoring the low-skilled

[2] In the same spirit as Melitz (2003) and Bernard et al. (2007), the model is best thought of as a model of two tradable sectors, within each sector, part of which turns out to be non-traded in equilibrium.

[3] In Antras and Helpman (2004), the output of a firm z is a Cobb-Douglas function of two inputs that use domestic and foreign inputs respectively, $y_{V,t} = [\frac{Z_t z l_t}{\alpha}]^{\alpha}[\frac{Z^*_t z l^*_t}{1-\alpha}]^{1-\alpha}$.

task to the South incurs an iceberg cost τ_V^i, which will be reflected on the cost side of firm's profit maximization problem. Therefore, the output of producing both tasks domestically is $y_{D,t}^i(z) = zZ_t \left[h_t^i(z)\right]^{\alpha^i} \left[l_t^i(z)\right]^{1-\alpha^i}$ whereas keeping the high-skilled task produced in-house and offshoring the low-skilled tasks generates output $y_{V,t}^i(z) = z\left[Z_t h_t^i(z)\right]^{\alpha^i} \left[Z_t^* l_t^{i*}(z)\right]^{1-\alpha^i}$. Given that sector H is high-skill intensive and sector L is low-skill intensive, this implies $0 < \alpha^L < \alpha^H < 1$. The labor market is assumed to be perfectly competitive, implying that the real wage of both high-skilled and low-skilled labor equals their marginal revenue product of labor. Cost minimization pins down the number of high-skilled and low-skilled workers each firm hires to produce one unit of output, depending on the wages, firms' relative productivity z and aggregate productivity Z_t and Z_t^*. For the firms in the North, the marginal costs of production for the two strategies then follow– $mc_{D,t}^i(z) = \frac{1-s_D^i}{Z_t z}\left(\frac{w_t^{il}}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w_t^{ih}}{\alpha^i}\right)^{\alpha^i}$ for domestically producing firms, where s_D^i stands for the production subsidy of sector i received from the Northern government. To separate out the effect of import tariff from that of offshoring friction, we assume tariff is only levied on final goods, not on tasks. Thus, the marginal cost of offshoring firms is given by $mc_{V,t}^i(z) = \frac{1}{z}\left(\frac{\tau_V^i Q_t w_t^{il*}}{Z_t^*(1-\alpha^i)}\right)^{1-\alpha^i}\left(\frac{w_t^{ih}}{Z_t \alpha^i}\right)^{\alpha^i}$. w_t^{il} is the real wage for low-skill labor and w_t^{ih} is the real wage for high-skill labor in the North. Similarly, w_t^{il*} is the real wage for the Southern low-skill labor.

The monopolistically competitive firms maximize profits for the two different production strategies:

$$\max_{\rho_D^i(z)} d_{D,t}^i(z) = \rho_{D,t}^i(z) y_{D,t}^i(z) - mc_{D,t}^i(z) y_{D,t}^i(z)$$

$$\max_{\rho_V^i(z)} d_{V,t}^i(z) = \rho_{V,t}^i(z) y_{V,t}^i(z) - mc_{V,t}^i(z) y_{V,t}^i(z) - f_V^i \frac{Q_t}{Z_t^*}\left(\frac{w_t^{il*}}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w_t^{ih*}}{\alpha^i}\right)^{\alpha^i}$$

where $\rho_D^i(z)$ and $\rho_V^i(z)$ are the real prices associated with each of the two production strategies. Offshoring firms also need to pay the fixed offshoring costs f_V^i units of Southern effective labor, which is associated with building and running maintenance of the factories and facilities offshore. Following Zlate (2016), we assume that Northern offshoring firms in sector i hire workers from the Southern labor market to cover these fixed offshoring costs. Therefore, the fixed offshoring cost is $f_V^i \frac{Q_t}{Z_t^*}\left(\frac{w_t^{il*}}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w_t^{ih*}}{\alpha^i}\right)^{\alpha^i}$ units of the Northern consumption basket. It can be interpreted as a friction (e.g., a non-tariff trade barrier) or productivity disadvantage (less control and monitoring over the products) due to distance.

The demand for variety produced by firm z using the two production strategies are $y^i_{D,t}(z) = \left[\rho^i_{D,t}(z)/\psi^i_t\right]^{-\theta}(\gamma^i/\psi^i)C_t$ and $y^i_{V,t}(z) = \left[\rho^i_{V,t}(z)/\psi^i_t\right]^{-\theta}(\gamma^i/\psi^i)C_t$, respectively. Prices are set as markup over marginal costs, thus generating the pricing conditions: $\rho^i_{D,t}(z) = \frac{\theta}{\theta-1}mc^i_{D,t}(z)$ and $\rho^i_{V,t}(z) = \frac{\theta}{\theta-1}mc^i_{V,t}(z)$. Profits are $d^i_{D,t}(z) = \frac{1}{\theta}\left[\rho^i_{D,t}(z)/\psi^i_t\right]^{1-\theta}\gamma^i C_t$ for domestic production and $d^i_{V,t}(z) = \frac{1}{\theta}\left[\rho^i_{V,t}(z)/\psi^i_t\right]^{1-\theta}\gamma^i C_t - f^i_V\frac{Q_t}{Z^*_t}\left(\frac{w^{il*}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih*}_t}{\alpha^i}\right)^{\alpha^i}$ for offshoring the low-skilled task.

The offshoring cutoff $z^i_{V,t}$ is pinned down by equalizing profits of the two strategies for firms' production: $z^i_{V,t} = \left\{z|d^i_{D,t}(z^i_{V,t}) = d^i_{V,t}(z^i_{V,t})\right\}$. It indicates that at this productivity level $z^i_{V,t}$, producing both tasks domestically and offshoring the low-skilled task generate the same profit. Every period, a firm compares, based on its productivity level, whether the strategy of producing both tasks domestically or that of offshoring the low-skilled task gives the firm higher profits. The cutoff is time-varying; it is responsive to changes in the labor cost of two types of labor across the two countries as well as the iceberg trade cost. The set of offshoring firms fluctuates over time with changes in the profitability of offshoring. A lowering of the trade cost or the wage cost of the low-skilled workers abroad increases the profitability of offshoring and thus lowers the offshoring cutoff, incentivizing more firms to offshore.

Consistent with the implications of Zlate (2016), firms with productivity level above the cutoff productivity self select into offshoring since the benefit of offshoring outweighs the cost of doing so for these firms. In order to ensure the existence of the offshoring cutoff, the slope of offshoring profit function in $z^{\theta-1}$ must exceed the slope of domestic profit function, which gives us the following condition:

$$\tau^i_V\left(1 - s^i_D\right)^{\frac{1}{\alpha^i-1}} TOL^i_l < 1 \tag{1}$$

where $TOL^i_l = \frac{Q_t w^{il*}_t/Z^*_t}{w^{il}_t/Z_t}$ stands for the ratio between the cost of effective low-skill labor in the South and the North in sector i expressed in the same currency. This condition states that effective low-skill wage in the South must be sufficiently lower than in the North, so that some firms in the North still finds it profitable to offshore these tasks abroad amidst all the industrial policies driven by geoeconomic tension.

The corresponding condition to ensure the existence of the offshoring cutoff in the South is the following:

$$(\tau_V^{i*})^{-1}\left(1-s_D^{i*}\right)^{\frac{1}{\alpha^i}} TOL_h^i > 1 \tag{2}$$

where $TOL_h^i = \frac{Q_t w_t^{ih*}/Z_t^*}{w_t^{ih}/Z_t}$ stands for the ratio between the cost of effective high-skill labor in the South and the North expressed in the same currency. This condition states that effective high-skill wage in the North must be sufficiently lower than in the South, so that some firms in the South still finds it profitable to offshore these tasks abroad in the midst of all the trade barriers. We will set the high-skilled and low-skilled endowment of labor of each country such that both condition (1) and condition (2) are satisfied.

Exporting

Firms in sector i in the North not only serve their domestic market, but can also choose to serve the foreign market through exports, as in Ghironi and Melitz (2005). In the North, the firm with productivity level z produces goods for exporting using domestic low-skilled and high-skilled labor $l_{X,t}^i(z)$ and $h_{X,t}^i(z)$, generating exporting output $y_{X,t}^i(z) = zZ_t\left[h_{X,t}^i(z)\right]^{\alpha^i}\left[l_{X,t}^i(z)\right]^{1-\alpha^i}$. Profit maximization implies that the price of exports for firm with productivity level z is $\rho_{X,t}^i(z) = \frac{\theta}{\theta-1}\frac{\tau^i Q_t^{-1}}{zZ_t}\left(\frac{w_t^{il}}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w_t^{ih}}{\alpha^i}\right)^{\alpha^i}$. Notice that $\rho_{X,t}^i(z)$ is the dock export price, i.e. it does not include Southern import tariff. The profit function is thus given by: $d_{X,t}^i(z) = \frac{1}{\theta}(1+\tau_{IM}^{i*})^{-\theta}\left[\rho_{X,t}^i(z)/\psi_t^{i*}\right]^{1-\theta}\gamma^i C_t^* Q_t - \frac{f_X^i}{Z_t}\left(\frac{w_t^{il}}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w_t^{ih}}{\alpha^i}\right)^{\alpha^i}$, where C_t^* is aggregate consumption in the South, τ_{IM}^{i*} is the ad-valorem tariff imposed by South on North exporters' sales in sector i. In terms of a firm's export decisions, a firm will only export if the export profit it earns is nonnegative. Therefore, the export cutoff for firms is $z_{X,t}^i = \inf\left\{z|d_{X,t}^i(z) > 0\right\}$. Firms with productivity level above the export cutoff $z_{X,t}^i$ choose to export whereas firms with productivity level below $z_{X,t}^i$ choose to serve the domestic market only.

2.4 Firm Entry

Firm entry in sector i in the North requires an entry cost that is equal to f_E^i effective labor units, which is equal to $\frac{f_E^i}{Z_t}\left(\frac{w_t^{il}}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w_t^{ih}}{\alpha^i}\right)^{\alpha^i}$ units of the Northern consumption basket. Part of the entry cost is subsidized by Northern government with the rate equal to s_E^i. After paying the sunk entry cost, each firm is randomly assigned an idiosyncratic productivity z which is drawn from a Pareto distribution over the interval $[z_{\min}, \infty)$, and it stays the same for the firm's entire operation term. There are $N^i_{E,t}$ new firms entering the market every period and start producing in the next period. With all firms including the new entrants being subject to a random death shock with probability δ at the end of every period, the law of motion for the mass of firms is $N^i_{t+1} = (1-\delta)\left(N^i_t + N^i_{E,t}\right)$.

All firms in the economy are owned by a mutual fund that invests in new firms, collects all the profits, and redistributes the surplus back to households via a lump-sum transfer. To separate firm-entry from household heterogeneity, we assume that mutual fund acts on behalf of the entire population and therefore uses the stochastic discount factor based on aggregate consumption $\beta^{s-t}(1-\delta)^{s-t}(C_s/C_t)^{-1}$ to discount between period s and t.

Every period, the new entrants in sector i form an expectation of their post-entry firm value $\tilde{v}^i_t$, which is a function of the stochastic discount factor, the probability of exit δ and the expected monopolistic stream of profits $\tilde{d}^i_t$. This yields the expected post-entry value of the average firm:

$$\tilde{v}^i_t = \mathbb{E}_t \sum_{s=t+1}^{\infty} [\beta(1-\delta)]^{s-t} \left(\frac{C_s}{C_t}\right)^{-1} \tilde{d}^i_s$$

As a result, every period, potential entrants make their decision to enter or not by comparing the sunk entry cost that they need to pay upfront before entry with the expected profits after entry. In equilibrium, firm entry takes place until the expected value of the average firm value is equal to the sunk entry cost: $\tilde{v}^i_t = (1-s^i_E)\frac{f^i_E}{Z_t}\left(\frac{w^{il}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih}_t}{\alpha^i}\right)^{\alpha^i}$, which is $(1-s^i_E)f^i_E$ times the cost of effective labor.

The surplus of the mutual fund is redistributed back to the households via a lump-sum transfer:

$$\Pi_t(H+L) = N^H_t\tilde{d}^H_t + N^L_t\tilde{d}^L_t - N^H_{E,t}\tilde{v}^H_t - N^L_{E,t}\tilde{v}^L_t$$

2.5 Averages

For a given sector i, the model is isomorphic to a framework with three representative firms in the North: one produces both tasks domestically, another offshores the low-skilled task and only produces the high-skilled task in the North (both serving the domestic market), and a third produces both tasks domestically and engages in exporting.

