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Keywords

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1 Introduction

The world economy has moved from a period of integration into one marked with persistent disruption and backlash. The commencement of the US-China trade war in 2018 placed further strain on an already sluggish recovery, following the global financial crisis. Pressure on global value chains continued to build in the face of the COVID-19 pandemic, as well as wars in Ukraine and the Middle East. Amid these waves of geoeconomic tension, industrial policy has emerged as a popular tool for policymakers to fuel international rivalry and safeguard national interests. Use of these tools has been highly volatile, reactive and frequently aimed at short-run objectives such as "addressing near-term supply chain disruptions" (The White House, 2021). Understanding their intended and unintended consequences is challenging, as these policies operate through complex general equilibrium interactions in the global economy. Our study builds an open-economy framework, with trade and offshoring as its micro-foundation, to quantify the inter-temporal effects of industrial policy interventions.

Our general equilibrium framework incorporates core ingredients necessary to capture the dynamic trade-offs inherent in the recent industrial policy landscape. The model features two countries with asymmetric endowments of skilled and unskilled labor — a source of comparative advantage that industrial policy interventions often seek to alter or reinforce. We refer to the country endowed with relatively more skilled labor as the North and that with more unskilled labor as the South. The household in each country saves through local firm equities, which anchors the inter-temporal dynamics of the equilibrium. We make use of a single production sector, keeping the interpretation focused on the reallocations over time rather than on additional sectoral margins.[1] Since industrial policies impact firms differentially, we model firm-level productivity heterogeneity, in addition to endogenous firm creation and choices to export and/or offshore part of their production process. The offshoring aspect of our model extends Zlate (2016) by embedding trade-in-task (as in Grossman and Rossi-Hansberg, 2008), allowing for two-way offshoring.[2] The asymmetric labor endowments translate into wage disparities across skill types in each country. Offshoring firms then exploit this by paying a fixed cost, then relocating the tasks that are intensive in their relatively scarce factor.

[1] An important part of the policy discussion relates to sectoral re-allocations, particularly with respect to targeted policy actions. We explore this interesting issue in follow-up work Ding, Spencer and Wang (2024).

[2] In Zlate (2016), only firms in the North offshore their production to the South to take advantage of the lower labor costs. Firms in the South only access the North market via export.

Unilateral industrial policies in our structure operate on three static distortions (as in Felbermayr, Jung and Larch (2013)) and their interaction with consumption smoothing by the household. Firstly, monopolistic competition induces a markup distortion operating on the intensive margin, whereby the consumption of each domestic variety tends to be sub-optimally low relative to imported variety.[3] Secondly, a consumer surplus distortion operates on the imported-variety extensive margin, since the mass of imported varieties is endogenous. Home consumers do not receive the profits earned by foreign exporters, and therefore fail to internalize that higher import spending raises foreign export profitability and induces additional entry. As a result, the number of imported varieties is inefficiently low. Thirdly, a classic terms-of-trade externality arises where a policymaker can improve national welfare by manipulating the country's import demand to raise its relative price in trade, in contrast with private agents, who take this as given. Policy interventions work on these distortions, with forward-looking households smoothing the induced changes in real income, so that the welfare consequences of each static distortion are felt over time, rather than occurring only on impact.

We then calibrate the model to the US-China context and study the welfare effects of industrial policy tools, from the perspective of a unilateral policymaker with differing time horizons of interest. We implement these horizons as alternative evaluation windows, from full transition path welfare to one and four year objectives, where shorter windows proxy for the idea of policymaker myopia.[4] The policy instruments we consider are import tariffs (on final and offshored imports), domestic production subsidies and entry subsidies. Each policy change is introduced as a temporary shock that decays according to an AR(1) process. The initial shock magnitude is calibrated so that the net present value of its entire transition fiscal effect equals 1% of world pre-reform consumption. We start the discussion of our quantitative results by first exploring the impact of unilateral policy reforms on macroeconomic aggregates. We then provide a detailed discussion and a welfare decomposition that highlights the mechanisms through which unilateral policies generate gains and losses over time. We then finish with an application to simultaneous policy actions from each country, designed to approximate the consequences of industrial policy wars.

Our first quantitative finding is that horizon length shapes unilateral policy rankings. Fo-

[3]See also Gros (1987) and Demidova and Rodríguez-Clare (2009) for the interpretation of the markup distortion.

[4]For a similar approach, see Akcigit, Ates and Impullitti (2018) and Milicevic, Defever, Impullitti and Spencer (2022).

cusing on the North, from an initial state free of interventions, small production subsidies perform best over short windows, tariffs perform best over longer ones and entry subsidies are always dominated. The accounting follows from the way each instrument shifts resources across the firm distribution. A production subsidy expands the activity of incumbents while discouraging entry, shifting resources toward consumption in the short run. A tariff instead supports both incumbent and potential entrant firms, giving a short-run fall in consumption as new firms are created and the price of imports rises, followed by welfare gains over time as the productive capacity of the economy expands. In contrast, an entry subsidy tilts the firm distribution excessively toward new startups, draining resources from incumbents, producing a sharper short-run contraction and only a mild long-run gain. While all three instruments reduce wage inequality, the production subsidy yields the strongest effect, primarily because it has the most significant impact in reshoring production to the domestic market.

Our second quantitative finding draws on a welfare decomposition to disentangle the economic mechanisms driving these unilateral outcomes. Whereas the previous paragraph's accounting exercise traced how policy instruments reallocate activity across firms, the decomposition highlights how households' dynamic optimization shapes the consumption path through aggregate productivity, terms of trade, and love-of-variety channels. In the short run, although all policies improve the terms of trade, they uniformly reduce aggregate productivity. As households adjust their consumption portfolios in response to these shocks, the resulting reallocation alters both markup and consumer-surplus distortions. At the same time, households balance current consumption against investment in firm creation—and thus future consumption—given evolving market conditions. These intra- and intertemporal adjustments jointly determine the total number of product varieties in the economy. Although the terms-of-trade channel remains quantitatively important in the short run, long-run differences across policy instruments are driven mainly by the love-of-variety and aggregate productivity channels, highlighting the central role of within-industry firm dynamics in shaping the evolution of welfare effects over time across instruments.

Related Literature. There is an extensive literature examining the rationales and implications of industrial policy, as surveyed by Harrison and Rodríguez-Clare (2010) and, more recently, Juhász et al. (2024). The earlier literature is largely theoretical (Baldwin, 1969; Krueger, 1990; Krugman, 1992), followed by empirical analyses assessing the gains for specific industries or countries (Baldwin and Krugman, 1988; Head, 1994; Luzio and Greenstein, 1995). More recent studies focus on the consequences of industrial policy for productivity and inter-sectoral spillovers (Aghion et al., 2015; Liu, 2019; Choi and Levchenko, 2021; Lane, 2025). Most of these works primarily analyze whether industrial policy should be implemented and, if so, which industries should be targeted. Our study complements this literature by taking a targeted industry as given and jointly evaluating the distributional and welfare effects of various industrial policy instruments.[5] In addition, our approach is more "macro" in nature, as we emphasize the intra-sectoral dimension of industrial policy within an intertemporal framework featuring rich firm heterogeneity.[6] While our one-sector setting does not capture cross-sector spillover effects, this simplification allows us to transparently isolate the role of firm-level dynamics within an industry in shaping the time profile of the welfare effects across different time horizons.

Our paper is also related to the literature on trade and industrial policies in models featuring firm heterogeneity, as reviewed by Ossa (2016); Ding (2022); Caliendo and Parro (2022). This literature usually uses static trade framework, with much of it exploring the canonical Melitz model (Demidova and Rodríguez-Clare, 2009; Felbermayr et al., 2013; Haaland and Venables, 2016; Lashkaripour and Lugovskyy, 2023).[7] Our framework builds on the one-sector two-country Melitz model as in Felbermayr et al. (2013) and shares the same static distortions that are common in such model. In our setting with dynamics, however, industrial policies not only serve to improve the static distortions but also manipulate the consumption smoothing incentives, which drives the differential welfare effects across time horizons. In this regard, our paper is closely related to Larch and Lechthaler (2013), which studies the distributional aspects of strategic tariffs in a dynamic trade model. We differ from their framework by abstracting from cross-sector reallocations but allowing for two-way offshoring, and demonstrate that the endogenous selection of firms into offshoring plays a quantitatively important role in the distributional impacts of industrial policies.

This paper also connects to the burgeoning literature on the macroeconomic consequences

[5]In a similar spirit, Barwick et al. (2025) estimate a dynamic industry model of the Chinese shipbuilding sector to provide a structural analysis of the design and performance of different industrial policy instruments.

[6]Another noteworthy paper which takes a macroeconomic approach to study industrial policy is Ottonello et al. (2024). The authors examine the exchange rate as a distinctive industrial policy instrument, exploring both normative and quantitative dimensions of how this tool can be leveraged to enhance welfare during a country's development process.

[7]Some studies depart from the Melitz model by introducing variable markups (Demidova, 2017; Nocco et al., 2019) or foreign direct investment (Díez, 2014).

of geoeconomic fragmentation. In recent years, intensifying geopolitical tensions have led the global economy to exhibit increasing signs of fragmentation (Aiyar et al., 2023). Empirical and theoretical studies have analyzed the aggregate losses from trade and supply chain decoupling (Bolhuis et al., 2023; Attinasi et al., 2023; Javorcik et al., 2024),[8] the unintended consequences of financial fragmentation for imposing countries (Bianchi and Sosa-Padilla, 2024; Keerati, 2022; Clayton et al., 2023), and the amplified welfare losses from technology decoupling (Bekkers and Góes, 2022; Cerdeiro et al., 2021). We make two key contributions to this literature. First, we jointly assess the dynamic effects of three distinct industrial policy instruments that policymakers commonly use to advance their geoeconomic objectives in a unified quantitative framework. Second, we offer novel insights into the distributional consequences of fragmentation—particularly the evolution of wages across different skill groups—a dimension largely overlooked in previous researches.

From the modeling perspective, our paper builds on the literature on international macroeconomic models with heterogeneous firms as its micro-foundation, which evolved following work by Melitz (2003) and Ghironi and Melitz (2005). Several studies have extended this line of framework to address different questions in international macroeconomics. These include works by Auray and Eyquem (2011), Bergin and Corsetti (2020), Cacciatore and Ghironi (2021), Corsetti et al. (2013), Hamano and Zanetti (2017), Imura and Shukayev (2019), Jiang (2023), Jiang and Wang (2025), Kim (2021), and Zlate (2016) among others. Our contribution to this literature is embedding two-way trade-in-tasks into this class of models. We then utilize this model to examine the dynamic and distributional effects of various industrial policies.

The rest of the paper is organized as follows: Section 2 presents the baseline model. Section 3 presents the calibration. Section 4 studies the dynamics and welfare implications of industrial policies. Section 5 concludes. The Appendix contains our computation method and additional figures and tables.

2 The Model

Overview

[8] Some studies focus on the specific case of the US–China trade war and investigate its effects on welfare, labor markets, and trade balances (Amiti et al., 2019, 2020; Benguria and Saffie, 2020; Tu et al., 2020; Ma and Meng, 2023).