Average Productivities, Prices and Profits

Firms' productivities are drawn from the Pareto distribution over the interval $[z_{\min}, \infty)$, where the common distribution is $G(z)$ with density $g(z)$. Every period in the North, there are $N^i_{D,t}$ firms whose idiosyncratic productivities are below the offshoring cutoff $z_{\min} < z_t < z^i_{V,t}$ that produce both tasks domestically; and there are $N^i_{V,t}$ firms with productivity levels above the cutoff $z^i_t > z^i_{V,t}$ that choose to offshore. The average productivity of domestically producing firms is $\tilde{z}^i_{D,t}$ whereas that of offshoring firms is $\tilde{z}^i_{V,t}$. The average productivity levels follow as:

$$\tilde{z}^i_{D,t} = \left[\frac{1}{G\left(z^i_{V,t}\right)}\int_{z_{\min}}^{z^i_{V,t}} z^{\theta-1}g(z)dz\right]^{\frac{1}{\theta-1}}, \quad \tilde{z}^i_{V,t} = \left[\frac{1}{1-G\left(z^i_{V,t}\right)}\int_{z^i_{V,t}}^{\infty} z^{\theta-1}g(z)dz\right]^{\frac{1}{\theta-1}}$$

As the Pareto distribution of the productivity has a p.d.f. $g(z) = kz^k_{\min}/z^{k+1}$ and c.d.f. $G(z) = 1-(z_{\min}/z)^k$, the average productivity levels $z^i_{D,t}$ and $z^i_{V,t}$ can both be expressed as functions of the offshoring productivity cutoff $z^i_{V,t}$:

$$\tilde{z}^i_{D,t} = \nu z_{\min} z^i_{V,t}\left[\frac{(z^i_{V,t})^{k-(\theta-1)} - z^{k-(\theta-1)}_{\min}}{(z^i_{V,t})^k - z^k_{\min}}\right]^{\frac{1}{\theta-1}}, \quad \tilde{z}^i_{V,t} = \nu z^i_{V,t}$$

where $\nu = \left[\frac{k}{k-(\theta-1)}\right]^{\frac{1}{\theta-1}}$, $k > \theta-1$, and the cutoff is $z^i_{V,t} = z_{\min}\left(N^i_t/N^i_{V,t}\right)^{1/k}$.The average productivity of exporting firms are: $\tilde{z}^i_{X,t} = \nu z_{\min}\left(N^i_t/N^i_{X,t}\right)^{1/k}$.

The average price index for sector i in the North is as follows: $(\psi^i_t)^{1-\theta} = N^i_{D,t}\left(\tilde{\rho}^i_{D,t}\right)^{1-\theta} + N^i_{V,t}\left(\tilde{\rho}^i_{V,t}\right)^{1-\theta} + N^{i*}_{X,t}\left((1+\tau^i_{IM})\tilde{\rho}^{i*}_{X,t}\right)^{1-\theta}$. The aggregate price index in the North can be written as $1 = (\psi^H_t/\gamma^H)^{\gamma^H}(\psi^L_t/\gamma^L)^{\gamma^L}$. The total profits of firms in sector i in the North is $N^i_t\tilde{d}^i_t = N^i_{D,t}\tilde{d}^i_{D,t} + N^i_{V,t}\tilde{d}^i_{V,t} + N^i_{X,t}\tilde{d}^i_{X,t}$. The linkages between the average profit of offshoring and that of domestically producing both tasks are:

$$\tilde{d}^i_{V,t} = \frac{k}{k-(\theta-1)}\left(\frac{z^i_{V,t}}{\tilde{z}^i_{D,t}}\right)^{\theta-1}\tilde{d}^i_{D,t} + \frac{\theta-1}{k-(\theta-1)}f^i_V\frac{Q_t}{Z^*_t}\left(\frac{w^{il*}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih*}_t}{\alpha^i}\right)^{\alpha^i}$$

From the above relationships, it can be noted that the average profit of offshoring firms is higher than that of domestically producing firms because firms above the productivity cutoff self-select into offshoring. Exploiting the property that the firm at the productivity cutoff $z^i_{X,t}$ obtains zero profits from exporting in sector i, the average profits from exports in the North can be expressed as:

$$\tilde{d}^i_{X,t} = \frac{\theta - 1}{k - (\theta - 1)} \frac{f^i_X}{Z_t} \left(\frac{w^{il}_t}{1 - \alpha^i} \right)^{1-\alpha^i} \left(\frac{w^{ih}_t}{\alpha^i} \right)^{\alpha^i}$$

2.6 Other Equilibrium Conditions

Labor Market Clearing

For sector i in the North, denote $\tilde{h}^i_{D,t}$ as the amount of high-skilled labor used by the representative domestically producing firms that serves the domestic market, $\tilde{h}_{V,t}$ as that used by the representative offshoring firms, and $\tilde{h}_{X,t}$ by the representative exporter. The high-skilled labor market clearing condition for sector i in the North is:

$$H^i_t = N^i_{D,t}\tilde{h}^i_{D,t} + N^i_{X,t}\tilde{h}^i_{X,t} + N^i_{V,t}\tilde{h}^i_{V,t} + N^{i*}_{V,t}\tilde{h}^{i*}_{V,t}\tau^{i*}_V + \left(N^i_{E,t}\frac{f^i_E}{Z_t} + N^i_{X,t}\frac{f^i_X}{Z_t} + N^{i*}_{V,t}\frac{f^{i*}_V}{Z_t} \right) \left(\frac{\alpha^i w^{il}_t}{(1-\alpha^i)w^{ih}_t} \right)^{1-\alpha^i}$$

The Northern high-skilled labor in sector i is used for production by domestically producing firms (serving either the domestic or export market), Northern offshoring firms and Southern offshoring firms[4], as well as for sunk entry cost, fixed exporting cost and fixed offshoring cost activities.

Similarly, the low-skilled labor marketing clearing condition for sector i in the North is:

$$L^i_t = N^i_{D,t}\tilde{l}^i_{D,t} + N^i_{X,t}\tilde{l}^i_{X,t} + \left(N^i_{E,t}\frac{f^i_E}{Z_t} + N^i_{X,t}\frac{f^i_X}{Z_t} + N^{i*}_{V,t}\frac{f^{i*}_V}{Z_t} \right) \left(\frac{(1-\alpha^i)w^{ih}_t}{\alpha^i w^{il}_t} \right)^{\alpha^i}$$

The Northern low-skilled labor in sector i is used for production only by domestically producing firms, as well as for sunk entry cost, fixed exporting cost and fixed offshoring cost activities.

Bond Market Clearing

Since we do not allow bond trading across the border, each country is in financial autarky. This implies that the total number of bonds in each country are in zero net supply: $B^{Hh}_t + B^{Hl}_t + B^{Lh}_t + B^{Ll} = 0$, $B^{Hh*}_t + B^{Hl*}_t + B^{Lh*}_t + B^{Ll*} = 0$.

[4]The amount of high-skilled labor used by the representative Southern offshoring firm is $\tilde{h}^{i*}_{V,t}\tau^{i*}_V$ taking into account of the iceberg offshoring cost τ^{i*}_V.

Government Budget Constraint

The Northern government keeps a balanced budget for each period:

$$\sum_{i=H,L}\left[\tau_{IM}^{i}N_{X,t}^{i*}\tilde{\rho}_{X,t}^{i*}\left((1+\tau_{IM}^{i})\frac{\tilde{\rho}_{X,t}^{i*}}{\psi_t^i}\right)^{-\theta}\frac{\gamma^i}{\psi_t^i}C_t - s_E^i N_{E,t}^i\frac{f_E^i}{Z_t}\left(\frac{w_t^{il}}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w_t^{ih}}{\alpha^i}\right)^{\alpha^i}\right.$$
$$\left.-s_D^i N_{D,t}^i\left(\frac{\tilde{\rho}_{D,t}^i}{\psi_t^i}\right)^{-\theta}\frac{\gamma^i C_t}{\psi_t^i Z_t \tilde{z}_D^i}\left(\frac{w_t^{il}}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w_t^{ih}}{\alpha^i}\right)^{\alpha^i}\right] = T_t(H+L)$$

which states that the total tax from the ad valorem tariff, minus the sum of entry subsidy and production subsidy, for both sectors, must equal to the total transfer to the households in each period.

Balance of International Payments

The balance of international payments (expressed in units of the Northern consumption basket) requires that the trade balance equals the net aggregate fixed offshoring cost across the sectors:

$$TB_t = \sum_{i=H,L}\left[N_{V,t}^i f_V^i\frac{Q_t}{Z_t^*}\left(\frac{w_t^{il*}}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w_t^{ih*}}{\alpha^i}\right)^{\alpha^i} - N_{V,t}^{i*}f_V^{i*}\frac{1}{Z_t}\left(\frac{w_t^{il}}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w_t^{ih}}{\alpha^i}\right)^{\alpha^i}\right]$$

where the trade balance, TB_t, is given by the value of regular exports and the value of offshoring exports of high-skilled tasks minus the value of offshoring imports of low-skilled tasks and the value of regular imports across both sectors:

$$TB_t \equiv \sum_{i=H,L}\left[\underbrace{N_{X,t}^i\tilde{\rho}_{X,t}^i\left((1+\tau_{IM}^{i*})\frac{\tilde{\rho}_{X,t}^i}{\psi_t^{i*}}\right)^{-\theta}\frac{\gamma^i}{\psi_t^{i*}}C_t^*Q_t}_{\text{Regular exports}} + \underbrace{N_{V,t}^{i*}w_t^{ih}\tilde{h}_{V,t}^{i*}\tau_V^{i*}}_{\text{Offshoring exports}}\right.$$
$$\left.-\underbrace{N_{V,t}^i w_t^{il*}\tilde{l}_{V,t}^i\tau_V^i Q_t}_{\text{Offshoring imports}} - \underbrace{N_{X,t}^{i*}\tilde{\rho}_{X,t}^{i*}\left((1+\tau_{IM}^i)\frac{\tilde{\rho}_{X,t}^{i*}}{\psi_t^i}\right)^{-\theta}\frac{\gamma^i}{\psi_t^i}C_t}_{\text{Regular imports}}\right]$$

Model Summary

Taken altogether, we have 163 equations for 163 endogenous variables: (i) 38 sector-specific variables, C_t^{ih}, C_t^{il}, B_t^{ih}, B_t^{il}, T_t^{ih}, T_t^{il}, V_t^{ih}, V_t^{il}, H_t^i, L_t^i, $H_{E,t}^i$, $L_{E,t}^i$, w_t^{il}, w_t^{ih}, $\tilde{v}_t^i$, N_t^i, $N_{E,t}^i$, $N_{D,t}^i$, $N_{V,t}^i$, $N_{X,t}^i$, ψ_t^i, $\tilde{\rho}_{D,t}^i$, $\tilde{\rho}_{V,t}^i$, $\tilde{\rho}_{X,t}^i$, $\tilde{d}_t^i$, $\tilde{d}_{D,t}^i$, $\tilde{d}_{V,t}^i$, $\tilde{d}_{X,t}^i$, $\tilde{z}_{D,t}^i$, $z_{V,t}^i$, $\tilde{z}_{V,t}^i$, $\tilde{z}_{X,t}^i$, $\tilde{h}_{D,t}^i$, $\tilde{h}_{V,t}^i$, $\tilde{h}_{X,t}^i$, $\tilde{l}_{D,t}^i$, $\tilde{l}_{V,t}^i$, $\tilde{l}_{X,t}^i$, and their Southern counterparts; (ii) 5 country-specific variables, T_t, Π_t, r_t, $\bar{\varepsilon}^H$, $\bar{\varepsilon}^L$ and equivalent variables for the South; (iii) the real exchange rate Q_t. A full summary of the model equations is in Table 3.

3 Model Calibration and Solution

We calibrate the model's deterministic steady state to quarterly data, with a set of parameters calibrated inside the model using a simulated method of moments procedure. We also fix several parameters outside the model, with a view towards giving clean identification and lowering the computational burden of the iterative calibration procedure. The list of parameter values is given in Table 1, while the fit of the model to the data moments are given in Table 2. In total, we have over 40 parameters to discipline and 163 equations involved in the model solution.

Parameter	Meaning	Value	Source/target
β	discount factor	0.9900	Ghironi and Melitz (2005)
γ	(inverse) intertemporal elasticity	1.0000	logarithmic utility
η	bond adjustment cost	0.5000	normalization
s	retirement rate	0.0050	Lechthaler and Mileva (2021)
γ_H	weight of skill intensive good in consumption	0.6000	Lechthaler and Mileva (2021)
μ_h	mean preference shock skilled	-18.558	$w^{Lh} = 0.94$
μ_l	mean preference shock unskilled	-19.221	$w^{Hl} = 1.00$
μ_h^*	mean preference shock skilled	-16.369	$w^{Lh*} = 1.18$
μ_l^*	mean preference shock unskilled	-16.752	$w^{Hl*} = 0.75$
σ_h	variance preference shock skilled	1.0000	normalization
σ_l	variance preference shock skilled	1.0000	σ_h
H	high skilled labor endowment North	0.3916	endogenous labor demand H North
L	low skilled labor endowment North	0.5967	endogenous labor demand L North
H^*	high skilled labor endowment South	0.2348	endogenous labor demand H South
L^*	low skilled labor endowment South	0.9996	endogenous labor demand L South
θ	elasticity of substitution between varieties	3.8000	Ghironi and Melitz (2005)
k	shape parameter of productivity distribution	3.4000	Ghironi and Melitz (2005)
z_{min}	lower bound of productivity	1.0000	normalization
δ	exogenous firm exit shock	0.0250	Ghironi and Melitz (2005)
α^H	skill intensity in production H sector	0.4500	Lechthaler and Mileva (2021)
α^L	skill intensity in production L sector	0.3200	Lechthaler and Mileva (2021)
Z	steady state aggregate productivity	1.0000	normalization
ζ_Z	persistence of TFP process	0.9000	Ghironi and Melitz (2005)
ζ	persistence of policy process	0.5600	Barattieri, Cacciatore and Ghironi (2021)
f_V^L	fixed cost of offshoring in North L sector	0.0200	fraction of Northern L offshorers
f_X^L	fixed cost of exporting in North L sector	0.0100	fraction of Northern L exporters
f_E^L	sunk entry cost in North L sector	0.1866	$w^{Ll} = 0.75$
f_V^H	fixed cost of offshoring in North H sector	0.0220	fraction of Northern H offshorers
f_X^H	fixed cost of exporting in North H sector	0.0050	fraction of Northern H exporters
f_E^H	sunk entry cost in North H sector	0.2471	$w^{Hh} = 1.25$
f_V^{L*}	fixed cost of offshoring in South L sector	0.0130	fraction of Southern L offshorers
f_X^{L*}	fixed cost of exporting in South L sector	0.0050	fraction of Southern L exporters
f_E^{L*}	sunk entry cost in South L sector	0.3812	$w^{Ll*} = 0.56$
f_V^{H*}	fixed cost of offshoring in South H sector	0.0200	fraction of Southern H offshorers
f_X^{H*}	fixed cost of exporting in South H sector	0.0120	fraction of Southern H exporters
f_E^{H*}	sunk entry cost in South H sector	0.2559	$w^{Hh*} = 1.56$
τ	melting-iceberg trade cost	1.0000	no steady state friction
τ^{IM}	import tariff	0.0000	no steady state intervention
τ^V	iceberg friction on offshoring	1.0000	no steady state intervention
s_E	entry subsidy	0.0000	no steady state intervention
s_D	domestic production subsidy	0.0000	no steady state intervention

Table 1. Benchmark calibration

We now explain the parameter choices fixed outside the model. Standard parameters taken from the literature include the discount factor $\beta = 0.99$, a value consistent with low real interest rates in recent years and a unit coefficient of relative risk aversion σ. We normalise the bond market adjustment cost to $\eta = 0.5$, giving a derivative term in households' Euler equations of one. We take several parameters relating to the two sector industry structure from Lechthaler and Mileva (2021). Namely, we take the relatively low per quarter retirement rate of $s = 0.005$, the fraction of the H good in households' consumption baskets of $\gamma_H = 0.6$ and the skill intensities for each industry in production of $\alpha^L = 0.32$ and $\alpha^H = 0.45$. We take the elasticity of substitution and productivity distribution shape parameters from Ghironi and Melitz (2005), with values of $\theta = 3.8$ and $k = 3.4$, respectively. We take an exogenous firm exit rate of $\delta = 0.025$, with the aim of matching economy-wide annual exit rates around 10%. We normalise the lower bound of productivity z_{min} and steady state TFP level Z to unity. We assume zero interventions for policy instruments and the physical variable trade cost in the steady state. We model the policy interventions as being transitory, with AR(1) processes and persistence parameter of 0.6 taken from Barattieri, Cacciatore and Ghironi (2021).