Our framework consists of two countries, North (N) and South (S), all variables for the South are denoted with an asterisk. Each country has one sector, featured with heterogeneous firms producing differentiated varieties. The production of each variety requires two types of labor: high-skilled labor and low-skilled labor, both are supplied inelastically. The North has a relatively higher endowment of high-skilled labor, whereas the South has a relatively higher endowment of low-skilled labor. We model endogenous firm entry and selection into export as in Ghironi and Melitz (2005). The offshoring aspect of our model extends Zlate (2016) by embedding trade-in-task (as in Grossman and Rossi-Hansberg, 2008), allowing for two-way offshoring.

While the traditional industrial policy literature typically involves a multi-sector setting (e.g., Lashkaripour and Lugovskyy, 2023), our one-sector model allows us to transparently isolate the role of firm-level dynamics within an industry in shaping the time profile of the welfare effects, without the added opacity that comes with inter-sectoral reallocation. The model is featured with the following three sets of popular industrial policy instruments (Juhász et al., 2022): (i) ad valorem import tariffs (τ^{IM}, τ^{IM*}) levied both on final goods and offshored tasks, (ii) domestic production subsidies (s_D, s_D^*), and (iii) entry subsidies (s_E, s_E^*). The following graph presents an overview of the model's structure.

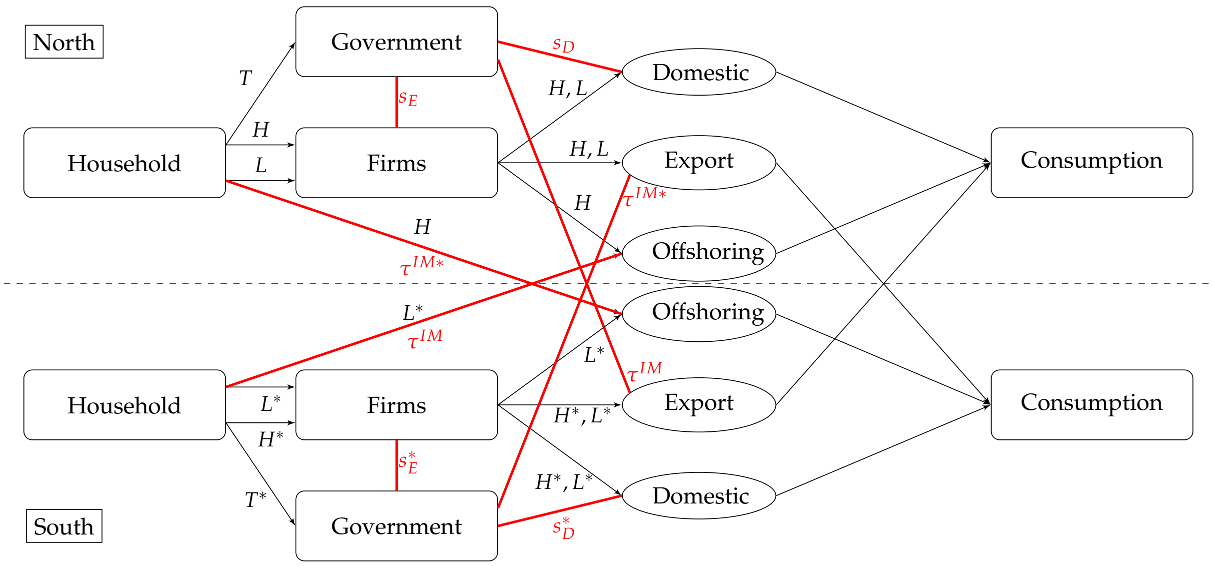


Figure 1. Model structure

2.1 Households

There are two countries – North and South. We denote the Northern endowments of high-skilled labor by H and low-skilled labor by L. The North is assumed to be more high-skilled labor abundant than the South, so that the relative skill abundance is higher for the North than for the South: $H/L > H^*/L^*$. Each economy consists of a unit mass of atomistic households and a continuum of monopolistically competitive firms with heterogeneous levels of labor productivity. As in Ghironi and Melitz (2005), all contracts are written in nominal terms. Since prices are flexible, the variables solved for are all in real terms. Here we mostly focus on presenting the model setup for the North, noting that those for the South hold analogously.

The representative household maximizes expected lifetime utility:

$$\max_{\{C_s, B_{s+1}, x_{s+1}\}_{s=t}^{\infty}} \mathbb{E}_t \sum_{s=t}^{\infty} \beta^{s-t} \frac{C_s^{1-\gamma}}{1-\gamma},$$

where $\beta \in (0,1)$ is the subjective discount factor, C_t is the aggregate consumption basket, and $\gamma > 0$ is the inverse of the inter-temporal elasticity of substitution. The budget constraint is:

$$C_t + (N_t + N_{E,t})\,\tilde{v}_t x_{t+1} + B_{N,t+1} = \left(\tilde{v}_t + \tilde{d}_t\right) N_t x_t + (1 + r_t)\, B_{N,t} + w_{h,t} H + w_{l,t} L + T_t. \quad (1)$$

The household purchases two types of assets. First, it purchases x_{t+1} shares in a mutual fund of Northern firms, which includes N_t incumbent firms producing either domestically or offshore at time t, and also $N_{E,t}$ new entrants in period t. The date t price of a claim to the future profit stream of the mutual fund of $N_t + N_{E,t}$ Northern firms is equal to the average nominal price of claims to future profits of Northern firms, $P_t\tilde{v}_t$. The mutual fund pays a total profit that is equal to the average total profits of all Northern firms that produce in that period, $P_t\tilde{d}_t N_t$. The household also receives dividends equal to the average firm profit $\tilde{d}_t$ proportional to the mass of firms N_t. The household also purchases the risk free bond issued by its own country $B_{N,t+1}$, denominated in units of the issuing country's consumption basket. The domestic risk-free bond pays interest rate r_t. Entering period t, the household has share holdings x_t in a mutual fund of N_t Northern firms whose average market value is $\tilde{v}_t$. There are two types of labor – high-skilled labor and low-skilled labor, supplied inelastically, earning real wages $w_{h,t}$ and $w_{l,t}$, while pooling income together. The household also receives transfers from the Northern government.

The consumption basket for the Northern household includes varieties produced by the Northern domestically producing firms ($\omega \in \Omega_{D,t}$), and the Northern offshoring firms ($\omega \in \Omega_{V,t}$), as well as varieties produced by the Southern exporters ($\omega \in \Omega^*_{X,t}$), with the elasticity of substitution $\theta > 1$:

$$C_t = \left[\int_{\omega \in \Omega_{D,t}} y_{D,t}(\omega)^{\frac{\theta-1}{\theta}} d\omega + \int_{\omega \in \Omega_{V,t}} y_{V,t}(\omega)^{\frac{\theta-1}{\theta}} d\omega + \int_{\omega \in \Omega^*_{X,t}} y^*_{X,t}(\omega)^{\frac{\theta-1}{\theta}} d\omega \right]^{\frac{\theta}{\theta-1}}. \tag{2}$$

The consumption-based price index for the North is then $P_t = \left(\int p_t(\omega)^{1-\theta} d\omega\right)^{1/(1-\theta)}$, where $p_t(\omega)$ is the nominal price of variety ω and $\omega \in \Omega_{D,t} \cup \Omega_{V,t} \cup \Omega^*_{X,t}$. Setting the consumption basket C_t as numeraire, the price index for the North is $1 = \left(\int \rho_t(\omega)^{1-\theta} d\omega\right)^{1/(1-\theta)}$, where $\rho_t(\omega)$ is the real price of variety ω. The household's demand for each individual variety ω is $c_t(\omega) = \rho_t(\omega)^{-\theta} C_t$.

The Southern household earns real wage rate $w^*_{l,t}$ and $w^*_{h,t}$, in units of Southern consumption basket. It maximizes a similar utility function. However, the composition of the consumption basket is different. The subset of goods available for consumption in the South consists of goods produced by the Southern domestically producing firms ($\omega \in \Omega^*_{D,t}$), and the Southern offshoring firms ($\omega \in \Omega^*_{V,t}$), as well as goods produced by the Northern exporters ($\omega \in \Omega_{X,t}$), which is expressed as:

$$C^*_t = \left[\int_{\omega \in \Omega^*_{D,t}} y^*_{D,t}(\omega)^{\frac{\theta-1}{\theta}} d\omega + \int_{\omega \in \Omega^*_{V,t}} y^*_{V,t}(\omega)^{\frac{\theta-1}{\theta}} d\omega + \int_{\omega \in \Omega_{X,t}} y_{X,t}(\omega)^{\frac{\theta-1}{\theta}} d\omega \right]^{\frac{\theta}{\theta-1}}.$$

Northern household's utility maximization problem delivers the following Euler equation for bonds,

$$1 = \beta (1 + r_{t+1}) \mathbb{E}_t \left[\left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} \right] \tag{3}$$

and the Euler equation for stocks

$$\tilde{v}_t = \beta (1 - \delta) \mathbb{E}_t \left[\left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} \left(\tilde{d}_{t+1} + \tilde{v}_{t+1} \right) \right], \tag{4}$$

where δ is firms' exogenous exit rate, which reflects the random exit shock that can hit all firms including the entrants every period. Similar equations also hold for the Southern households.

2.2 Firms

Firm entry in the North (South) requires an entry cost that is equal to f_E (f_E^*) effective labor units, which is equal to $\frac{f_E}{Z_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$ units of the Northern consumption basket. Part of the entry cost is subsidized by Northern government with the rate equal to s_E. 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 $[z_{\min}, \infty)$. This productivity stays the same for the firm's entire term of operation. Southern firms draw productivity levels from an identical distribution over the same interval. Therefore, there are $N_{E,t}$ 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 $N_{t+1} = (1-\delta)(N_t + N_{E,t})$. Similar to Ghironi and Melitz (2005), the sunk entry cost together with the time to build assumption is crucial in generating endogenously persistent dynamics in our model.

Every period, the new entrants form expectation of their post-entry firm value $\tilde{v}_t$, which is a function of the stochastic discount factor, the probability of exit δ and the expected monopolistic stream of profits $\tilde{d}_t$. Equation (4) yields the expected post-entry value of the average firm:

$$\tilde{v}_t = \mathbb{E}_t \sum_{s=t+1}^{\infty} [\beta(1-\delta)]^{s-t} \left(\frac{C_s}{C_t}\right)^{-\gamma} \tilde{d}_s \tag{5}$$

As a result, every period, potential entrants make their decision of entering 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 : $\tilde{v}_t = (1-s_E)\frac{f_E}{Z_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$, which is $(1-s_E)f_E$ times the cost of effective labor.