We now detail the parameter values calibrated inside the model. Given the size of the model, we leverage several free parameters to increase precision and stability of the steady state solution. The model contains 8 different wage rates, we fix these to loosely match comparative advantage patterns across the U.S. and China. Specifically, we fix the low skilled wage in the North H sector (w^{Hl}) to unity and then take 25% increments relative to that value to set wages in other sectors and abroad. For instance, we set the corresponding wage in the South (w^{Hl*}) to be 0.75 and the high skilled wage in the same sector in the North (w^{Hh}) to be 1.25. We then absorb the free entry conditions for the two sectors in each country (4 conditions) by treating the sunk entry costs as free parameters (4 objects: $f_E^L, f_E^H, f_E^{L*}, f_E^{H*}$). The fixed wages imply endogenous levels of labor demand of each skill class, for each sector in the two economies (8 objects). We then treat the steady state labor supply for each skill class in each country (4 objects: H, L, H^*, L^*), as well as the mean for the preference shock distributions (4 objects: $\mu_l, \mu_h, \mu_l^*, \mu_h^*$) as free parameters to match the implied endogenous labour demands.[5] Endogenous choices and objects are then of course flexible along the transition after a shock. Note that the implied endowments of labor give that the North is relatively abundant in the high skill class ($H/L = 0.66 > 0.24 = H^*/L^*$) and that the South has a larger workforce in the absolute sense ($H + L = 0.99 < 1.24 = H^* + L^*$).

Moment	**Data**	**Model**	**Moment**	**Data**	**Model**
Fraction offshorers North L	0.5400	0.8226	Fraction offshorers South L	0.5400	1.2966
Fraction exporters North L	9.0000	7.2956	Fraction exporters South L	9.0000	9.9107
Fraction offshorers North H	0.5400	1.1799	Fraction offshorers South H	0.5400	0.5687
Fraction exporters North H	9.0000	9.8594	Fraction exporters South H	9.0000	6.0965

Table 2. Fit of model to the data. All moments are expressed as percentages after multiplication by 100.

[5] We specify the preference shock distributions for the households to be normal. The variance of each distribution is normalized to unity.

Finally, we calibrate the fixed costs of exporting and offshoring in each country and sector (8 parameters) internally with simulated method of moments so that the model can replicate data facts on the firm distribution. Specifically, we match a 9% export participation rate and a 0.5% offshoring participation rate in each country/sector (data moments taken from Zlate (2016)). A higher fixed cost serves to increase the equilibrium cutoff productivity, above which firms select into a particular status of operation. As such, lower data moments would generally necessitate higher fixed cost values. Although these moments are informative regarding the parameters we calibrate internally, note that the general equilibrium nature of the model means the moment matching exercise must be done for all parameters simultaneously. That is — all parameters affect all implied model moments jointly. Note that the differences in skill intensities across the sectors, as well as differences in wages across countries, give that the values of these fixed cost parameters, as well as the implied model moments, can vary quite substantially. We then solve for the transition after a policy shock using local approximation methods. We give more details regarding the exact solution algorithm of the model in Appendix B.

4 Industrial Policy Wars

Here we present the results of the numerical simulations. These exercises are designed such that the world economy starts out in the (calibrated) deterministic steady state at time $t = 0$. We then consider temporary 1% shocks to each of the 8 policy instruments in the world separately, where after the shock, the instrument gradually returns back to steady state, in accordance with its specified AR(1) process. We assume that each instrument is applied to both sectors in the economy for the country in question. Note that, since our solution method is a local perturbation, one can infer the effects of policy wars with multiple instruments levied at once as affecting variables additively. Figures 1–4 give the impulse responses of variables for all the different shocks from the North.[6]

To gauge how each type of household is affected differently across policies over time, we present their welfare metrics in Figures 5 and 6, in consumption equivalent variation, for varying time horizons after the shocks. Specifically, for a chosen time horizon T, we compute the cumulative utility level for each household type over the period $t = 0$ to $t = T$, in the absence

[6] In the interest of space, we present all the impulse responses of variables for all the different shocks from the South in the Appendix A, Figures 7–10.

of the policy shock. Then we compute the cumulative welfare over the same period, in the presence of the shock. We then quantify the difference between these objects using consumption equivalents (denoted ν^{ih} for sector i worker and skill class h).[7]

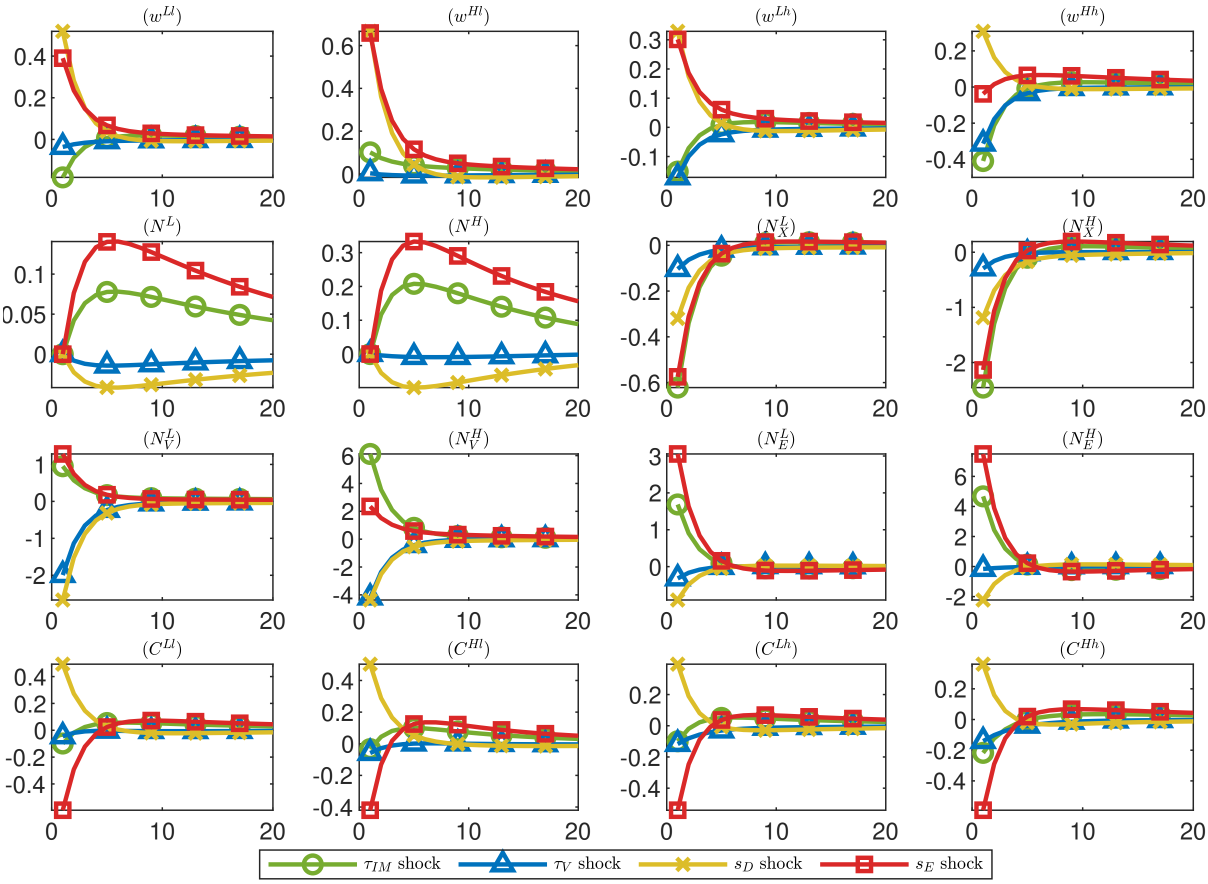

Figure 1. Impulse responses of North variables to 1% of individual industrial policy shocks in the North. The policy instrument is presented as absolute percentage points, while all other variables are presented as percentage deviations from the initial steady state (all after multiplication by 100).

4.1 Tariff War

A unilateral increase in the Northern import tariff makes the imported Southern varieties more costly to the Northern households, thus reducing their demand for imports. This gives a rise in the export cutoff (z_X^{H*}, z_X^{L*}) and a drop in the number of exporters in both sectors in the South (N_X^{H*}, N_X^{L*}). At the same time, the real exchange rate (Q) appreciates (fall) in response

[7] E.g. consider sector i workers that are highly skilled and a time horizon T. We first find the steady state cumulative welfare $u_{ss}^{ih}(T) = \sum_{k=0}^{T} \beta^k \log(C^{ih}) H^i$ where notice that neither C^{ih} nor H^i have time subscripts. Then we compute cumulative welfare after the shock $u_{tr}^{ih}(T) = \sum_{k=0}^{T} \beta^k \log(C_k^{ih}) H_k^i$ and find consumption equivalent welfare differences as $\nu^{ih}(T) = \exp\left((u_{tr}(T) - u_{ss}(T)) / \sum_{k=0}^{T} \beta^k \right) - 1$, which will clearly be a function of the time horizon T.

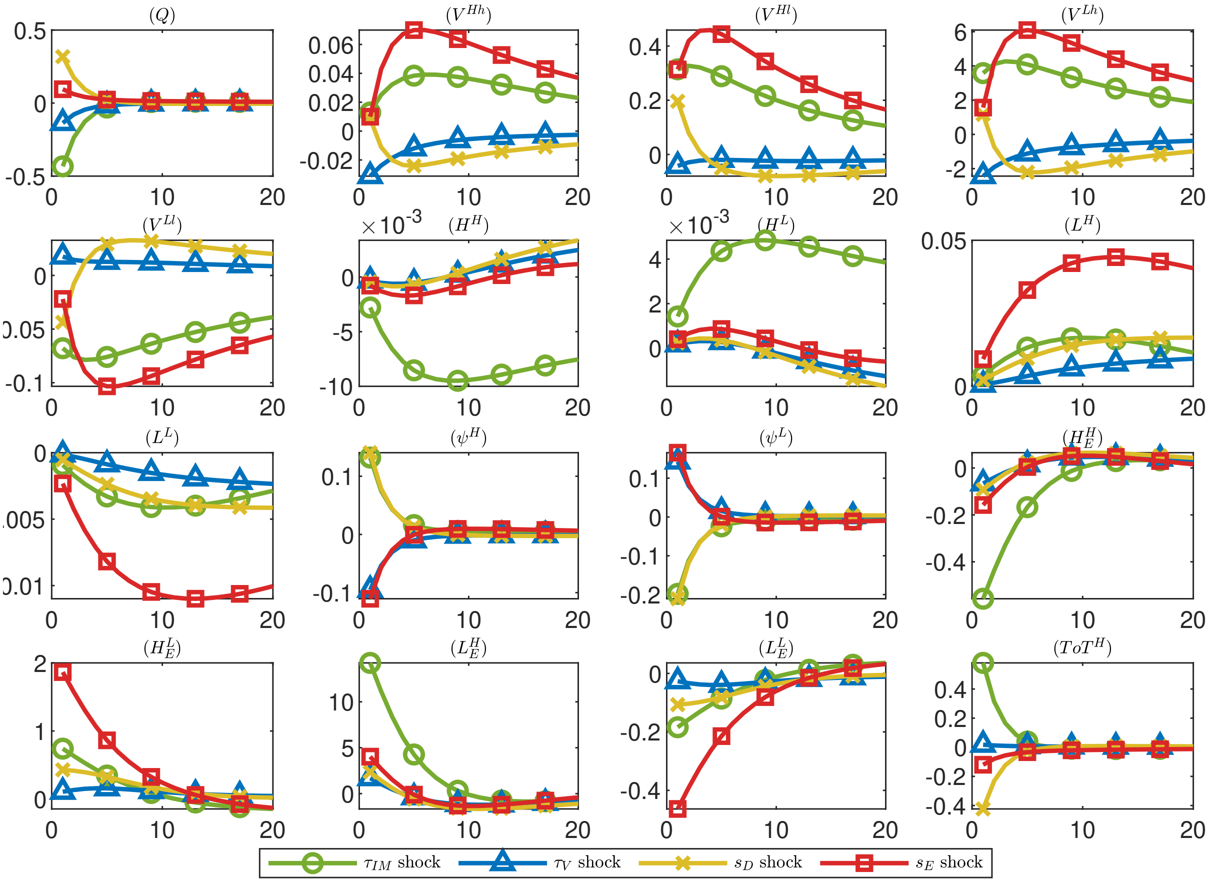

Figure 2. Impulse responses of North variables to 1% of individual industrial policy shocks in the North. The policy instrument is presented as absolute percentage points, while all other variables are presented as percentage deviations from the initial steady state (all after multiplication by 100).

to the decline in the demand for Southern varieties, which makes the Northern exporters less competitive, thus leading to a rise in the export cutoff (z_X^H, z_X^L) and a drop in the number of exporters in both sectors (N_X^H, N_X^L) in the North.