Firms' Production Location and Market Decisions

The structure of firms' offshoring decisions is based on Zlate (2016), with the main difference being that there are two types of labor in our setting. There is one final-good sector.[9] Firms are all final-good producers with heterogeneity in their productivities, each producing a different variety of the final goods. Production of the final good requires two tasks – y_h and y_l. Task y_h

[9] In the same spirit as Melitz (2003), the model is best thought of as that of the tradable sector, part of which turns out to be non-traded in equilibrium.

uses high skilled labor only and task y_l uses low skilled labor only. The production function is assumed to take the following form: $y_t(z) = [y_{h,t}(z)]^{\alpha} [y_{l,t}(z)]^{1-\alpha}$.[10]

The high and low-skilled endowments of each country are set up to deliver a cost relationship, where some firms in the North have incentive to offshore the low-skilled task to the South, to utilize the associated cost advantage. Similarly, some firms in the South have incentive 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 Strategies for Firms in the North

For a firm in the North, if it decides to produce both tasks domestically, then $y_{h,t}(z) = zZ_t h_t(z)$ and $y_{l,t}(z) = zZ_t l_t(z)$. If the firm instead decides to offshore the low-skilled task, $y_{h,t}(z) = zZ_t h_t(z)$ but $y_{l,t}(z) = zZ_t^* l_t^*(z)$. Offshoring the low-skilled task to the South incurs an iceberg cost τ^V, which is reflected on the cost side of firm's profit maximization problem. Therefore, the output of producing both tasks domestically is $y_{D,t}(z) = zZ_t [h_t(z)]^{\alpha} [l_t(z)]^{1-\alpha}$. In contrast, keeping the high-skilled task produced in-house and offshoring the low-skilled tasks generates output $y_{V,t}(z) = z [Z_t h_t(z)]^{\alpha} [Z_t^* l_t^*(z)]^{1-\alpha}$.

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 productivities Z_t and Z_t^*. For the firms in the North, the marginal costs of production for the two strategies then follow — $mc_{D,t}(z) = \frac{1-s_D}{Z_t z} \left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha} \left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$ for domestically producing firms, where s_D stands for the production subsidy 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 $mc_{V,t}(z) = \frac{1}{z} \left(\frac{(1+\tau^{IM})\tau^V Q_t w_{l,t}^*}{Z_t^*(1-\alpha)}\right)^{1-\alpha} \left(\frac{w_{h,t}}{Z_t \alpha}\right)^{\alpha}$, where $w_{l,t}$ is the real wage for low-skilled labor and $w_{h,t}$ is the real wage for high-skilled labor. Similarly, $w_{l,t}^*$ is the real wage for the Southern low-skilled labor. The monopolistically competitive firms maximize profits for the

[10]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, $y_{V,t} = \left[\frac{Z_t z l_t}{\alpha}\right]^{\alpha} \left[\frac{Z_t^* z l_t^*}{1-\alpha}\right]^{1-\alpha}$.

two different production strategies:

$$\max_{\rho_{D(z)}} d_{D,t}(z) = \rho_{D,t}(z)y_{D,t}(z) - mc_{D,t}(z)y_{D,t}(z) \tag{6}$$

$$\max_{\rho_{V(z)}} d_{V,t}(z) = \rho_{V,t}(z)y_{V,t}(z) - mc_{V,t}(z)y_{V,t}(z) - f_V \frac{Q_t}{Z_t^*}\left(\frac{w_{l,t}^*}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}^*}{\alpha}\right)^{\alpha} \tag{7}$$

where $\rho_D(z)$ and $\rho_V(z)$ are the real prices of the two production strategies. $Q_t \equiv \varepsilon_t P_t^*/P_t$ is the consumption-based real exchange rate (ε_t is the nominal exchange rate). Offshoring firms also need to pay the fixed offshoring cost f_V 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 hire workers from Southern labor market to cover these fixed offshoring costs. Therefore, the fixed offshoring cost is $f_V \frac{Q_t}{Z_t^*}\left(\frac{w_{l,t}^*}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}^*}{\alpha}\right)^{\alpha}$ 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 $y_{D,t}(z) = \rho_{D,t}(z)^{-\theta}C_t$ and $y_{V,t}(z) = \rho_{V,t}(z)^{-\theta}C_t$. Prices are at a markup over marginal costs, with pricing conditions: $\rho_{D,t}(z) = \frac{\theta}{\theta-1}mc_{D,t}(z)$ and $\rho_{V,t}(z) = \frac{\theta}{\theta-1}mc_{V,t}(z)$. Profits are $d_{D,t}(z) = \frac{1}{\theta}\rho_{D,t}(z)^{1-\theta}C_t$ for domestic production and $d_{V,t}(z) = \frac{1}{\theta}\rho_{V,t}(z)^{1-\theta}C_t - f_V \frac{Q_t}{Z_t^*}\left(\frac{w_{l,t}^*}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}^*}{\alpha}\right)^{\alpha}$ for offshoring the low-skilled task.

The offshoring cutoff $z_{V,t}$ is pinned down by equalizing profits of the two strategies for firms' production: $z_{V,t} = \{z | d_{D,t}(z_{V,t}) = d_{V,t}(z_{V,t})\}$. It indicates that at this productivity level $z_{V,t}$, 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 yields 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.

In order to ensure the existence of the offshoring cutoff, the slope of offshoring profit function must exceed the slope of domestic profit function. This gives the following condition:

$$\tau^{V}(1+\tau^{IM})\,(1-s_D)^{\frac{1}{\alpha-1}}\,TOL_l < 1 \tag{8}$$

where $TOL_l = \frac{Q_t w^*_{l,t}/Z^*_t}{w_{l,t}/Z_t}$ stands for the ratio between the cost of effective low-skill labor in the South and the North 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 the North still finds it profitable to offshore these tasks abroad amidst all the industrial policies driven by geoeconomic tension.

Production Location Strategies for Firms in the South

Similarly, for a firm in the South, if it decides to produce both tasks domestically, then $y^*_{D,t}(z) = zZ^*_t\,[h^*_t(z)]^{\alpha}\,[l^*_t(z)]^{1-\alpha}$. The South offshoring firms share a very similar production with North offshoring firms, the only difference comes from the fact that now the offshoring of high-skilled task to the North will incur iceberg cost τ^{V*}, which is reflected on the cost side of firm's profit maximization problem. The corresponding marginal costs of production for the two strategies then follow — $mc^*_{D,t}(z) = \frac{1-s^*_D}{Z^*_t z}\left(\frac{w^*_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w^*_{h,t}}{\alpha}\right)^{\alpha}$ for domestically producing firms. The marginal cost of offshoring firms is $mc^*_{V,t}(z) = \frac{1}{z}\left(\frac{w^*_{l,t}}{Z^*_t(1-\alpha)}\right)^{1-\alpha}\left(\frac{(1+\tau^{IM*})\tau^{V*}Q_t^{-1}w_{h,t}}{Z_t\alpha}\right)^{\alpha}$. The monopolistically competitive firms set optimal prices to maximize profits for the two different production strategies:

$$\max_{\rho^*_{D(z)}} d^*_{D,t}(z) = \rho^*_{D,t}(z)y^*_{D,t}(z) - mc^*_{D,t}(z)y^*_{D,t}(z)$$
$$\max_{\rho^*_{V(z)}} d^*_{V,t}(z) = \rho^*_{V,t}(z)y^*_{V,t}(z) - mc^*_{V,t}(z)y^*_{V,t}(z) - f^*_V\frac{Q_t^{-1}}{Z_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$$

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

$$(\tau^{V*})^{-1}(1+\tau^{IM*})^{-1}(1-s^*_D)^{\frac{1}{\alpha}}\,TOL_h > 1 \tag{9}$$

where $TOL_h = \frac{Q_t w^*_{h,t}/Z^*_t}{w_{h,t}/Z_t}$ 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 the South still finds it profitable to offshore these tasks abroad in the midst of all the geoeconomic tensions generated by industrial policies. We will set the high-skilled and low-skilled endowment of labor of each country such that both condition (8) and condition (9) are satisfied.

Exporting

Firms in the North and the South 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 $l_{X,t}(z)$ and $h_{X,t}(z)$, generating output $y_{X,t}(z) = zZ_t\left[h_{X,t}(z)\right]^{\alpha}\left[l_{X,t}(z)\right]^{1-\alpha}$. The Southern exporters produce output in a similar fashion, $y^*_{X,t}(z) = zZ^*_t\left[h^*_{X,t}(z)\right]^{\alpha}\left[l^*_{X,t}(z)\right]^{1-\alpha}$. Profit maximization implies that the price of exports for a firm with productivity level z is $\rho_{X,t}(z) = \frac{\theta}{\theta-1}\frac{\tau Q_t^{-1}}{zZ_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$, with $\tau > 1$ representing a melting-iceberg trade cost. Notice that $\rho_{X,t}(z)$ is the dock export price, i.e. it does not include Southern import tariff. The profit function is thus given by: $d_{X,t}(z) = \frac{1}{\theta}(1+\tau^{IM*})^{-\theta}\rho_{X,t}(z)^{1-\theta}C^*_t Q_t - \frac{f_X}{Z_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$, where C^*_t is aggregate consumption in the South, τ^{IM*} is the ad-valorem tariff imposed by South on North exporters' sales. In terms of a firm's export decisions, a firm will export if and only if the export profit it would earn is nonnegative, giving export cutoff for firms of $z_{X,t} = \inf\{z|d_{X,t}(z) > 0\}$. Firms with productivity level above the export cutoff $z_{X,t}$ choose to export whereas firms with productivity level below $z_{X,t}$ choose to serve the domestic market only.

2.3 Averages

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

Average Productivities

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 $N_{D,t}$ firms, whose idiosyncratic productivities are below the offshoring cutoff $z_{\min} < z_t < z_{V,t}$, that produce both tasks domestically. Then there are $N_{V,t}$ firms with productivity levels above the cutoff $z_t > z_{V,t}$ that choose to offshore. We denote average productivity of domestically producing firms as $\tilde{z}_{D,t}$ and that of offshoring firms as $\tilde{z}_{V,t}$. The average productivity levels follow as:

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

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

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

where $\nu = \left[\frac{k}{k-(\theta-1)}\right]^{\frac{1}{\theta-1}}$, $k > \theta - 1$,[11] and the cutoff is $z_{V,t} = z_{\min} \left(N_t / N_{V,t}\right)^{1/k}$.

Similarly, in the South, the average productivity for the firms which produces both tasks domestically and the average productivity for those which offshore the high-skilled task to the North are:

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

where $z_{V,t}^*$ is the offshoring productivity cutoff for firms in the South.

The average productivity of exporting firms in the North and the South are:

$$\tilde{z}_{X,t} = \nu z_{\min} \left(\frac{N_t}{N_{X,t}}\right)^{1/k} \text{ and } \quad \tilde{z}_{X,t}^* = \nu z_{\min}^* \left(\frac{N_t^*}{N_{X,t}^*}\right)^{1/k}$$

Average Price Indices

The average price indices for the North and the South follow as

$$1 = N_{D,t} \left(\tilde{\rho}_{D,t}\right)^{1-\theta} + N_{V,t} \left(\tilde{\rho}_{V,t}\right)^{1-\theta} + N_{X,t}^* \left((1+\tau^{IM})\tilde{\rho}_{X,t}^*\right)^{1-\theta}$$
$$1 = N_{D,t}^* \left(\tilde{\rho}_{D,t}^*\right)^{1-\theta} + N_{V,t}^* \left(\tilde{\rho}_{V,t}^*\right)^{1-\theta} + N_{X,t} \left((1+\tau^{IM*})\tilde{\rho}_{X,t}\right)^{1-\theta}.$$

[11] In Section 4, when we discuss the welfare implications of industrial policies, we further restrict $k > \theta$, which ensures $k > \theta - 1$ and a meaningful discussion of the relevant welfare channels.