The appreciation of real exchange rates also results in a drop in the terms of labor for high-skilled in both sectors (TOL_h^H, TOL_h^L), which implies the cost of offshoring high-skilled tasks to the North for Southern offshoring firms increases. This hence drives a rise in the offshoring cutoffs (z_V^{H*}, z_V^{L*}) and a drop in the offshoring firms in both sectors (N_V^{H*}, N_V^{L*}) in the South. At the same time, although higher tariffs raises the cost of importing low-skilled task from the South, its impact was dominated by the appreciation of real exchange rates (which implies a lower terms of labor for low-skilled in both sectors ,TOL_l^H, TOL_l^L). This subsequently causes a drop in the offshoring cutoffs (z_V^H, z_V^L) and a rise in the number of offshoring firms in both sectors (N_V^H, N_V^L) in the North.

The drop in Southern offshoring firms implies the demand for Northern high-skill labor

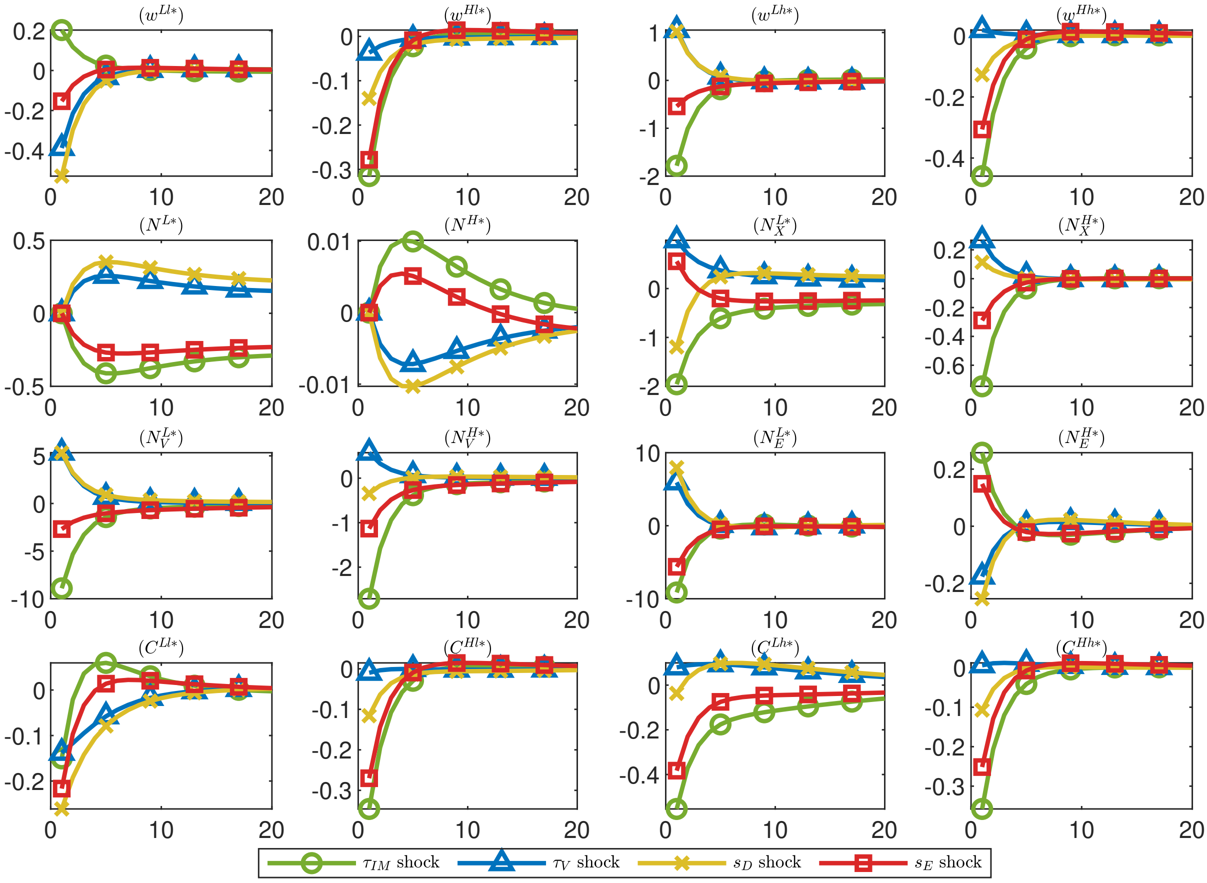

Figure 3. Impulse responses of South variables to 1% of individual industrial policy shocks in the North. The policy instrument is presented as absolute percentage points, while all other variables are presented as percentage deviations from the initial steady state (all after multiplication by 100).

decreases in both sectors, giving downward pressure to high-skill wages (w^{Hh}, w^{Lh}), with the effect in the skill-intensive sector being more pronounced. Meanwhile, as stated in Bernard et al. (2007), an increase in trade barrier shrinks the production of the comparative advantage good (H) and generates a reduction in the high-skilled wages. These two forces jointly results in the drop of high-skilled wages in the North. Taken together, this implies the value of a high-skill worker will be higher in the low-skill intensive sector (V^{Lh} increases more than V^{Hh}), therefore a decline in the high-skill labor supply in sector H (H^H goes down) and a rise in the high-skill labor supply in sector L (H^L goes up).

As for the low-skilled workers in the North, the presence of tariff shrinks the production of the high-skill intensive sector and expands the production of the low-skill intensive sector (since imported goods from the South are becoming more expensive). This implies the relative demand for the low-skill labor increases and the low-skilled workers wage should increase. This is indeed true for low-skill workers over time (w^{Hl} and w^{Ll} eventually all go up). How-

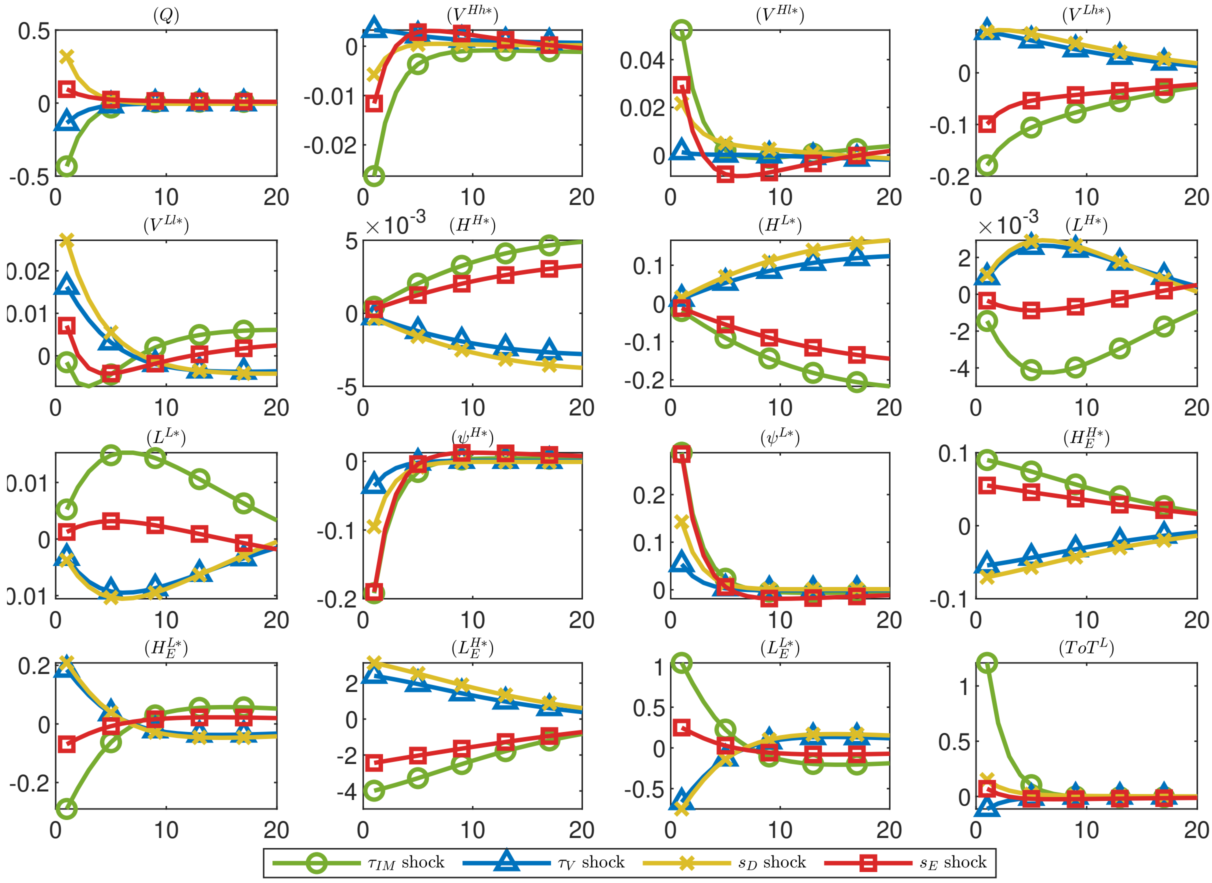

Figure 4. Impulse responses of South variables to 1% of individual industrial policy shocks in the North. The policy instrument is presented as absolute percentage points, while all other variables are presented as percentage deviations from the initial steady state (all after multiplication by 100).

ever, on impact, the low-skilled worker in the comparative disadvantage sector (w^{Ll}) will suffer a loss. This implies a rise of low-skill labor in the high-skill intensive sector (H^L goes up) and a decline of low-skill labor in the low-skill intensive sector (L^L goes down).

Distributional Effects. We infer the welfare effects of the Northern tariff by looking at the first sub-figure in Figures 5 and 6, on the Northern and Southern households, respectively. For all instruments and households, welfare has roughly converged to the lifetime welfare effect after ten years (40 quarters). In the long-run, all 4 types of Northern households stand to benefit from the Northern tariff. Low skilled workers in the H sector stand to benefit at all time horizons, realizing a 0.05% increase in consumption on impact and peaking at around 0.11% after 2 years. Workers in the L sector, of both skill types, take around one year to achieve a net positive welfare effect of the tariff. High skilled workers in the H sector take much longer to see gains — around ten years. Notice that the Southern households, of all types, follow roughly the same lifetime welfare trajectory, both qualitatively and quantitatively; all realize

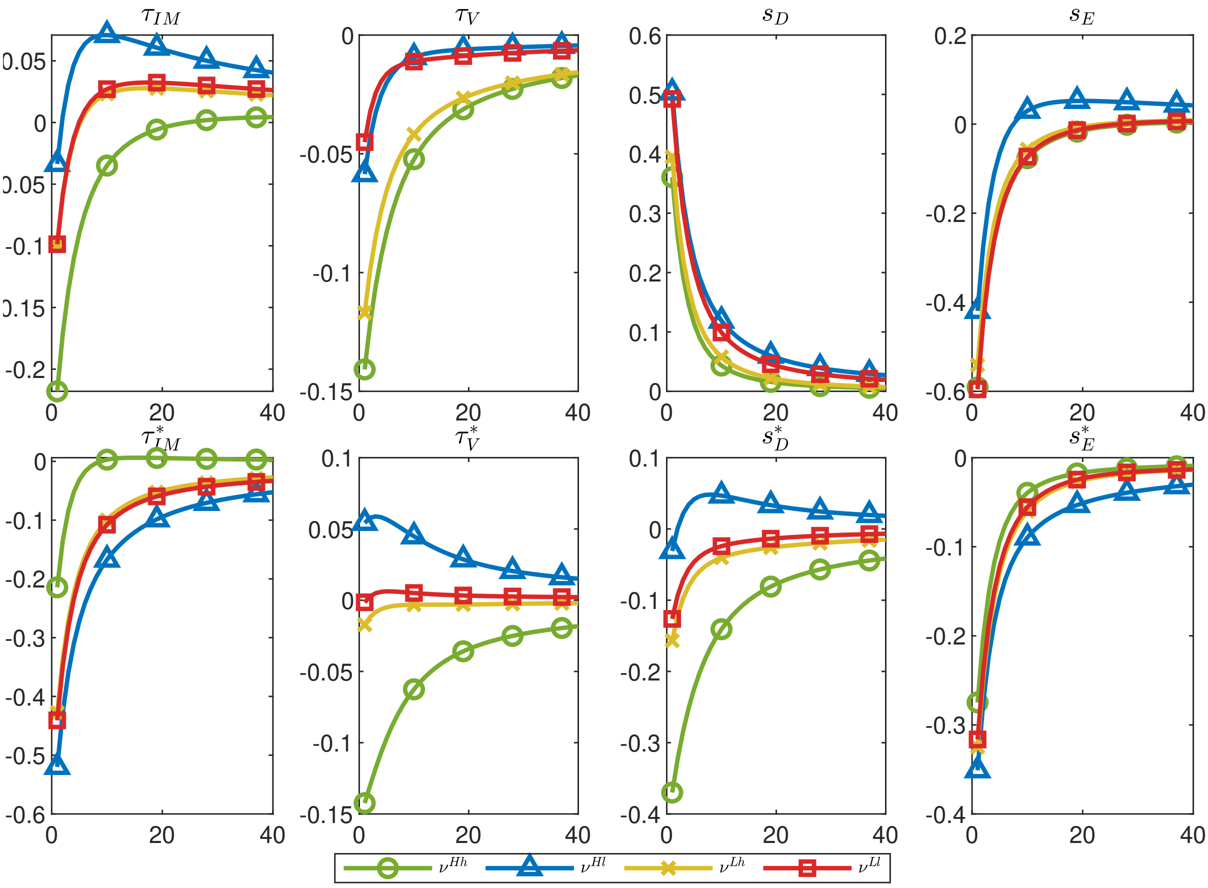

Figure 5. Northern consumption equivalent variation

lifetime welfare losses. We infer the effects of the Southern tariff on welfare by looking at the sub-figure in the first column of the second row for each figure. The Southern tariff has a similar effect on the Northern households — all trajectories converge to around 0.02% welfare losses. Finally, while the effect of the Southern tariff on Southern households offers a great deal of heterogeneity, notice that all Southern households stand to benefit at all time horizons.

4.2 Production Subsidy War

A unilateral increase in the Northern subsidy makes producing domestically a more profitable option for Northern firms. The cutoffs for exports (z^H_X, z^L_X) and offshoring rise in both sectors (z^H_V, z^L_V), implying a drop in the number of exporters (N^H_X, N^L_X) and offshoring firms (N^H_V, N^L_V) in both sectors. In this sense, production subsidy indeed causes the firms in the North to reshore their production. At the same time, the production subsidy benefits incumbents at the cost of entrants — we see a drop in firm entry in both sectors in the North (N^H_E, N^L_E).

More domestic production implies the demand for both high-skilled and low-skilled labor,

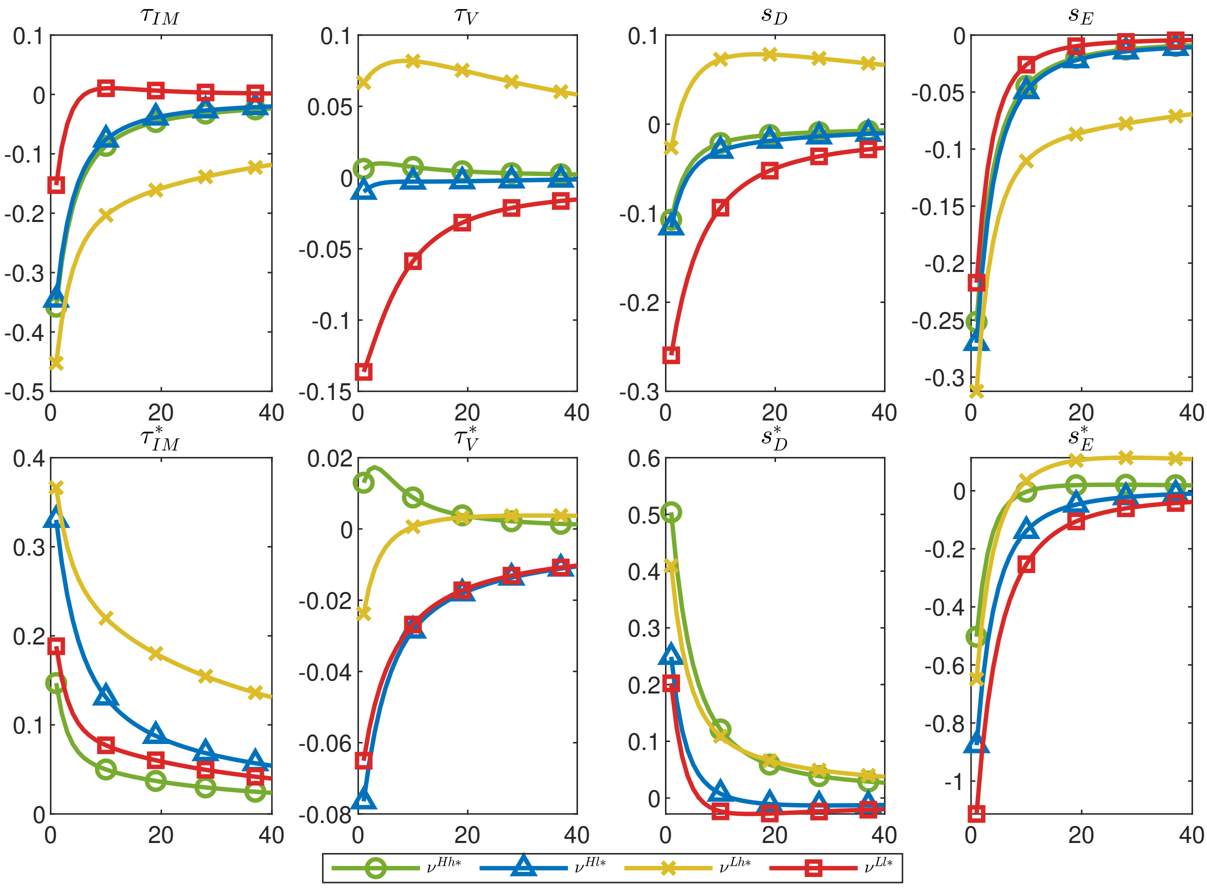

Figure 6. Southern consumption equivalent variation

which drives up the wages ($w^{Hh}, w^{Hl}, w^{Lh}, w^{Ll}$) and consumption ($C^{Hh}, C^{Hl}, C^{Lh}, C^{Ll}$) in both sectors, with the largest increase among the low-skilled workers. The rise in wages makes the Northern exporters less competitive, hence a rise in the export cutoff (z_X^H, z_X^L) and a drop in the number of exporters in both sectors (N_X^H, N_X^L). North's reshoring reduces the demand for low-skilled labor in the South, hence a drop in the respective wages (w^{Ll*}, w^{Hl*}). In the low-skill intensive sector, the low-skill labor now needs to be absorbed by domestic firms, this drives up the marginal product of high-skill labor and hence the high-skill wage (w^{Lh*}). The rise in high-skill wage dominates the drop in low-skill wage in sector L in the South, causing the number of exporters to drop in that sector (N_X^{L*}).

Due to the reshoring of production, the majority of the low-skill tasks will be absorbed by the North's low-skill labor, primarily in the comparative advantage sector (H) since this sector is bigger. The increasing wage and the expansion of domestic production cause more workers to reallocate to this sector (both H^H and L^H go up) and reallocate away from the comparative disadvantage sector (both H^L and L^L go down). Interestingly, this seemingly protectionist policy ends up expanding the sector that has a comparative advantage, a feature one typically gets following trade liberalization (as in Bernard et al., 2007).

Distributional Effects. For all types of households, the Northern production subsidy gives a surge in welfare in the short-run, which converges to slightly positive lifetime welfare effects after around 3 years. The spillover effect on the Southern households is much more heterogeneous. On impact, lower incentive for Northern firms to offshore production drives a drop in all Southern utility levels. However, after in the second year after implementation, high skilled Southern households in the L sector stand to realize a positive net welfare effect for the remainder of the simulation. Prior to the Northern subsidy, Northern multinationals would drive-up the price of low-skilled labor in the South, lowering production of Southern firms at the intensive margin. The subsidy disincentizes these effects, driving Southern firms to substitute towards local high skilled labor. The remaining Southern households stand to lose, with the largest effect being on the low skilled labour in the L sector. In contrast, not all Southern households benefit from the Southern production subsidy. After around two years, low skilled labor in the L sector start to suffer in welfare terms, while low skilled labor in the H sector start to lose after 3 years.

4.3 Decoupling/Fragmentation

If the North leverages offshoring friction to decouple from the South, this makes it more costly for the Northern firms to offshore low-skill tasks to the South. Consequently, it increases the offshoring cutoff (z_V^H, z_V^L) and reduces the number of offshoring firms in both sectors (N_V^H, N_V^L). As the Northern firms reshore their low-skill tasks, it increases the demand for low-skill workers and gives an upward pressure on the low-skilled wages in the North. However, here we observe a uniform drop in wages across all types of households ($w^{Hh}, w^{Hl}, w^{Lh}, w^{Ll}$).

This can be rationalized by the findings in Grossman and Rossi-Hansberg (2008). They argue that in a large economy with offshoring in a Heckscher-Ohlin setting where countries are incompletely specialized, a reduction in offshoring cost does not always hurt the low-skilled workers in the North. If the demand for goods is inelastic and/or the import-competing and export sectors are not very different in their factor intensities, responses of wages to the relative price can be large and it can even dominate the productivity-enhancing effect. This will then result in a drop in the low-skilled wages in the North. In our case, we have an increase in the offshoring friction and the demand for goods is elastic due to consumers' CES preferences. It then must be the case that the productivity-enhancing effect (i.e. that the low-skill wage in the South is sufficiently cheap) dominates the relative price effect, causing the wages of all types of workers to drop in this case.

Since decoupling hurts firms' prospective profits from offshoring and exports, it depresses firm entry in both sectors (N_E^H, N_E^L). The reduction in firm entry gradually translates into a smaller number of firms in both sectors (N^H, N^L). Over time, as the low-skill tasks being absorbed more intensively in North's comparative advantage sector, this eventually makes the value of working in that sector higher for both types of workers ($V^{Hh} > V^{Lh}, V^{Hl} > V^{Ll}$), hence we observe both types of workers relocate toward skill-intensive sector (both H^H and L^H go up).

Distributional Effects. Completely at odds with policy rhetoric, the Northern offshoring instrument works to the detriment of all types of Northern households, while coming at the benefit of some of those in the South. Northern low skilled workers in both sectors suffer less than high skilled, both in the short and the long run, given the substitution of Northern firms towards local labor. Due to the low fraction of offshorers in the calibration, the Northern firms that cease offshoring with this friction are highly productive. The contraction in Southern low skilled wages in their absence gives short-run losses, which dissipate to a roughly zero lifetime effect for those in the H sector, but remain negative for those in the L. In contrast, the high skilled Southern workers in both sectors gain, given a strong entry effect induced in the Southern H sector and stronger export participation across the board. The Northern welfare effects of the Southern instrument are the mirror image, given the reversed direction of offshoring. Differently though, the Southern high skilled workers realize welfare gains in both sectors in the long-run, while those in the H sector gain along the entire transition path.

4.4 Entry Subsidy War

If the North unilaterally increases its entry subsidy, this immediately encourages firm entry in both sectors (N_E^H, N_E^L) and gradually leads to a larger number of firms in both sectors (N^H, N^L). In order to finance firm entry, consumption declines across all types of households ($C^{Hh}, C^{Hl}, C^{Lh}, C^{Ll}$). At the same time, firm entry also drives up the labor demand for low-skilled workers in both sectors (w^{Hl}, w^{Ll}), which in turn causes an appreciation of both TOL_l^H and TOL_l^L. The appreciation makes it more profitable for Northern firms to offshore low-skill tasks to the South, hence we see a drop in the offshoring cutoff (z_V^H, z_V^L) and a rise in the number of offshoring firms in both sectors (N_V^H, N_V^L).

The rise in wages makes the exporters in the North less competitive, which implies a rise in the export cutoff (z_X^H, z_x^L) and a drop in the number of exporters in both sectors (N_X^H, N_X^L). While the drop in the wages in the South ($w^{Hh*}, w^{Hl*}, w^{Lh*}, w^{Ll*}$) tends to make the Southern exporters more competitive, which implies a rise in the Southern exporters and a drop in the export cutoffs in both sectors. However, the reduction in Northern consumption in the high-skill intensive has the opposite effects and dominates. As such, we see a drop in the number of exporters in the skill-intensive sector (N_X^{H*}) and a rise in the export cutoff (z_X^{H*}).

The value of a high-skill worker in the high-skill intensive sector rises less than that of a high-skill worker in the low-skill intensive sector ($V^{Lh} > V^{Hh}$). This implies that the low-skill intensive sector becomes more attractive for the high-skill worker, hence we see a rise in H^L. Similarly, the value of a low-skill worker in the high-skill intensive sector is higher than that of a low-skill worker in the low-skill intensive sector ($V^{Hl} > V^{Ll}$), suggesting low-skill workers will gradually relocate to the high-skill intensive sector (L^H goes up). Overall, although entry subsidies spur firm entry and expand the size of production, it might weaken North's country's comparative advantage if there are too many high-skill workers leaving the high-skill intensive sector (H^H goes down) and/or too few low-skill workers leaving the low-skill intensive sector (L^L goes down).

Distributional Effects. The Northern entry subsidy gives quite different welfare inferences for the Northern households, when comparing the transition with the long-run. All Northern workers suffer in the short-run, as consumption drops in favor of saving, to facilitate the creation of new firms. Welfare drops on impact by between 0.4% and 0.5% for all Northern households in consumption equivalents, when compared with the steady state. Low skilled workers employed by H firms realize welfare gains within two years of the policy reform, given the sector's relatively stronger entry response. The remaining Northern worker classes follow similar welfare trajectories, with very slightly positive effects materializing after around six years. The Southern workers all suffer from the North subsidy, with high skilled workers in the L sector suffering the most. The effects of the Southern entry subsidy are similar qualitatively.