Average Profits

The total profits of firms in the two countries are $N_t\tilde{d}_t = N_{D,t}\tilde{d}_{D,t} + N_{V,t}\tilde{d}_{V,t} + N_{X,t}\tilde{d}_{X,t}$ and $N_t^*\tilde{d}_t^* = N_{D,t}^*\tilde{d}_{D,t}^* + N_{V,t}^*\tilde{d}_{V,t}^* + N_{X,t}^*\tilde{d}_{X,t}^*$. The linkages between the average profit of offshoring and that of domestically producing both tasks are:

$$\tilde{d}_{V,t} = \frac{k}{k-(\theta-1)}\left(\frac{z_{V,t}}{\tilde{z}_{D,t}}\right)^{\theta-1}\tilde{d}_{D,t} + \frac{\theta-1}{k-(\theta-1)}f_V\frac{Q_t}{Z_t^*}\left(\frac{w_{l,t}^*}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}^*}{\alpha}\right)^{\alpha}$$
$$\tilde{d}_{V,t}^* = \frac{k}{k-(\theta-1)}\left(\frac{z_{V,t}^*}{\tilde{z}_{D,t}^*}\right)^{\theta-1}\tilde{d}_{D,t}^* + \frac{\theta-1}{k-(\theta-1)}f_V^*\frac{Q_t^{-1}}{Z_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}.$$

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 $z_{X,t}$ obtains zero profits from exporting, the average profits from exports can be expressed as:

$$\tilde{d}_{X,t} = \frac{\theta-1}{k-(\theta-1)}\frac{f_X}{Z_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$$
$$\tilde{d}_{X,t}^* = \frac{\theta-1}{k-(\theta-1)}\frac{f_X^*}{Z_t}\left(\frac{w_{l,t}^*}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}^*}{\alpha}\right)^{\alpha}.$$

2.4 Closing the Model

There are labor market clearing conditions for both high-skilled and low-skilled labor, governments in both countries balance their budgets, aggregate accounting across households and balance of international payments. A full summary of the model equations is in Table A.1.

Labor Market

Here we explicitly set out the high-skilled labor market clearing conditions, noting that those for the low-skilled will be implicitly implied by all other equilibrium conditions in the model. Denote $\tilde{h}_{D,t}$ as the amount of high-skilled labor used by the representative domestically producing firms that serve 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 conditions for the two countries then are:

$$
\begin{aligned}
H =& N_{D,t}\tilde{h}_{D,t} + N_{X,t}\tilde{h}_{X,t} + N_{V,t}\tilde{h}_{V,t} + N^*_{V,t}\tilde{h}^*_{V,t}\tau^{V*} \\
&+ \left(N_{E,t}\frac{f_E}{Z_t} + N_{X,t}\frac{f_X}{Z_t} + N^*_{V,t}\frac{f^*_V}{Z_t}\right)\left(\frac{\alpha w_{l,t}}{(1-\alpha)w_{h,t}}\right)^{1-\alpha} \\
H^* =& N^*_{D,t}\tilde{h}^*_{D,t} + N^*_{X,t}\tilde{h}^*_{X,t} + \left(N^*_{E,t}\frac{f^*_E}{Z^*_t} + N^*_{X,t}\frac{f^*_X}{Z^*_t} + N_{V,t}\frac{f_V}{Z^*_t}\right)\left(\frac{\alpha w^*_{l,t}}{(1-\alpha)w^*_{h,t}}\right)^{1-\alpha}
\end{aligned}
$$

Northern high-skilled labor is used for production by domestically-producing firms (serving either the domestic or export market), Northern offshoring firms and Southern offshoring firms, as well as for sunk entry costs, fixed exporting costs and fixed offshoring costs.[12] In contrast, the Southern high-skilled labor is used for production by only the domestically producing firms and for sunk entry costs, fixed exporting costs and fixed offshoring costs. Similarly, the low-skilled labor market clearing conditions for the two countries are:

$$
\begin{aligned}
L_t =& N_{D,t}\tilde{l}_{D,t} + N_{X,t}\tilde{l}_{X,t} + \left(N_{E,t}\frac{f_E}{Z_t} + N_{X,t}\frac{f_X}{Z_t} + N^*_{V,t}\frac{f^*_V}{Z_t}\right)\left(\frac{(1-\alpha)w_{h,t}}{\alpha w_{l,t}}\right)^{\alpha} \\
L^*_t =& N^*_{D,t}\tilde{l}^*_{D,t} + N^*_{X,t}\tilde{l}^*_{X,t} + N_{V,t}\tilde{l}_{V,t}\tau^V + N^*_{V,t}\tilde{l}^*_{V,t} \\
&+ \left(N^*_{E,t}\frac{f^*_E}{Z^*_t} + N^*_{X,t}\frac{f^*_X}{Z^*_t} + N_{V,t}\frac{f_V}{Z^*_t}\right)\left(\frac{(1-\alpha)w^*_{h,t}}{\alpha w^*_{l,t}}\right)^{\alpha}.
\end{aligned}
$$

Government

The Northern government keeps a balanced budget for each period:

$$
\begin{aligned}
&\tau^V\tau^{IM}N_{V,t}w^*_{l,t}\tilde{l}_{V,t}Q_t + \tau^{IM}N^*_{X,t}\tilde{\rho}^*_{X,t}[(1+\tau^{IM})\tilde{\rho}^*_{X,t}]^{-\theta}C_t \\
&= s_E N_{E,t}\frac{f_E}{Z_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha} + s_D N_{D,t}\tilde{\rho}^{-\theta}_{D,t}C_t\frac{1}{Z_t\tilde{z}_D}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha} + T_t,
\end{aligned} \tag{10}
$$

which states that the revenue generated from imposing tariffs on offshoring imports and final exports must be equal to the sum of entry subsidy, production subsidy and transfer to the households in each period. Similarly, the balanced budget for the Southern government is

[12] With a slight abuse of notation, we define the South's demand of high-skill labor from North as $\tilde{h}^*_{V,t}$. A similar definition is also made for North's demand of low-skill labor from South.

given by:

$$
\begin{aligned}
&\tau^{V*}\tau^{IM*}N^*_{V,t}w_{h,t}\tilde{h}^*_{V,t}Q_t^{-1} + \tau^{IM*}N_{X,t}\tilde{\rho}_{X,t}[(1+\tau^{IM*})\tilde{\rho}_{X,t}]^{-\theta}C^*_t \\
&= s^*_E N^*_{E,t}\frac{f^*_E}{Z^*_t}\left(\frac{w^*_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w^*_{h,t}}{\alpha}\right)^{\alpha} + s^*_D N^*_{D,t}\tilde{\rho}^{*-\theta}_{D,t}C^*_t\frac{1}{Z^*_t\tilde{z}^*_D}\left(\frac{w^*_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w^*_{h,t}}{\alpha}\right)^{\alpha} + T^*_t.
\end{aligned} \tag{11}
$$

Aggregate Accounting

Aggregating the budget constraint (1) across Northern households and imposing the equilibrium conditions of bonds and shares ($B_{t+1} = B_t = 0$ and $x_{t+1} = x_t = 1$) yields the aggregate accounting equation $C_t = w_{l,t}L + w_{h,t}H + T_t + N_t\tilde{d}_t - N_{E,t}\tilde{v}_t$. A similar equation holds in the South. Consumption in each period must equal labor income plus government transfer plus investment income net of the cost of investing in new firms.

Balance of 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:

$$
TB_t = N_{V,t}f_V\frac{Q_t}{Z^*_t}\left(\frac{w^*_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w^*_{h,t}}{\alpha}\right)^{\alpha} - N^*_{V,t}f^*_V\frac{1}{Z_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}.
$$

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

$$
\begin{aligned}
TB_t \equiv\ & \underbrace{N_{X,t}\tilde{\rho}_{X,t}\left((1+\tau^{IM*})\tilde{\rho}_{X,t}\right)^{-\theta}C^*_tQ_t}_{\text{Regular exports}} + \underbrace{\tau^{V*}N^*_{V,t}w_{h,t}\tilde{h}^*_{V,t}}_{\text{Offshoring exports}} \\
& - \underbrace{\tau^{V}N_{V,t}w^*_{l,t}\tilde{l}_{V,t}Q_t}_{\text{Offshoring imports}} - \underbrace{N^*_{X,t}\tilde{\rho}^*_{X,t}\left((1+\tau^{IM})\tilde{\rho}^*_{X,t}\right)^{-\theta}C_t}_{\text{Regular imports}}.
\end{aligned} \tag{12}
$$

Model Summary

The equations listed above constitute a system of 57 equations in 57 endogenous variables: C_t, r_t, $\tilde{v}_t$, $\tilde{d}_t$, $w_{l,t}$, $w_{h,t}$, N_t, $N_{E,t}$, $N_{D,t}$, $N_{V,t}$, $N_{X,t}$, $\tilde{\rho}_{D,t}$, $\tilde{\rho}_{V,t}$, $\tilde{\rho}_{X,t}$, T_t, $\tilde{d}_{D,t}$, $\tilde{d}_{V,t}$, $\tilde{d}_{X,t}$, $\tilde{z}_{D,t}$, $z_{V,t}$, $\tilde{z}_{V,t}$, $\tilde{z}_{X,t}$, $\tilde{h}_{D,t}$, $\tilde{h}_{V,t}$, $\tilde{h}_{X,t}$, $\tilde{l}_{D,t}$, $\tilde{l}_{V,t}$, $\tilde{l}_{X,t}$, their Southern counterparts and the real exchange rate Q_t. We list all the model equations in Appendix A and describe our computation methods in detail in Appendix B.

3 Calibration

We interpret the skill-abundant North as the United States and the skill-scarce South as China. Our model and calibration are developed with a view towards demonstrating the mechanisms of firm entry and comparative advantage of producing different tasks in driving the welfare trade-offs across different time horizons and the distributional implications. For this reason, we keep the asymmetries across the two countries to a minimum.

In particular, we take one period in the model to be a quarter and set the discount factor $\beta = 0.99$ to match an average annualized interest rate of 4%. We set the (inverse) intertemporal elasticity $\gamma = 2$, a standard choice for quarterly business cycle models. Following Ghironi and Melitz (2005), we set the elasticity of substitution between varieties to be $\theta = 3.8$. Following Zlate (2016), the shape parameter of productivity distribution taken as $k = 4.2$ and the physical iceberg cost is set to $\tau = 1.3$. We set the quarterly death rate of firms $\delta = 0.025$, which is consistent with the yearly exit rates reported in U.S. firm data around of 10% (see Tian (2018)). We set the production function parameter $\alpha = 0.4$, which implies the wage share of high skilled workers to be 40%.

The set of parameters $\{f_X, f_X^*, f_V, f_V^*\}$ are calibrated internally using a simulated method of moments procedure to ensure the model reproduces data moments relating to participation margins for exporting and offshoring. Specifically, we minimize a quadratic loss function to match data targets of 9% for exporting and 1% for offshoring, which are the steady-state values obtained in Zlate (2016) in each country. This process yields values of $f_V = 0.2919$ and $f_X = 0.1428$ for the North and $f_V^* = 0.2846$ and $f_X^* = 0.1445$ for the South. The sunk cost of entry in the North f_E is chosen to normalize the high-skilled wage in the North to unity; we then take the counterpart in the South to be identical $f_E^* = f_E$.

The main source of asymmetry between the North and the South in the calibration is the relative endowments of the two types of labor. To reflect the context of US and China, we follow Lechthaler and Mileva (2021) to use the average production workers to managers ratio over 1990 and 2005 for the US as 3.5 to 1, and China as 9.5 to 1, respectively, to set the relative endowments of low-skill to high-skill labor, while the total endowment is normalized to unity. Together with the choices of other parameters, this ensures the offshoring conditions for both the North and the South are met. Thus, in our model offshoring occurs endogenously due to the comparative advantage in producing different tasks driven by the different relative endowment of labor.

Lastly, the three policy instruments in each country (import tariff, production subsidy and entry subsidy) are assumed to follow an AR(1) process. To make the comparison of the dynamic effects across these policy instruments transparent, we set the persistence parameters (ζ) to be the same $\zeta = 0.56$ as in Barattieri, Cacciatore and Ghironi (2021). The steady-state values of these instruments are set to reflect no government intervention. Table 1 summarizes the calibration.

Parameter	Meaning	Value	Source/target
β	discount factor	0.9900	average interest rate
γ	(inverse) intertemporal elasticity	2.0000	Ghironi and Melitz (2005)
θ	elasticity of substitution between varieties	3.8000	Ghironi and Melitz (2005)
k	shape parameter of productivity distribution	4.2000	Zlate (2016)
τ	melting-iceberg trade cost	1.3000	Ghironi and Melitz (2005)
$z_{\min}$	lower bound of productivity	1.0000	normalization
δ	exogenous firm exit shock	0.0250	firm exit rate
α	skill intensity in production	0.4000	wage share of high-skilled
τ^V	iceberg friction on offshoring	1.0000	normalization
Z	steady state aggregate productivity	1.0000	normalization
ζ	persistence of policy process	0.5600	Barattieri, Cacciatore and Ghironi (2021)
H	endowment of high-skilled labor in North	0.2220	US production workers to managers ratio
L	endowment of low-skilled labor in North	0.7780	US production workers to managers ratio
H^*	endowment of high-skilled labor in South	0.0955	China production workers to managers ratio
L^*	endowment of low-skilled labor in South	0.9045	China production workers to managers ratio
f_V	fixed cost of offshoring in North	0.2919	fraction offshoring firms (1% data, 1% model)
f_V^*	fixed cost of offshoring in South	0.2846	fraction offshoring firms (1% data, 1% model)
f_X	fixed cost of exporting in North	0.1428	fraction exporting firms (9% data, 9% model)
f_X^*	fixed cost of exporting in South	0.1445	fraction exporting firms (9% data, 9% model)
f_E	sunk entry cost	5.8887	normalization of high-skilled wage N
τ^{IM}	import tariff	0.0000	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

4 Industrial Policies Amidst Geoeconomic Tensions

In this section, we investigate the dynamic and welfare effects of various industrial policies by solving for the transitional dynamics of the model to a first-order approximation around the deterministic steady state. We begin by looking at the impulse responses of the model, following a one-time shock of each industrial policy. We then explore the welfare implications of unilateral policy actions over varying time horizons. Having established the quantitative and qualitative motives for unilateral policy actions, we then move to explore the welfare effects of bilateral policy actions, designed to resemble policy wars. To ensure comparability of shock sizes, we implement initial shocks that hold the net present value of the fiscal impact, along the entire transition path, equal to one percent of steady state aggregate world consumption.

4.1 Impulse responses

In this subsection, we focus on describing the impulse responses to individual policy instruments implemented by the North, as illustrated in Figure 2; the impulse responses to those implemented by the South are relegated to Figure A.1 in the Appendix.

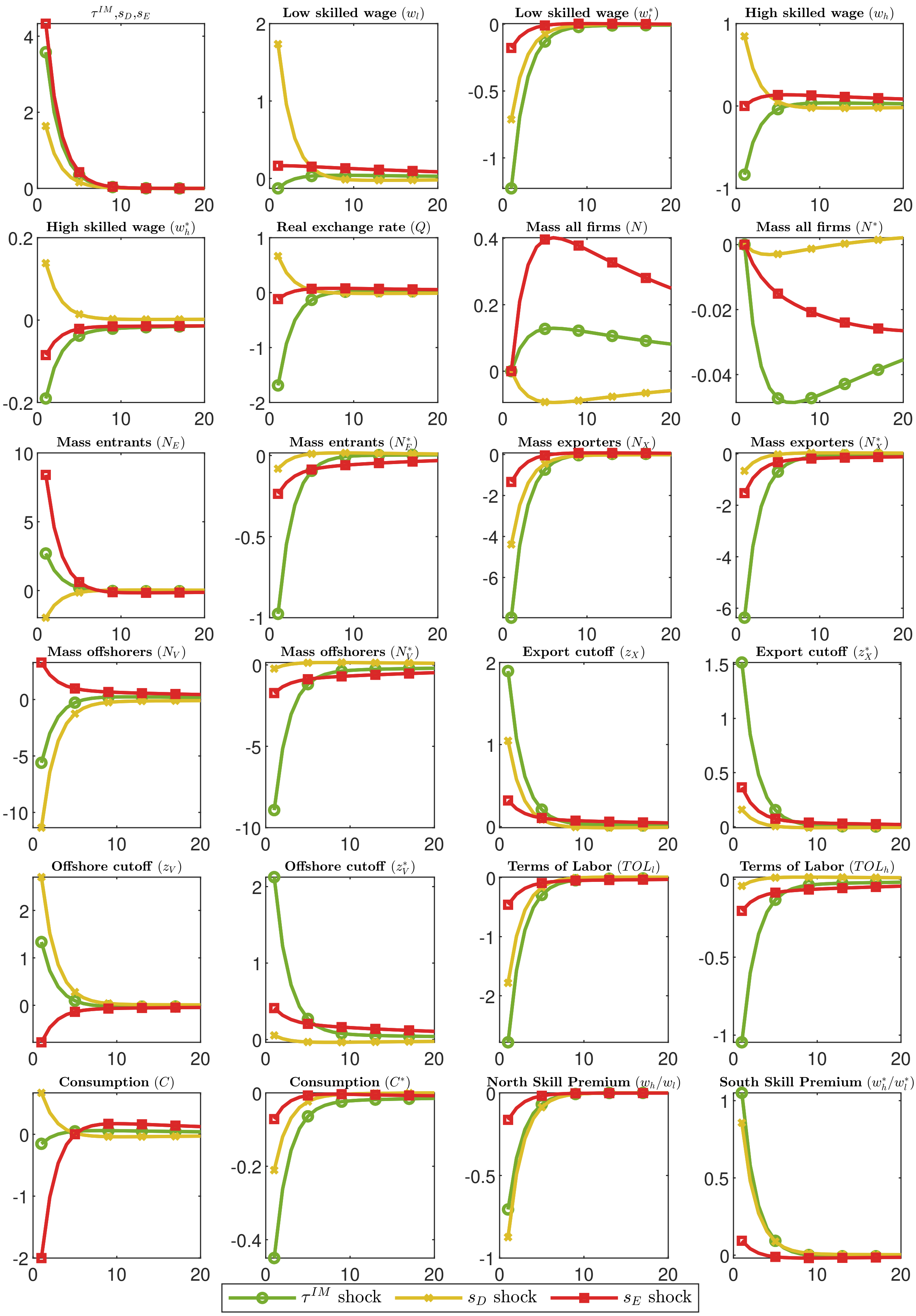


Figure 2. Impulse responses of North and South variables to NPV 1% of world consumption shock to individual policy instruments in the North. The policy instrument is presented as absolute percentage points, while all other variables are presented as percentage deviations from the initial steady state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

4.1.1 North increases import tariff τ^{IM}

The increase in the North's tariff makes the imported Southern varieties more costly to the Northern consumers, thus reducing their the demand for imported goods. It in turn implies an increase in the export cutoff (z_X^*) and a drop in the number of exporters (N_X^*) in the South. Meanwhile, the real exchange rate (Q) appreciates (fall) in response to the decline in the demand for imported Southern goods, which makes Northern exporters less competitive, thus also leading to a rise in the export cutoff (z_X) and a drop in the number of exporters (N_X) in the North.

The higher tariff also raises the cost of importing low-skilled task from the South faced by the Northern offshoring firms. As a result, the offshoring cutoff (z_V) increases and the number of offshoring firms (N_V) drops in the North. This subsequently reduces the demand for Southern low-skilled labor and therefore their wage (w_l^*). As the low-skilled labor previously employed by Northern offshoring firms being reabsorbed into domestic firms, they tend to increase the marginal product of high-skilled labor and impose upward adjustment pressure on their wage (w_h^*). Although less demand for Southern exports tends to reduce the wages of Southern high and low skilled workers, the magnitude of the former change is much less than the latter, translating into a higher skill premium. Meanwhile, the appreciation of the real exchange rate implies that the terms of labor for high-skilled (TOL_h) appreciates (fall). It raises the cost of offshoring high-skilled task to the North for the Southern offshoring firms, thus causing a rise in the offshoring cutoff (z_V^*) and a drop in the number of offshoring firms (N_V^*) in the South. Analogously, this decreases the demand for Northern high-skilled labor and significantly lowers their wage while the low-skilled wage only declines slightly, resulting in a fall in the skill premium of the North.

Due to the higher average price (inclusive of tariff) of imported goods, the households in the North increase their demand for domestic goods (expenditure switching effect). This raises the profitability of the firms serving the domestic markets, inducing more firm entry. As firm entry demands investment, resources left for consumption decline on impact. However, as more firms/varieties are being created, consumption gradually rises, given love of variety preferences. For the South, lower demand for its exports reduces the profitability of its firms, discouraging firm entry, and the number of firms drops. Moreover, as market share is reallocated towards less efficient domestic firms, it tends to depress the real income of its households. This, coupled with the higher average price of imports driven by the change in the real exchange rate, reduces the consumption in the South.

4.1.2 North increases domestic production subsidy s_D

The increase in the production subsidy in the North reduces the marginal cost of production for the domestic firms, which raises their profits. As producing domestically and serving the domestic markets becomes more profitable, the cutoff values of both offshoring (z_V) and export (z_X) rise and the numbers of offshoring firms and exporters drop. In this sense, production subsidy induces firms to reshore.[13]

More domestic production increases the demand for labor, which drives up both the low-skilled and high-skilled wages (w_l, w_h), with the former increasing relatively more as some offshoring firms reshore their low-skilled task. At the same time, the significant decline in the number of offshoring firms in the North (N_V) reduces the demand for Southern low-skilled labor, which imposes downward adjustment pressure on their wages (w_l^*). However, as these low-skilled workers are reabsorbed by Southern domestic and exporting firms, they drive up the marginal product of high-skilled labor, thus increasing their wage (w_h^*). Changes in these wages imply a decline in the skill premium of the North but a rise in that of the South.