5 Conclusion

In this paper, we investigate the distributional effects of various industrial policy wars in a dynamic general equilibrium model with two-countries, two-sectors and two skill classes of labor. The model endogenizes offshoring in a framework with Heckscher-Ohlin type of comparative advantage and firm heterogeneity. Households of workers are also heterogeneous and divided-up across both sectors and skill classes. This setup allows us to embed four industrial policy instruments-import tariff, barrier to offshoring, production subsidy and entry subsidy-and study how they may have heterogeneous welfare implications for different workers and how these effects vary over time.

We find different industrial policy shocks generate different transmission channels in our model. When interacting with firms' dynamic decisions of export and offshoring, together with households' decision to relocate across sectors, could alter a country's comparative advantage over time. We quantify the effect of these policies on the dynamics of the distribution and behavior of heterogeneous households. Political rhetoric has often alluded to the idea these policies can be leveraged as tools to protect marginalized workers. We find that, while this can be true at least at some point along the economy's transition, it can take time for the befits to accrue. In a similar fashion, large costs to non-marginalized workers in the short-run can often dissipate when increasing the welfare horizon.

Our framework can be easily modified in several ways. For example, by introducing nominal rigidities into our framework, one can investigate what are the distributional consequences of monetary policy amid the ongoing wave of deglobalization. Incorporating more realistic asset market features will enable us to explore the impact of industrial policy war on financial markets and capital flows. In addition, there are many more countries in the world besides the North and South in our framework. An extension toward a three-country model can shed important insights for the rest of the world when big nations are in rivalry with each other. Exploration of these issues will contribute valuable insights to ongoing discussions on geoeconomic tensions, and their effects on the global economy.

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APPENDIX

A Additional Figures and Tables

Table 3. Model Equations

	Sector-specific equations
Euler equation, bonds	$1+\eta B^{ih}_{t+1}=\beta\left(1+r_{t+1}\right)\mathbb{E}_t\left[\left(C^{ih}_{t+1}/C^{ih}_t\right)^{-1}\right]$
	$1+\eta B^{il}_{t+1}=\beta\left(1+r_{t+1}\right)\mathbb{E}_t\left[\left(C^{il}_{t+1}/C^{il}_t\right)^{-1}\right]$
Average firm value	$\tilde{v}^i_t=\beta\left(1-\delta\right)\mathbb{E}_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-1}\left(\tilde{d}^i_{t+1}+\tilde{v}^i_{t+1}\right)\right]$
Free entry condition	$\tilde{v}^i_t=(1-s^i_E)\frac{f^i_E}{Z_t}\left(\frac{w^{il}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih}_t}{\alpha^i}\right)^{\alpha^i}$
Law of motions, firms	$N^i_{t+1}=(1-\delta)\left(N^i_t+N^i_{E,t}\right)$
Price index, sector	$(\psi^i_t)^{1-\theta}=N^i_{D,t}\left(\tilde{\rho}^i_{D,t}\right)^{1-\theta}+N^i_{V,t}\left(\tilde{\rho}^i_{V,t}\right)^{1-\theta}+N^{i*}_{X,t}\left[(1+\tau^i_{IM})\tilde{\rho}^{i*}_{X,t}\right]^{1-\theta}$
Households budget constraints	$C^{ih}_tH^i_t+B^{ih}_{t+1}+\frac{\eta}{2}(B^{ih}_{t+1})^2=(1+r_t)\,B^{ih}_t+w^{ih}_tH^i_t+T_tH^i_t+\Pi_tH^i_t+T^{ih}_t$
	$C^{il}_tL^i_t+B^{il}_{t+1}+\frac{\eta}{2}(B^{il}_{t+1})^2=(1+r_t)\,B^{il}_t+w^{il}_tL^i_t+T_tL^i_t+\Pi_tL^i_t+T^{il}_t$
Bond cost reimbursement	$T^{ih}_t=\frac{\eta}{2}(B^{ih}_{t+1})^2$
	$T^{il}_t=\frac{\eta}{2}(B^{il}_{t+1})^2$
Sector profits	$N^i_t\tilde{d}^i_t=N^i_{D,t}\tilde{d}^i_{D,t}+N^i_{V,t}\tilde{d}^i_{V,t}+N^i_{X,t}\tilde{d}^i_{X,t}$
Number of firms, sector	$N^i_t=N^i_{D,t}+N^i_{V,t}$
Offshoring profit links	$\tilde{d}^i_{V,t}=\frac{k}{k-(\theta-1)}\left(\frac{z^i_{V,t}}{\tilde{z}^i_{D,t}}\right)^{\theta-1}\tilde{d}^i_{D,t}+\frac{\theta-1}{k-(\theta-1)}f^i_V\frac{Q_t}{Z^*_t}\left(\frac{w^{il*}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih*}_t}{\alpha^i}\right)^{\alpha^i}$
Export profit links	$\tilde{d}^i_{X,t}=\frac{\theta-1}{k-(\theta-1)}\frac{f^i_X}{Z_t}\left(\frac{w^{il}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih}_t}{\alpha^i}\right)^{\alpha^i}$
Average productivity	$\tilde{z}^i_{D,t}=\left(\frac{k}{k-(\theta-1)}\right)^{\frac{1}{\theta-1}}z_{\min}z^i_{V,t}\left[\frac{(z^i_{V,t})^{k-(\theta-1)}-z_{\min}^{k-(\theta-1)}}{(z^i_{V,t})^k-z^k_{\min}}\right]^{\frac{1}{\theta-1}}$
	$\tilde{z}^i_{V,t}=\left(\frac{k}{k-(\theta-1)}\right)^{\frac{1}{\theta-1}}z_{\min}\left(\frac{N^i_t}{N^i_{V,t}}\right)^{1/k}$
	$\tilde{z}^i_{X,t}=\left(\frac{k}{k-(\theta-1)}\right)^{\frac{1}{\theta-1}}z_{\min}\left(\frac{N^i_t}{N^i_{X,t}}\right)^{1/k}$
Offshoring cutoff	$z^i_{V,t}=z_{\min}\left(\frac{N^i_t}{N^i_{V,t}}\right)^{1/k}$
Average prices	$\tilde{\rho}^i_{D,t}=\frac{\theta}{\theta-1}\frac{1-s^i_D}{Z_t\tilde{z}^i_{D,t}}\left(\frac{w^{il}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih}_t}{\alpha^i}\right)^{\alpha^i}$
	$\tilde{\rho}^i_{V,t}=\frac{\theta}{\theta-1}\frac{1}{\tilde{z}^i_{V,t}}\left(\frac{\tau^i_VQ_tw^{il*}_t}{Z^*_t(1-\alpha^i)}\right)^{1-\alpha^i}\left(\frac{w^{ih}_t}{Z_t\alpha^i}\right)^{\alpha^i}$
	$\tilde{\rho}^i_{X,t}=\frac{\theta}{\theta-1}\frac{\tau^iQ^{-1}_t}{Z_t\tilde{z}^i_{X,t}}\left(\frac{w^{il}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih}_t}{\alpha^i}\right)^{\alpha^i}$
Average profits	$\tilde{d}^i_{D,t}(z)=\frac{1}{\theta}\left[\frac{\tilde{\rho}^i_{D,t}(z)}{\psi^i_t}\right]^{1-\theta}\gamma^iC_t$
	$\tilde{d}^i_{V,t}(z)=\frac{1}{\theta}\left[\frac{\tilde{\rho}^i_{V,t}(z)}{\psi^i_t}\right]^{1-\theta}\gamma^iC_t-f^i_V\frac{Q_t}{Z^*_t}\left(\frac{w^{il*}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih*}_t}{\alpha^i}\right)^{\alpha^i}$
	$\tilde{d}^i_{X,t}(z)=\frac{1}{\theta}(1+\tau^{i*}_{IM})^{-\theta}\left[\frac{\tilde{\rho}^i_{X,t}(z)}{\psi^{i*}_t}\right]^{1-\theta}\gamma^iC^*_tQ_t-\frac{f^i_X}{Z_t}\left(\frac{w^{il}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih}_t}{\alpha^i}\right)^{\alpha^i}$

Worker value function	$V_t^{ih} = \mathbb{E}_t \left[\ln(C_t^{ih}) + \beta(1-s)V_{t+1}^{ih}\right]$
	$V_t^{il} = \mathbb{E}_t \left[\ln(C_t^{il}) + \beta(1-s)V_{t+1}^{il}\right]$
Worker flows	$H_t^i = (1-s)H_{t-1}^i + H_{E,t}^i$
	$L_t^i = (1-s)L_{t-1}^i + L_{E,t}^i$
High-skill labor demand	$\tilde{h}_{D,t}^i = \frac{1}{Z_t \tilde{z}_{D,t}^i} \left(\frac{\alpha^i}{1-\alpha^i} \frac{w_t^{il}}{w_t^{ih}}\right)^{1-\alpha^i} \left[\frac{\tilde{\rho}_{D,t}^i(z)}{\psi_t^i}\right]^{-\theta} \frac{\gamma^i}{\psi_t^i} C_t$
	$\tilde{h}_{V,t}^i = \frac{1}{Z_t^{\alpha^i} Z_t^{*1-\alpha^i} \tilde{z}_{V,t}^i} \left(\frac{\alpha^i}{1-\alpha^i} \frac{\tau_V^i Q_t w_t^{il*}}{w_t^{ih}}\right)^{1-\alpha^i} \left[\frac{\tilde{\rho}_{V,t}^i(z)}{\psi_t^i}\right]^{-\theta} \frac{\gamma^i}{\psi_t^i} C_t$
	$\tilde{h}_{X,t}^i = \frac{\tau^i}{Z_t \tilde{z}_{X,t}^i} \left(\frac{\alpha^i}{1-\alpha^i} \frac{w_t^{il}}{w_t^{ih}}\right)^{1-\alpha^i} \left[(1+\tau_{IM}^{i*}) \frac{\tilde{\rho}_{X,t}^i}{\psi_t^{i*}}\right]^{-\theta} \frac{\gamma^i}{\psi_t^{i*}} C_t^*$
Low-skill labor demand	$\tilde{l}_{D,t}^i = \frac{1}{Z_t \tilde{z}_{D,t}^i} \left(\frac{1-\alpha^i}{\alpha^i} \frac{w_t^{ih}}{w_t^{il}}\right)^{\alpha^i} \left[\frac{\tilde{\rho}_{D,t}^i(z)}{\psi_t^i}\right]^{-\theta} \frac{\gamma^i}{\psi_t^i} C_t$
	$\tilde{l}_{V,t}^i = \frac{1}{Z_t^{\alpha^i} Z_t^{*1-\alpha^i} \tilde{z}_{V,t}^i} \left(\frac{1-\alpha^i}{\alpha^i} \frac{w_t^{ih}}{\tau_V^i Q_t w_t^{il*}}\right)^{\alpha^i} \left[\frac{\tilde{\rho}_{V,t}^i(z)}{\psi_t^i}\right]^{-\theta} \frac{\gamma^i}{\psi_t^i} C_t$
	$\tilde{l}_{X,t}^i = \frac{\tau^i}{Z_t \tilde{z}_{X,t}^i} \left(\frac{1-\alpha^i}{\alpha^i} \frac{w_t^{ih}}{w_t^{il}}\right)^{\alpha^i} \left[(1+\tau_{IM}^{i*}) \frac{\tilde{\rho}_{X,t}^i}{\psi_t^{i*}}\right]^{-\theta} \frac{\gamma^i}{\psi_t^{i*}} C_t^*$
Labor market clearing	$H_t^i = N_{D,t}^i \tilde{h}_{D,t}^i + N_{X,t}^i \tilde{h}_{X,t}^i + N_{V,t}^i \tilde{h}_{V,t}^i + N_{V,t}^{i*} \tilde{h}_{V,t}^{i*} \tau_V^{i*}$
	$+ \left(N_{E,t}^i \frac{f_E^i}{Z_t} + N_{X,t}^i \frac{f_X^i}{Z_t} + N_{V,t}^{i*} \frac{f_V^{i*}}{Z_t}\right) \left(\frac{\alpha^i w_t^{il}}{(1-\alpha^i) w_t^{ih}}\right)^{1-\alpha^i}$
	$L_t^i = N_{D,t}^i \tilde{l}_{D,t}^i + N_{X,t}^i \tilde{l}_{X,t}^i + \left(N_{E,t}^i \frac{f_E^i}{Z_t} + N_{X,t}^i \frac{f_X^i}{Z_t} + N_{V,t}^{i*} \frac{f_V^{i*}}{Z_t}\right) \left(\frac{(1-\alpha^i) w_t^{ih}}{\alpha^i w_t^{il}}\right)^{\alpha^i}$
	Non sector-specific equations
Price index, aggregate	$1 = (\psi_t^H / \gamma^H)^{\gamma^H} (\psi_t^L / \gamma^L)^{\gamma^L}$
Worker entry	$sH = H_{E,t}^H + H_{E,t}^L$
	$sL = L_{E,t}^H + L_{E,t}^L$
	$\bar{\varepsilon}_t^h = V_t^{Lh} - V_t^{Hh}$
	$\bar{\varepsilon}_t^l = V_t^{Ll} - V_t^{Hl}$
	$\frac{H_{E,t}^H}{sH} = 1 - J(\bar{\varepsilon}_t^h)$
	$\frac{L_{E,t}^H}{sL} = 1 - J(\bar{\varepsilon}_t^l)$
Firm transfers	$\Pi_t(H+L) = N_t^H \tilde{d}_t^H + N_t^L \tilde{d}_t^L - N_{E,t}^H \tilde{v}_t^H - N_{E,t}^L \tilde{v}_t^L$
Gov. budget constraint	Refer to Section 2.6
Balance of payment	Refer to Section 2.6

The above equations constitute a system of 36 sector-specific equations for sector $i = H, L$, 9 country-specific equations for each country, and 1 equation for the balance of payments. So altogether, we have 163 equations for 163 endogenous variables.