Lastly, higher wages in the North increase the cost of firm entry, driving down the number of new entrants (N_E) on impact. As investment in firm entry declines, it leaves more resources for consumption for the Northern households in the short run. In contrast, the higher price of imported goods and the decline in the low-skilled wage in the South depress Southern consumption.

4.1.3 North increases domestic entry subsidy s_E

The increase in the entry subsidy of the North immediately encourages firm entry (N_E) and leads to a sharp increase in the number of firms in the North (N) in the several quarters after the shock. In order to finance the creation of new firms, Northern consumption (C) declines. Since firm entry tends to raise the demand for labor, it causes a slight appreciation (fall) in both TOL_l and TOL_h. The appreciation of TOL_l makes offshoring low-skilled tasks to the

[13] The domestic production subsidy is only granted to domestic firms that both produce and sell domestically; offshoring firms and exporters do not receive it.

South more profitable, which results in a drop in the North offshoring cutoff (z_V) and a rise in the North offshoring firms (N_V). Meanwhile, the appreciation of TOL_h makes offshoring the high-skilled task to the North less profitable, and it leads to a rise in the South offshoring cutoff (z_V^*) and a drop in the number of South offshoring firms (N_V^*).

As the costs of effective low- and high-skilled labor become lower in the South relative to the North, it makes the exporters in the North less competitive, implying a small rise in the export cutoff in the North (z_X) and a slight drop in the number of North exporters (N_X). While this tends to bolster the competitiveness of Southern exporters, the reduction in Northern consumption (hence the reduction in demand for imported goods from the South) has the opposite effect and dominates. As such, we observe an increase in the South export cutoff (z_X^*) and a drop in the number of South exporters (N_X^*).

4.1.4 Overview and Policy Discussion

We summarize the above results by comparing the effectiveness of the three instruments to three specific goals of using industrial policies that are broadly discussed recently, in addition to addressing traditional market failures. One is to to create "good middle-class jobs" (Rodrik, 2022; Rodrik and Sabel, 2022), which may produce greater social cohesion and is closely related to reducing inequality. From the perspective of the North, all three policy instruments serve to reduce inequality as measured by the skill premium; the effects are particularly strong quantitatively for import tariff and production subsidy. Between the tariff and production subsidy, however, the latter reduces the skill premium by disproportionally raising the low-skilled wage while the former actually yields a slight decrease. In this sense, production subsidy is the most desirable instrument among the three to create "good middle-class jobs".

In our model, as alluded before, the effects on the skill premium are closely related to the endogenous selection of firms into offshoring. To better illustrate this point, we show the impulse responses of the skill premium in the scenario where we fix the offshoring cutoff to shut down endogenous selection into offshoring, alongside those in the baseline scenario in Figure A.5-A.7 in the Appendix for the three instruments respectively. The magnitudes of the changes in skill premium significantly alter when we shut down the endogenous selection into offshoring. For example, when we fix offshoring cutoff the decline in the skill premium upon impact of the tariff shock becomes only around one-third of that in the baseline.

Another commonly discussed goal is to prevent trading partner from acquiring key intermediate input (e.g. advanced semiconductor chips) perhaps due to national security concerns (Lane, 2025). In our context, one way to compare these instruments used by the North along this dimension is to look at their effects on the number of Southern firms engaging in offshoring high-skilled task ($N^*_{V,t}$). On impact, all three instruments reduce the number of Southern offshoring firms by raising the offshoring cutoff, and the effect is the strongest for import tariff. Along the transition, however, the effect of entry subsidy gradually becomes stronger than that of tariff due to higher persistence. An alternative way for comparison is to directly look at their effects on the value of Northern offshoring export ($\tau^{V*} N^*_{V,t} w_{h,t} \tilde{h}^*_{V,t}$). We plot the corresponding impulse responses in Figure A.2 in the Appendix. In contrast to the effects on the extensive margin, production subsidy raises the total value of high-skilled task exported to the South. For the other two instruments, though, it leads to similar results; import tariff offers the strongest effect on reducing this value on impact while the effect of entry subsidy gradually surpasses that of tariff along the transition. In other words, import tariff seems to be the most effective instrument among the three to prevent the trading partner from acquiring high-skilled input in the short run, but entry subsidy's effect is more persistent. Here again, it shows the importance of evaluating these policies from a dynamic perspective.

The third goal concerns boosting R&D (Bloom et al., 2019) which may generate strong spillover effects. To the extent that the process of firm/product creation can be a proxy to R&D, we can compare the three instruments also along this dimension based on our results. In particular, entry subsidy is directly relevant and the most effective. By reducing sunk entry costs—commonly viewed as expenditures related to product development (Melitz and Ottaviano, 2008)—entry subsidy substantially boosts product creation (N_E) and subsequently leads to a greater number of domestic varieties (N) for the North. Tariffs also encourage product creation through their protective effects, albeit to a lesser extent. Conversely, domestic subsidies bid up domestic wages, making it significantly more costly to create new firm/product in the market.

4.1.5 Sensitivity Analysis

To check the robustness of our results, we conduct a sensitivity analysis on some key parameters. These parameters include the policy process persistence (ζ), the elasticity of substitution across varieties (θ), the Pareto distribution shape parameter governing firm productivity dispersion (k), and the skill intensity in the firm's production function (α). Each parameter is varied by $\pm 10\%$ from its benchmark value. The impulse responses to the tariff shock of the main variables are presented in Appendix D.1–D.4. Note that changes to parameters θ, k, α all affect the deterministic steady state, leading to a change in the moments matched with the simulated method of moments process (fractions of offshoring and exporting firms). As such, we re-calibrate the fixed costs (f_V, f_V^*, f_X, f_X^*) with each robustness parameter change, thereby re-running the simulated method of moments process, to hold these export and offshoring fractions constant. Since ζ is only used along the transition after a shock, its robustness leaves the deterministic steady state unchanged. Similarly to the baseline exercises, we always adjust the policy shock sizes, such that the net present value of the fiscal effect is 1% of global consumption. Overall, the key macro variables behave similarly under alternative parameter values compared to the benchmark case.[14]

4.2 Welfare

In this subsection, we first define how we calculate welfare in our model with and without geoeconomic tensions triggered by our industrial policies, both in the short-run and in the long-run. We then explore the welfare implications of each unilateral industrial policy over varying time horizons. Finally, we study the welfare of bilateral individual policy (i.e. one policy each time) as a proxy for countries that engage in policy war against each other.

4.2.1 Welfare Metrics

We consider welfare in terms of the representative household from each country, in response to the initial shocks that hold the net present value of the fiscal impact, along the entire transition path, equal to one percent of steady state aggregate world consumption. The simulations of geoeconomic tension (henceforth GT) are designed such that the economy is shocked in period $t = 1$, where it then takes X periods to return to its initial steady state. To approximate the effect of policymaker myopia, we study several different policy horizons (T) — considering horizons of one year ($T = 4$), four years ($T = 16$) and the entire transition path ($T \to \infty$). When

[14] For brevity, we do not report sensitivity analyses for production and entry subsidies. The key conclusions remain unchanged relative to the tariff shock case, and full results are available upon request.

considering the whole transition, the lifetime utility measures with and without geoeconomic tension are given by

$$\mathbb{W}_0^{\mathrm{GT}}(T \to \infty) = \sum_{t=1}^{X} \beta^{t-1} \frac{C_t^{1-\gamma}}{1-\gamma} + \frac{\beta^X}{1-\beta} \times \frac{C_{X+1}^{1-\gamma}}{1-\gamma}$$
$$\mathbb{W}_0^{\mathrm{No\ GT}}(T \to \infty) = \frac{1}{1-\beta} \times \frac{C_0^{1-\gamma}}{1-\gamma}$$

where C_0 is North's consumption level without geoeconomic tension (i.e. in the pre-reform steady state). The expressions for South are defined similarly. For horizons $T < X$, we instead compute

$$\mathbb{W}_0^{\mathrm{GT}}(T) = \sum_{t=1}^{T} \beta^{t-1} \frac{C_t^{1-\gamma}}{1-\gamma}$$
$$\mathbb{W}_0^{\mathrm{No\ GT}}(T) = \frac{1-\beta^T}{1-\beta} \times \frac{C_0^{1-\gamma}}{1-\gamma}$$

where note that the same (full) transition path is computed as when $T \to \infty$, the policymaker simply disregards welfare information for longer time horizons. Note that there may be long-term costs that come with these policies, but myopic policymakers will abstract away from these when making their choices.

4.2.2 Unilateral Policies

In Table 2, we present the welfare effects of unilateral policies over different time horizons.[15] Consistent with the earlier results in this section, we observe that welfare inferences can differ markedly across considerations of short- and long-run horizons. For all unilateral policy actions, while the net welfare effect for the imposing country hinges on the time horizon, it is consistently beggar-thy-neighbor—meaning these policies harm the other country—across all horizons and policy instruments.

The use of tariffs (τ^{IM}) typically yields losses at short time horizon, as a sudden contraction in import and offshoring activity leads to limited consumption options for households. However, as more time goes by, positive effects from firm creation start to materialize, thereby leading to lifetime welfare gains for the tariff-imposing country. The finding that, over time, import tariffs lead to a welfare gain appears to contradict some recent literature. For instance, Boer

[15]See Figure A.3 for a graphical illustration of varying time horizons.

	Time horizon (T)		
	$T = 4$	$T = 16$	$T \to \infty$
τ^{IM}	(-0.0432, -0.2432)	(0.0286, -0.0848)	(0.0126, -0.0162)
s_D	(0.3189, -0.1105)	(0.0632, -0.0337)	(0.0035, -0.0046)
s_E	(-0.9247, -0.0362)	(-0.1450, -0.0133)	(0.0036, -0.0054)
τ^{IM*}	(-0.1685, -0.0757)	(-0.0679, 0.0410)	(-0.0149, 0.0190)
s_D^*	(-0.0889, 0.4166)	(-0.0278, 0.0831)	(-0.0038, 0.0047)
s_E^*	(-0.0486, -1.3121)	(-0.0235, -0.1931)	(-0.0089, 0.0102)

Table 2. Welfare for unilateral policy actions for North (top panel) and South (bottom panel). Numbers in parentheses are (welfare gain North, welfare gain South) expressed in consumption equivalent variation. Numbers are percentages (after multiplication by 100) of initial steady state consumption level.

and Rieth (2024) identify persistent negative effects of import tariffs on trade, investment, and output. While both frameworks incorporate tariff revenue rebates within an open-economy macroeconomic setting, two key distinctions exist. First, we restrict our analysis to temporary policy shocks of small sizes imposed on an initial state of economy free of interventions, thus shedding light on the incentives facing policymakers to use different instruments. Second, in our framework, sunk entry costs and the time-to-build mechanism imply gradual changes in the stock of firms which affect the consumer welfare through love-of-variety. Import tariffs protect domestic firms from foreign competition, increasing their profitability and inducing more firm entry, which enhances welfare, but the effect takes time to materialise.