Table 4. Asymmetric Equations for the South

Offshoring profit links	$\tilde{d}^{i*}_{V,t} = \frac{k}{k-(\theta-1)}\left(\frac{z^{i*}_{V,t}}{\tilde{z}^{i*}_{D,t}}\right)^{\theta-1}\tilde{d}^{i*}_{D,t} + \frac{\theta-1}{k-(\theta-1)} f^{i*}_V \frac{Q_t^{-1}}{Z_t}\left(\frac{w^{il}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih}_t}{\alpha^i}\right)^{\alpha^i}$
Average prices	$\tilde{\rho}^{i*}_{V,t} = \frac{\theta}{\theta-1}\frac{1}{\tilde{z}^{i*}_{V,t}}\left(\frac{w^{il*}_t}{Z^*_t(1-\alpha^i)}\right)^{1-\alpha^i}\left(\frac{\tau^{i*}_V Q_t^{-1} w^{ih}_t}{Z_t\alpha^i}\right)^{\alpha^i}$
	$\tilde{\rho}^{i*}_{X,t} = \frac{\theta}{\theta-1}\frac{\tau^{i*}Q_t}{Z^*_t\tilde{z}^{i*}_{X,t}}\left(\frac{w^{il*}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih*}_t}{\alpha^i}\right)^{\alpha^i}$
Average profits	$\tilde{d}^{i*}_{V,t}(z) = \frac{1}{\theta}\left[\frac{\tilde{\rho}^{i*}_{V,t}(z)}{\psi^{i*}_t}\right]^{1-\theta}\gamma^i C^*_t - f^{i*}_V\frac{Q_t^{-1}}{Z_t}\left(\frac{w^{il}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih}_t}{\alpha^i}\right)^{\alpha^i}$
	$\tilde{d}^{i*}_{X,t}(z) = \frac{1}{\theta}(1+\tau^i_{IM})^{-\theta}\left[\frac{\tilde{\rho}^{i*}_{X,t}(z)}{\psi^i_t}\right]^{1-\theta}\gamma^i C_t Q_t^{-1} - \frac{f^{i*}_X}{Z^*_t}\left(\frac{w^{il*}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih*}_t}{\alpha^i}\right)^{\alpha^i}$
High-skill labor demand	$\tilde{h}^{i*}_{V,t} = \frac{1}{Z_t^{\alpha^i}Z_t^{*1-\alpha^i}\tilde{z}^{i*}_{V,t}}\left(\frac{\alpha^i}{1-\alpha^i}\frac{w^{il*}_t}{\tau^{i*}_V Q_t^{-1}w^{ih}_t}\right)^{1-\alpha^i}\left[\frac{\tilde{\rho}^{i*}_{V,t}(z)}{\psi^{i*}_t}\right]^{-\theta}\frac{\gamma^i}{\psi^{i*}_t}C^*_t$
	$\tilde{h}^{i*}_{X,t} = \frac{\tau^{i*}}{Z^*_t\tilde{z}^{i*}_{X,t}}\left(\frac{\alpha^i}{1-\alpha^i}\frac{w^{il*}_t}{w^{ih*}_t}\right)^{1-\alpha^i}\left[(1+\tau^i_{IM})\frac{\tilde{\rho}^{i*}_{X,t}}{\psi^i_t}\right]^{-\theta}\frac{\gamma^i}{\psi^i_t}C_t$
Low-skill labor demand	$\tilde{l}^{i*}_{V,t} = \frac{1}{Z_t^{\alpha^i}Z_t^{*1-\alpha^i}\tilde{z}^{i*}_{V,t}}\left(\frac{1-\alpha^i}{\alpha^i}\frac{\tau^{i*}_V Q_t^{-1}w^{ih}_t}{w^{il*}_t}\right)^{\alpha^i}\left[\frac{\tilde{\rho}^{i*}_{V,t}(z)}{\psi^{i*}_t}\right]^{-\theta}\frac{\gamma^i}{\psi^{i*}_t}C^*_t$
	$\tilde{l}^{i*}_{X,t} = \frac{\tau^{i*}}{Z^*_t\tilde{z}^{i*}_{X,t}}\left(\frac{1-\alpha^i}{\alpha^i}\frac{w^{ih*}_t}{w^{il*}_t}\right)^{\alpha^i}\left[(1+\tau^i_{IM})\frac{\tilde{\rho}^{i*}_{X,t}}{\psi^i_t}\right]^{-\theta}\frac{\gamma^i}{\psi^i_t}C_t$
Labor market clearing	$H^{i*}_t = N^{i*}_{D,t}\tilde{h}^{i*}_{D,t} + N^{i*}_{X,t}\tilde{h}^{i*}_{X,t} + \left(N^{i*}_{E,t}\frac{f^{i*}_E}{Z^*_t} + N^{i*}_{X,t}\frac{f^{i*}_X}{Z^*_t} + N^i_{V,t}\frac{f^i_V}{Z^*_t}\right)\left(\frac{\alpha^i w^{il*}_t}{(1-\alpha^i)w^{ih*}_t}\right)^{1-\alpha^i}$
	$L^{i*}_t = N^{i*}_{D,t}\tilde{l}^{i*}_{D,t} + N^{i*}_{X,t}\tilde{l}^{i*}_{X,t} + N^i_{V,t}\tilde{l}^i_{V,t}\tau^i_V + N^{i*}_{V,t}\tilde{l}^{i*}_{V,t}$
	$+ \left(N^{i*}_{E,t}\frac{f^{i*}_E}{Z^*_t} + N^{i*}_{X,t}\frac{f^{i*}_X}{Z^*_t} + N^i_{V,t}\frac{f^i_V}{Z^*_t}\right)\left(\frac{(1-\alpha^i)w^{ih*}_t}{\alpha^i w^{il*}_t}\right)^{\alpha^i}$
Gov. budget constraint	$\sum_{i=H,L}\Bigg[\tau^{i*}_{IM}N^i_{X,t}\tilde{\rho}^i_{X,t}\left((1+\tau^{i*}_{IM})\frac{\tilde{\rho}^i_{X,t}}{\psi^{i*}_t}\right)^{-\theta}\frac{\gamma^i}{\psi^{i*}_t}C^*_t - s^{i*}_E N^{i*}_{E,t}\frac{f^{i*}_E}{Z^*_t}\left(\frac{w^{il*}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih*}_t}{\alpha^i}\right)^{\alpha^i}$
	$-s^{i*}_D N^{i*}_{D,t}\left(\frac{\tilde{\rho}^{i*}_{D,t}}{\psi^{i*}_t}\right)^{-\theta}\frac{\gamma^i C^*_t}{\psi^{i*}_t Z^*_t\tilde{z}^{i*}_D}\left(\frac{w^{il*}_t}{1-\alpha^i}\right)^{1-\alpha^i}\left(\frac{w^{ih*}_t}{\alpha^i}\right)^{\alpha^i}\Bigg] = T^*_t(H^*+L^*)$

Table 4 consists the asymmetric conditions for the South; the rest of the conditions for the South are symmetric.

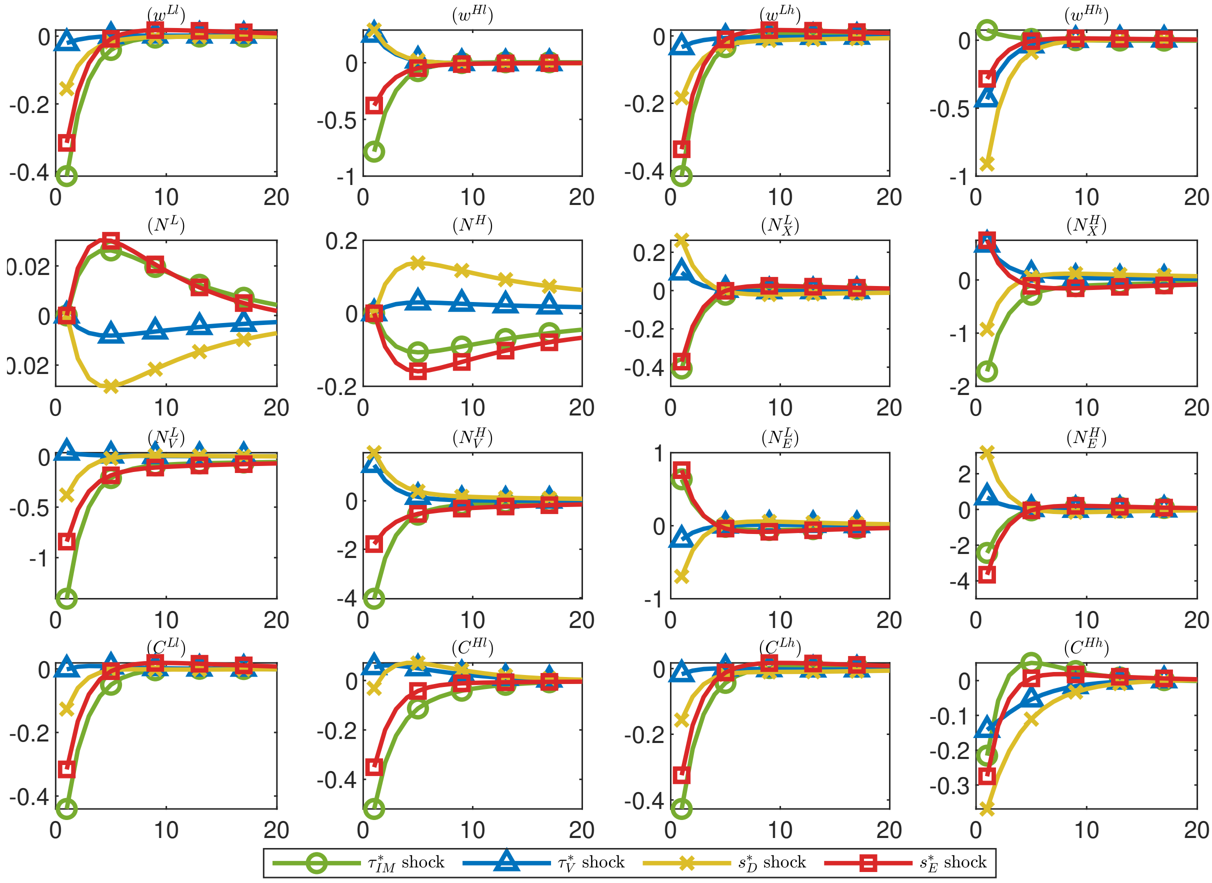

Figure 7. Impulse responses of North variables to 1% of individual industrial policy shocks in the South. The policy instrument is presented as absolute percentage points, while all other variables are presented as percentage deviations from the initial steady state (all after multiplication by 100).

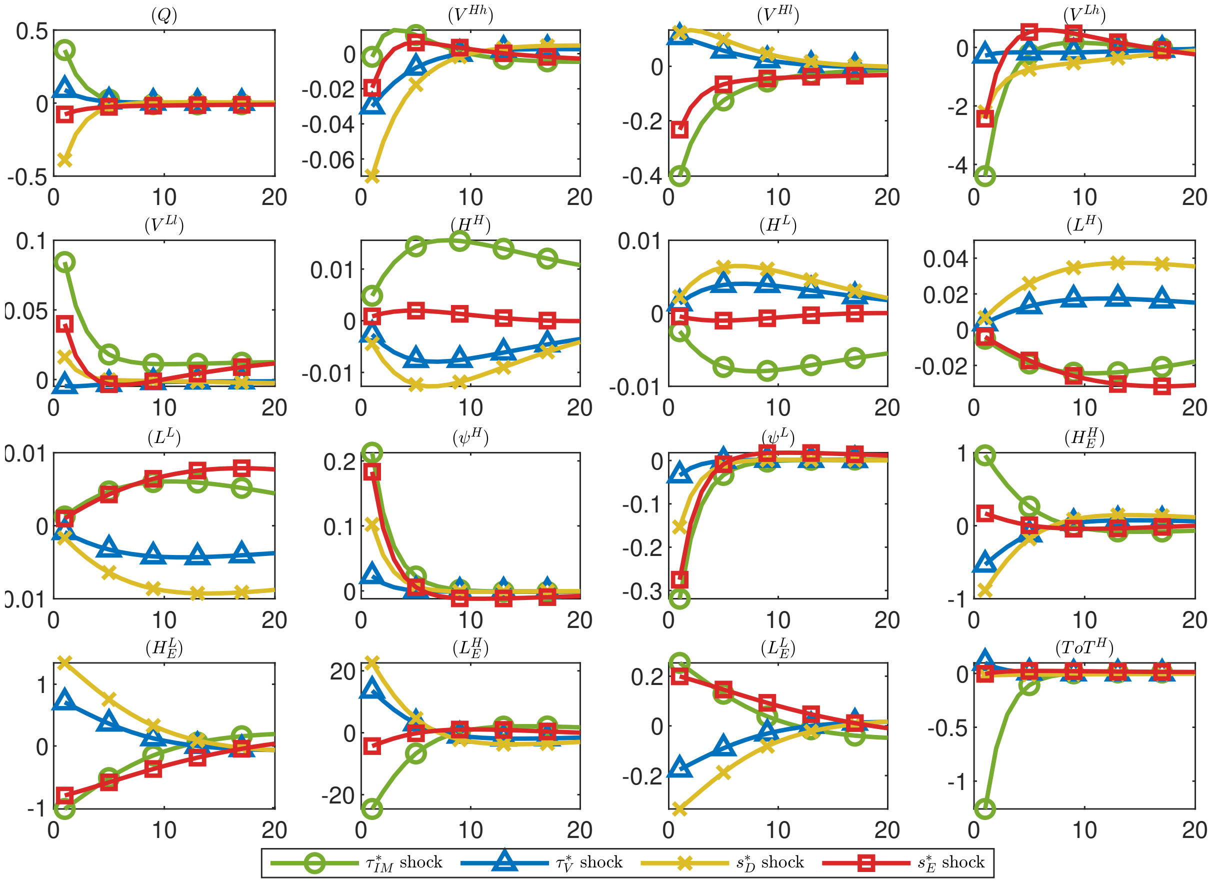

Figure 8. Impulse responses of North variables to 1% of individual industrial policy shocks in the South. The policy instrument is presented as absolute percentage points, while all other variables are presented as percentage deviations from the initial steady state (all after multiplication by 100).