Overwhelmingly, the production subsidy (s_D) is the strongest single instrument the two governments have at their disposal to increase domestic welfare with regard to short time horizons. This result comes from the fact that this is the only instrument that delivers a positive impact response of wages to both types of workers in the levying country. As the policy horizon is extended, from one to four years, the levying country's gains are driven down in magnitude before eventually turning just slightly above zero when accounting for the entire transition. This is mainly because production subsidy drives up the cost of firm entry, causing less variety to consume in the long run. In a recent paper, Du et al. (2023) find a negative aggregate productivity effect of state subsidies, driven by the fact that the adverse impact on non-subsidized firms outweighs the positive impact on subsidized firms. Our findings complement theirs, showing that while production subsidies benefit incumbents, they disadvantage potential entrants by raising entry costs. Nonetheless, the substantial short-term welfare benefits stem from rising wages and reduced costs of goods that outweigh the negative effects on firm entry and variety.

The entry subsidy (s_E) results in significant short-term welfare losses for the levying country. The initial cost required to support the surge in new firm entry imposes a substantial burden on household resources, with Northern losses reaching 0.92% over a one-year horizon from the Northern subsidy. A longer time horizon is needed for the benefits of an increased mass of firms to materialize; while welfare losses remain persistent in the short term, gains are eventually realized over an infinite horizon. Complementary to the static findings in Pflüger and Südekum (2013), which demonstrate that the unilateral optimal entry subsidy initially rises and then falls with increasing trade openness, our results suggest that even with trade freeness held constant, the welfare implications of entry subsidies vary between the short and long run due to the dynamic feature in our model.

4.2.3 Dissecting the Mechanisms

Here we aim to shed light on the drivers of our welfare results. We proceed in two steps. First, we decompose the consumption aggregator into a set of channels, which provide a transparent accounting of the period-by-period welfare effects. Secondly, we use this decomposition to discuss the underlying static distortions of the model environment and how each policy affects these channels over time.

Decomposing consumption. We follow Demidova and Rodríguez-Clare (2009) to rewrite consumption for each period as the product of the following four components (see detail steps in Appendix C.1):

$$C = \underbrace{Y_P}_{\text{Productivity Index}} \times \underbrace{\left[\frac{\frac{Y_X}{Y_P}}{\frac{Y_X^*}{Y_C}} \times \tilde{\text{TOT}} \times \frac{1}{\tau} \times (1-\Theta) \right]}_{\text{TOT Index}} \times \underbrace{M^{\frac{1}{\theta-1}}}_{\text{LOV Index}}$$
$$\times \underbrace{\frac{k-\theta}{k}\left(\frac{k}{k-\theta+1}\right)^{\frac{\theta}{\theta-1}} \left[\left(\frac{N_D}{M}\right)^{\frac{1}{\theta}} \left(\frac{Y_D}{Y_C}\right)^{\frac{\theta-1}{\theta}} \Gamma + \left(\frac{N_V}{M}\right)^{\frac{1}{\theta}} \left(\frac{Y_V}{Y_C}\right)^{\frac{\theta-1}{\theta}} + \left(\frac{N_X^*}{M}\right)^{\frac{1}{\theta}} \left(\frac{Y_X^*}{Y_C}\right)^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}}_{\text{Curvature}}$$

where $Y_P \equiv Y_D + Q_V + Y_X$ is the total quantity of output produced at home, stemming from home's domestic production ($Y_D \equiv \int_{\Omega_D} y(\omega)d\omega$), offshoring production that is accomplished at home ($Q_V \equiv \alpha Y_V = \alpha \int_{\Omega_V} y(\omega)d\omega$, high-skilled task), and home's export ($Y_X \equiv \int_{\Omega_X} y(\omega)d\omega$). $Y_C \equiv Y_D + Y_V + Y_X^*$ stands for the total quantity consumed by home consumers, which is composed of domestically produced varieties (Y_D), offshored varieties (Y_V) and foreign exports ($Y_X^* \equiv \int_{\Omega_X^*} y^*(\omega)d\omega$). M stands for the total number of varieties that home households consume, including domestically produced varieties (N_D), offshored varieties (N_V) and foreign exported varieties (N_X^*). Θ and Γ are two terms that adjust for the two-way offshoring setting in our model; see Appendix C.1 for their expressions.

As in Demidova and Rodríguez-Clare (2009), the first component is the productivity index (PROD) measured as total quantity of output per worker[16], the second component is the trade-adjusted terms of trade (TOT) index, the third component is the love of variety (LOV) index, and the last component is a curvature term (CURVE) that measures within and cross-country heterogeneity across varieties.[17] $\tilde{\text{TOT}} \equiv \varepsilon\tilde{p}_X/\tilde{p}_X^* = Q\tilde{\rho}_X/\tilde{\rho}_X^*$ is the average terms of trade as in Ghironi and Melitz (2005).

As the love-of-variety effect plays a critical role in our welfare analysis in the long run, we further decompose the LOV index as the following via log-linearization:

$$\widehat{M^{\frac{1}{\theta-1}}} = \underbrace{\frac{1}{\theta-1}\frac{N}{M}\hat{N}}_{\text{Domestic variety channel}} + \underbrace{\frac{1}{\theta-1}\frac{N_X^*}{M}\hat{N}_X^*}_{\text{Imported variety channel}}$$

where "hats" denote log deviations from steady state and N is the total number of domestic varieties ($N \equiv N_D + N_V$). It shows that changes in the LOV index are attributed to the contributions from both the domestic variety channel reflecting the effects of domestic firm entry and the imported variety channel driven by changes in the number of foreign exporters.

Distortions and dynamics. Policy instruments result in movements in the components of the above consumption decomposition. These movements are reflective of two interacting forces — static distortions and inter-temporal consumption smoothing. With regard to the static distortions, our theoretical framework builds-on the one-sector two-country Melitz model as in Felbermayr et al. (2013), which features three static distortions from the perspective of a unilateral policymaker:

- Markup distortion stemmed from monopolistic competition as in Gros (1987),

[16] Total endowment of workers is normalized to one in our calibration.

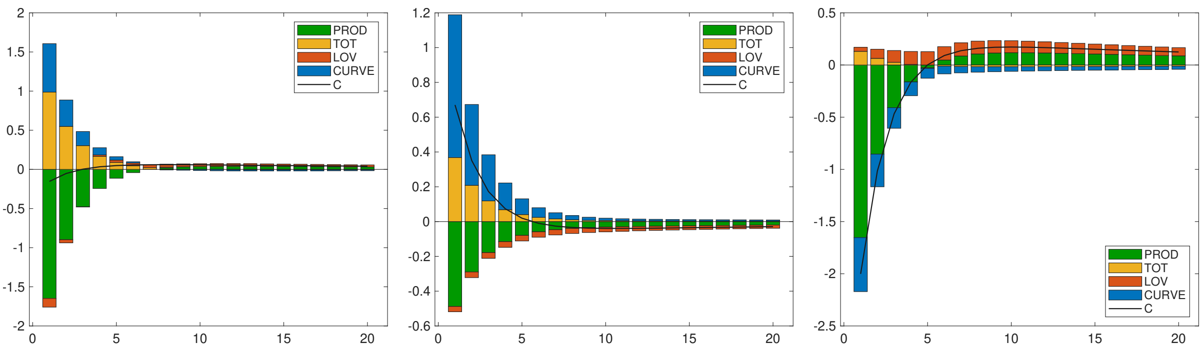
[17] As in Demidova and Rodríguez-Clare (2009), in the absence of any heterogeneity in prices within and across countries, households would consume the same quantity of each good, so the cross-country heterogeneity would equal to 1.

- Consumer surplus distortion from selection of foreign heterogeneous firms into export as in Demidova and Rodríguez-Clare (2009),[18]

- Classic terms-of-trade distortion.

The markup distortion creates a wedge between the private marginal cost and the social marginal cost of consumption for domestic varieties, resulting in the consumption of each domestic variety being sub-optimally low relative to imported variety (intensive margin). Consumer surplus distortion arises because consumers do not internalize how their purchases of foreign goods affect foreign firms' export decisions (extensive margin). The terms of trade externality relates to exercising monopsony importing power, thereby restricting the demand for imports from abroad, lowering their relative price and raising national income. These static distortions determine how policy affects consumption in a given period through the aforementioned decomposition components. Once policy is set, general equilibrium forces lead to changes in the firm cross-section, prices and wages, to which the household responds by choosing its optimal consumption profile through standard intra- and inter-temporal optimization.

The decomposition of consumption and the LOV index are presented in Figure 3 and 4. Since the productivity (PROD), terms-of-trade (TOT), and love-of-variety (LOV) channels are well established in the literature, we focus on these three for the purpose of interpretation and treat the curvature component as reflecting the combined effect of all other channels on consumption.[19] We first focus on the discussion of the short-run effects and then those along the transition.

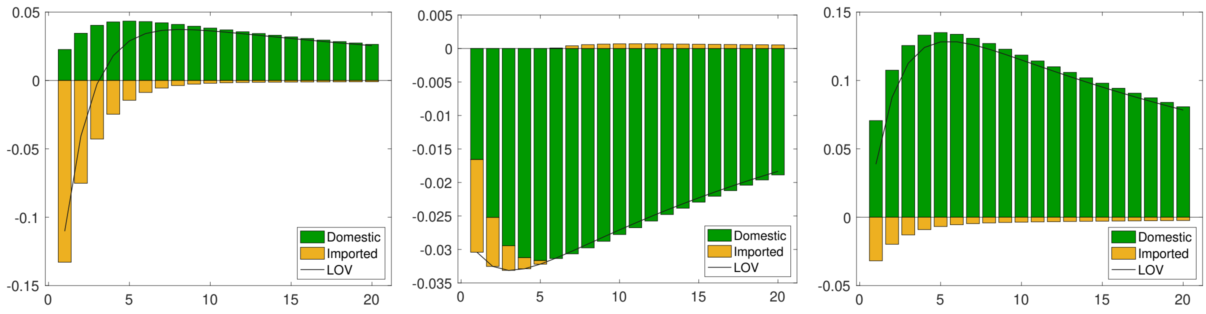


(a) Tariff shock (b) Subsidy D shock (c) Subsidy E shock

Figure 3. Decomposition of consumption with four components

[18]Felbermayr et al. (2013) term the consumer-surplus distortion as "entry distortion".

[19]The curvature component is needed to convert the productivity measure into something that matters for welfare as in Demidova and Rodríguez-Clare (2009); see footnote 13 of their paper.



(a) Tariff shock (b) Subsidy D shock (c) Subsidy E shock

Figure 4. Decomposition of LOV index in consumption

Starting from our calibrated steady state without policy interventions, a small increase in **import tariff** reallocates market shares toward less efficient local firms, thereby reducing aggregate productivity (PROD↓). However, tariff addresses the terms-of-trade externality via the standard monopsony-power mechanism (TOT↑). Additionally, by making foreign varieties relatively more expensive, it also induces households to rebalance their consumption portfolios towards domestic varieties, alleviating the markup distortion while worsening the consumer-surplus distortion, as reflected by a drop in the imported variety channel in panel (a) of Figure 4. Although the protective environment encourages households to invest in firm creation, its positive impact on variety (the domestic variety channel) is outweighed by the decline in the imported variety channel on impact (LOV↓). This, together with the sharp drop in aggregate productivity, offsets the static efficiency gains (from improvements in markup distortion and TOT externality), leading to a contraction in consumption in the short run.