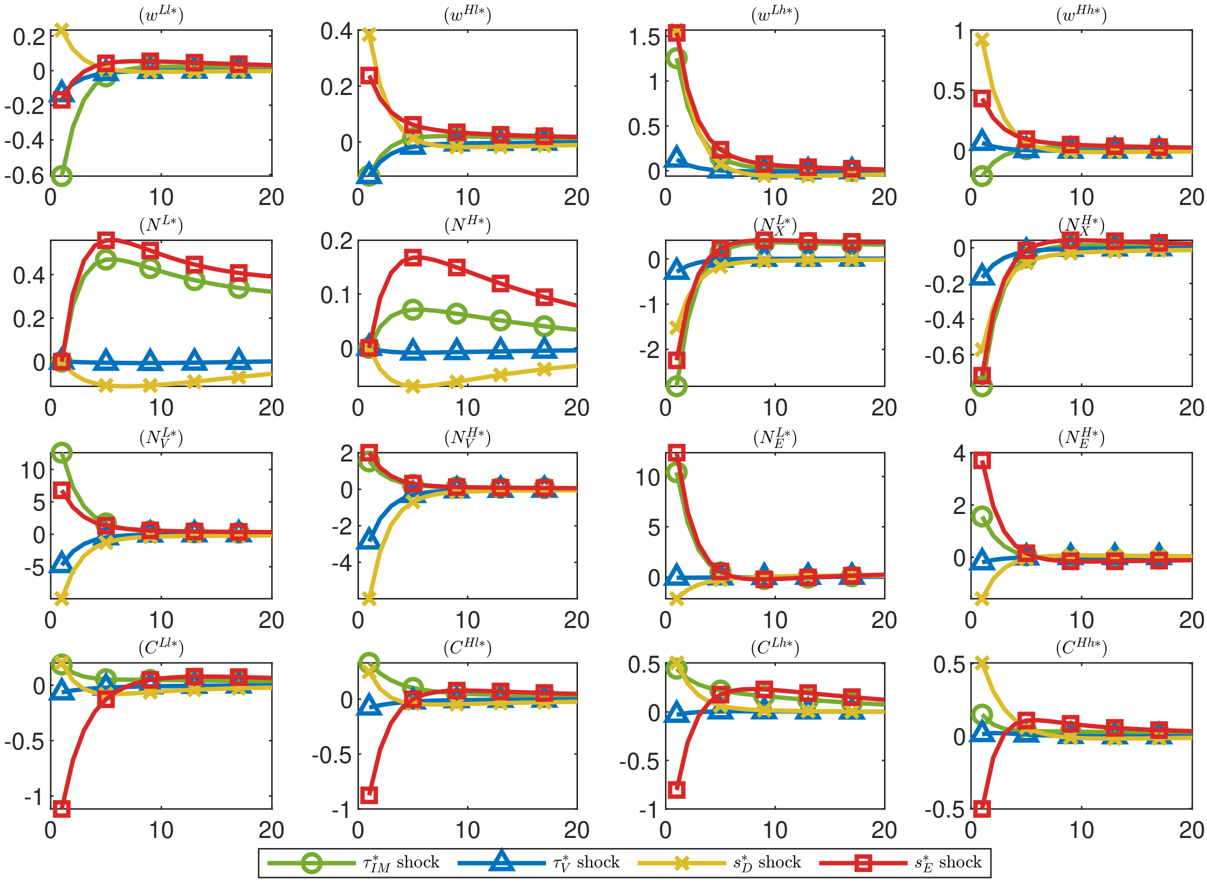

Figure 9. Impulse responses of South variables to 1% of individual industrial policy shocks in the South. The policy instrument is presented as absolute percentage points, while all other variables are presented as percentage deviations from the initial steady state (all after multiplication by 100).

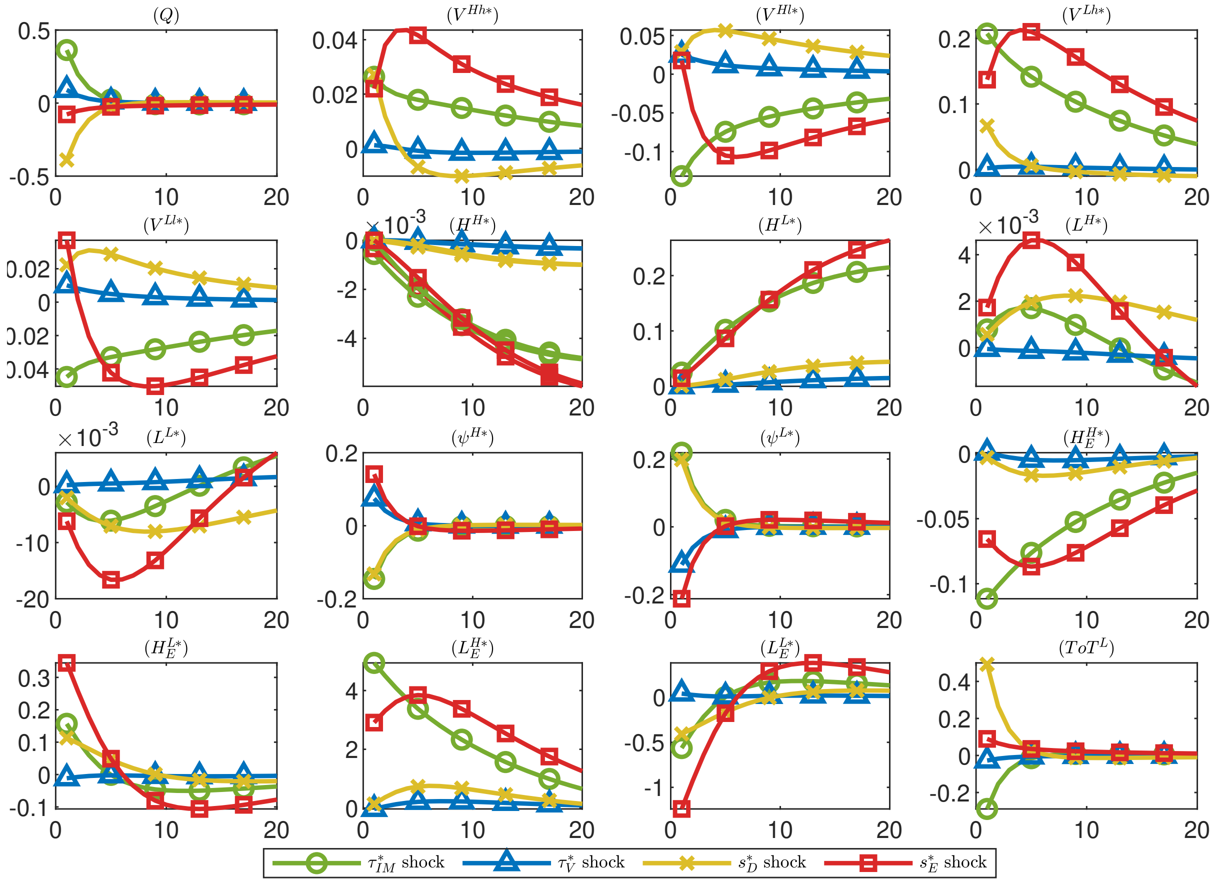

Figure 10. Impulse responses of South variables to 1% of individual industrial policy shocks in the South. The policy instrument is presented as absolute percentage points, while all other variables are presented as percentage deviations from the initial steady state (all after multiplication by 100).

B Solution Methods

Computation of the steady state uses an iterative algorithm, broken down into parts given an initial set of conjectures.[8] We guess for three aggregate objects — the real exchange rate Q and the aggregate demand shifters for each country, given as

$$
\begin{aligned}
C &= L^L C^{Ll} + L^H C^{Hl} + H^L C^{Hl} + H^H C^{Hh} \\
C^* &= L^{L*} C^{Ll*} + L^{H*} C^{Hl*} + H^{L*} C^{Hl*} + H^{H*} C^{Hh*}.
\end{aligned} \tag{3}
$$

Denote the vector of aggregate conjectures as $\vec{\Psi}_0 = (Q_0, C_0, C_0^*)$ where the 0 subscripts denote starting guesses. Given this vector and the parameter values in Table 1, we use the following algorithm.

1. Solve for the vector of equilibrium cutoffs $\vec{z} = (z_V^L, z_X^L, z_V^H, z_X^H, z_V^{L*}, z_X^{L*}, z_V^{H*}, z_X^{H*})$.

2. Find the vector of average productivity levels $\vec{\tilde{z}} = (\tilde{z}_V^L, \tilde{z}_X^L, \tilde{z}_V^H, \tilde{z}_X^H, \tilde{z}_V^{L*}, \tilde{z}_X^{L*}, \tilde{z}_V^{H*}, \tilde{z}_X^{H*})$.

3. Find the vector over average prices

$$\vec{\tilde{\rho}} = (\tilde{\rho}_D^L, \tilde{\rho}_V^L, \tilde{\rho}_X^L, \tilde{\rho}_D^H, \tilde{\rho}_V^H, \tilde{\rho}_X^H, \tilde{\rho}_D^{L*}, \tilde{\rho}_V^{L*}, \tilde{\rho}_X^{L*}, \tilde{\rho}_D^{H*}, \tilde{\rho}_V^{H*}, \tilde{\rho}_X^{H*}).$$

4. Find the vector of average profits

$$\vec{\tilde{d}} = (\tilde{d}_D^L, \tilde{d}_V^L, \tilde{d}_X^L, \tilde{d}_D^H, \tilde{d}_V^H, \tilde{d}_X^H, \tilde{d}_D^{L*}, \tilde{d}_V^{L*}, \tilde{d}_X^{L*}, \tilde{d}_D^{H*}, \tilde{d}_V^{H*}, \tilde{d}_X^{H*}).$$

5. Find the labour demand schedules for the high and low skill classes

$$
\begin{aligned}
\vec{\tilde{h}} &= (\tilde{h}_h^L, \tilde{h}_V^L, \tilde{h}_X^L, \tilde{h}_h^H, \tilde{h}_V^H, \tilde{h}_X^H, \tilde{h}_h^{L*}, \tilde{h}_V^{L*}, \tilde{h}_X^{L*}, \tilde{h}_h^{H*}, \tilde{h}_V^{H*}, \tilde{h}_X^{H*}) \\
\vec{\tilde{\ell}} &= (\tilde{\ell}_h^L, \tilde{\ell}_V^L, \tilde{\ell}_X^L, \tilde{\ell}_h^H, \tilde{\ell}_V^H, \tilde{\ell}_X^H, \tilde{\ell}_h^{L*}, \tilde{\ell}_V^{L*}, \tilde{\ell}_X^{L*}, \tilde{\ell}_h^{H*}, \tilde{\ell}_V^{H*}, \tilde{\ell}_X^{H*}).
\end{aligned}
$$

6. Find the value of entry in each sector: $\vec{\tilde{v}} = (\tilde{v}^L, \tilde{v}^H, \tilde{v}^{L*}\ \tilde{v}^{H*})$.

7. Set the sunk costs of entry so that the free entry conditions hold, given $\vec{\tilde{v}}$ implied.

[8] This approach is standard in models of firm dynamics, (e.g. see Spencer (2022)).

8. Find the equilibrium firm masses $\vec{N} = (N^L, N^H, N^{L*}, N^{H*})$ that make the definitions of the relative prices hold $\psi^L, \psi^H, \psi^{L*}, \psi^{H*}$ given $\vec{\rho}$ and the distribution of firms implied by $\vec{z}$ and $\vec{\tilde{z}}$.

9. Find aggregates that correspond to objects $\vec{z}$, $\vec{\tilde{z}}$, $\vec{\tilde{d}}$, $\vec{\tilde{h}}$, $\vec{\tilde{\ell}}$ and $\vec{N}$.

10. Set the endowments of labour supply H, L, H^*, L^* to be equal to the equilibrium aggregate labor demand, which comes from the aggregation step.

11. Find the lump sum taxes/transfers that come from the government budget constraints.

12. Find the equilibrium level of demand for each household type

$$\vec{C} = (C^{Ll}, C^{Hl}, C^{Lh}, C^{Hh}, C^{Ll*}, C^{Hl*}, C^{Lh*}, C^{Hh*}),$$

using the endowments of labor supply, taxes/transfers from the government and aggregate objects. Calculate the worker value functions for each sector and skill class. Find worker's preference cutoffs $(\varepsilon^l, \varepsilon^h, \varepsilon^{l*}, \varepsilon^{h*})$. Given these objects and the assumed normal distribution on preference shocks, find the mean parameters for the distributions that make the labor market clearing conditions hold.

13. Find the following metrics of distance

$$\Delta^Q = |BOP|$$
$$\Delta^C = |C_0 - C|$$
$$\Delta^{C*} = |C_0^* - C^*|$$

where BOP denotes the balance of payments condition and C and C^* are the levels of aggregate consumption implied $\vec{C}$ and (3).

14. Update the guesses inside vector Ψ_0 in accordance with Δ^Q, Δ^C and Δ^{C*}. Return to the initial step and repeat until convergence.