A small increase in the **production subsidy** also reallocates market shares toward less productive domestic firms, as their marginal production costs are subsidized, thereby lowering aggregate productivity (PROD↓). Meanwhile, higher domestic production increases labor demand, leading to an appreciation in the terms of labor (TOL) and an improvement in the terms of trade (TOT↑). The resulting lower relative price of domestic varieties, similarly to the case of the tariff, expands their share in the consumption baskets, which mitigates the markup distortion but worsens the consumer-surplus distortion. However, the overall effect on the short-run consumption differs sharply from that of the tariff. The production subsidy drives up wages, which increases the firm entry cost. This, together with the lower price of domestic varieties, gives strong incentives for the households to increase their current consumption, while cutting investment in firm creation in the short run. This is manifested by the significant increase in the curvature term (CURVE↑), driven by the large increase in the share of domestic consumption.[20]

The **entry subsidy** operates quite differently. It has no direct effect on the markup distortion, given that it affects the extensive margin, however it acts to drive-up the TOL due to higher demand for labor, consequently resulting in an improvement in terms-of-trade (TOT↑), which offsets the efficiency loss due to worsening consumer-surplus distortion. By directly lowering entry costs, however, it induces households to invest significantly in firm creation but leaves fewer resources for final goods production, which significantly lowers Y_P (PROD↓) and accounts for the sharp decline in consumption on impact.

As argued above, these instruments differentially impact the incentives of households to engage in consumption smoothing via investment in firm creation. This translates into the different transition paths of their consumption profile. In particular, as the magnitudes of these instruments gradually decline according to the AR(1) processes, PROD and LOV indices become the main drivers of the welfare effect. Intuitively, this shows that changes in varieties due to sluggish entry of firms, and their associated impacts on aggregate productivity via reallocation of market shares, have long-lasting effects on welfare. While both indices contribute positively in the cases of tariff and entry subsidy, their contributions are negative in the case of the production subsidy. Thus, in our model, within-industry firm-level dynamics plays a critical role in shaping the time profile of the welfare effects across different instruments as shown in Table 2.

4.2.4 Bilateral Actions: Policy Wars

Given that recent unilateral protectionist episodes have typically been met with retaliation, we now explore the welfare effects of simultaneous policy episodes. Table 3 presents welfare numbers, at differing horizons, for all possible single-instrument combinations for North and South. One can take these numbers in the spirit of a policy war between the two countries.[21] There is considerable variation across combinations and time horizons, highlighting the need to use dynamic analysis when studying this particular question.

At both one and four year time horizons, using a production subsidy is the dominant policy

[20]The domestic share Y_D/Y_C increases substantially in the decomposition of CURVE in panel (b) of Figure A.4 in Appendix C.2.

[21]Given the simple nature of our policy exercises, these numbers are meant to be illustrative, rather than a rigorous strategic analysis of the policy wars.

		One year horizon $(T = 4)$			
			South		
		—	τ^{IM*}	s_D^*	s_E^*
North	—	(0.0000, 0.0000)	(-0.1685, -0.0757)	(-0.0889, 0.4166)	(-0.0486, -1.3121)
	τ^{IM}	(-0.0432, -0.2432)	(-0.2118, -0.3192)	(-0.1321, 0.1742)	(-0.0918, -1.5580)
	s_D	(0.3189, -0.1105)	(0.1508, -0.1864)	(0.2303, 0.3065)	(0.2704, -1.4239)
	s_E	(-0.9247, -0.0362)	(-1.0944, -0.1120)	(-1.0143, 0.3805)	(-0.9736, -1.3488)

		Four year horizon $(T = 16)$			
			South		
		—	τ^{IM*}	s_D^*	s_E^*
North	—	(0.0000, 0.0000)	(-0.0679, 0.0410)	(-0.0278, 0.0831)	(-0.0235, -0.1931)
	τ^{IM}	(0.0286, -0.0848)	(-0.0393, -0.0441)	(0.0008, -0.0011)	(0.0051, -0.2800)
	s_D	(0.0632, -0.0337)	(-0.0044, 0.0072)	(0.0356, 0.0497)	(0.0398, -0.2278)
	s_E	(-0.1450, -0.0133)	(-0.2138, 0.0277)	(-0.1734, 0.0699)	(-0.1688, -0.2067)

		Infinite horizon $(T \to \infty)$			
			South		
		—	τ^{IM*}	s_D^*	s_E^*
North	—	(0.0000, 0.0000)	(-0.0149, 0.0190)	(-0.0038, 0.0047)	(-0.0089, 0.0102)
	τ^{IM}	(0.0126, -0.0162)	(-0.0023, 0.0028)	(0.0089, -0.0114)	(0.0037, -0.0063)
	s_D	(0.0035, -0.0046)	(-0.0113, 0.0144)	(-0.0002, 0.0002)	(-0.0054, 0.0055)
	s_E	(0.0036, -0.0054)	(-0.0114, 0.0136)	(-0.0002, -0.0007)	(-0.0053, 0.0048)

Table 3. Welfare of policy wars between North and South. Numbers in parentheses are (welfare gain North, welfare gain South) expressed in consumption equivalent variation. Numbers are percentages (after multiplication by 100) of initial steady state consumption level. Policy actions of North are indexed by rows and those of South are by columns (note that — means no policy action). The top panel considers a one-year time horizon, the second panel considers four years, and the third panel considers an infinite horizon.

instrument for each country; regardless of their opponent's policy action. This follows since the policy generates benefits through raising labor demand and income through reshoring, while also releasing more resources for consumption due to less investment in firm entry. Moreover, this instrument inflicts losses on the opponent at these horizons, given the higher price of imported goods and the decline in the labor income. However, when both North and South levy the production subsidy, they realize mutual gains of 0.23% and 0.31%, respectively at a one-year horizon. At a four-year horizon, the magnitude of mutual gain drops to 0.04% and 0.05%. At no other combination of North-South single policy instruments are mutual gains possible at any time horizon.

When looking at the infinite horizon setting, instead the import tariff arises as the dominant policy instrument for each country. If policymakers in each country made this choice, they incur mutual, albeit decreasing, welfare losses at almost every time horizon of the implementation.[22] The fact that each country has the option of taking zero action shows this scenario resembles a "race to the bottom" in terms of policy actions. This finding complements the insightful results of Larch and Lechthaler (2013), who demonstrate that the Nash tariff in a dynamic trade model differs from that in a static trade model. In addition, since the tariffs are also levied on intermediate inputs, our results also align with Baqaee et al. (2024), where the authors, using a multi-sector trade model with complex input-output linkages, demonstrate that an abrupt decoupling between Germany and China could lead to significantly greater welfare losses in the short run compared to the long run.

A popular consideration in the policy arena is imposing import tariffs on those subsidized imports, such as European Union (EU)'s tariff on Chinese solar panels and more recently, on electric vehicles.[23] Combining Figure 2 and A.1, it is evident that the combination of these two policies brings a double-hit to the high-skilled wage in the North, which is detrimental to the Northern household's welfare in the short-to-medium term. Although the Northern tariff hurts the labor income of Southern households, its impact is dwarfed by the Southern subsidy, which bids up both types of wages and results in a substantial welfare gain. Over time, however, the Northern tariff encourages firm entry in the North but discourages it in the South, while the Southern subsidy further depresses firm entry in the South. Together, these two policies eventually benefit the North at the cost of the South.

In terms of other possible outcomes, the largest overall losses come about, with an infinite horizon, when the North imposes tariff and the South does not retaliate. This will generate a welfare gain to the North at 0.013% and incur a loss to the South at -0.016%, giving overall losses close to 0.003%. For shorter horizons, jointly choosing the entry subsidy drains worldwide resources, leading to overall losses of 0.38% and 2.32% at four years and one year, respectively.

5 Conclusion

In this paper, we studied the effects of various industrial policies in a two-country DSGE model featuring firm heterogeneity, trade-in-tasks, endogenous export and offshoring decisions. Our focus was to understand the dynamic distributional and welfare implications of a group of

[22] The only exception is that the south get a gain in the infinite horizon, but the magnitude is negligible.

[23] For example, Reuters reporting on EU solar sector support (link), and a Bruegel analysis on EV tariffs (link).

industrial policy instruments both on impact and over time. This sets our approach apart from the traditional ones to studying industrial policies.

Our results emphasize the importance of using a dynamic general equilibrium framework to assess the impacts of industrial policies. The rich micro-foundations of our model place producer dynamics at the forefront of the policy debate, particularly when countries use industrial policies to intensify economic competition. While short-term gains may appear beneficial, they may not offset long-term losses. This is because firm creation is both costly and time-consuming. If impatient policymakers prioritize short-term benefits, their policy choices could lead to long-term welfare losses, despite temporary improvements in welfare or wage equality across different skill classes.

We restrict our analysis to the effects of small shocks to the policy instruments, starting from an intervention-free initial state, to shed light on the incentives for using different instruments. Changes in shock magnitude or different initial conditions could yield different effects. A comprehensive study of optimal dynamic policies within our context, we leave as an avenue for future research.

Our model intentionally takes the minimum number of distortions, abstracting from some traditional market failures that justify industrial policies (e.g., learning-by-doing externalities, cross-sector spillovers), in order to transparently isolate the role of firm-level dynamics within a industry in shaping the time profile of welfare effects across instruments. Thus, we do not view our welfare results as conclusive, as they are highly model-dependent and sector-specific. Instead, we employ our one-sector model as a parsimonious framework to illuminate a core mechanism under-explored in the literature, which hopefully will pave the way for more projects to come.

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APPENDIX

A Additional figures and tables

Table A.1. Model equations

Euler equation, bonds	$1 = \beta\,(1 + r_{t+1})\,\mathbb{E}_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}\right]$
	$1 = \beta^*\left(1 + r^*_{t+1}\right)\mathbb{E}_t\left[\left(\frac{C^*_{t+1}}{C^*_t}\right)^{-\gamma}\right]$
Euler equations, stocks	$\tilde{v}_t = \beta\,(1-\delta)\,\mathbb{E}_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}\left(\tilde{d}_{t+1} + \tilde{v}_{t+1}\right)\right]$
	$\tilde{v}^*_t = \beta^*\,(1-\delta^*)\,\mathbb{E}_t\left[\left(\frac{C^*_{t+1}}{C^*_t}\right)^{-\gamma}\left(\tilde{d}^*_{t+1} + \tilde{v}^*_{t+1}\right)\right]$
Free entry conditions	$\tilde{v}_t = (1 - s_E)\frac{f_E}{Z_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$
	$\tilde{v}^*_t = (1 - s^*_E)\frac{f^*_E}{Z^*_t}\left(\frac{w^*_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w^*_{h,t}}{\alpha}\right)^{\alpha}$
Law of motions, firms	$N_{t+1} = (1-\delta)\left(N_t + N_{E,t}\right)$
	$N^*_{t+1} = (1-\delta^*)\left(N^*_t + N^*_{E,t}\right)$
Price indices	$1 = N_{D,t}\left(\tilde{\rho}_{D,t}\right)^{1-\theta} + N_{V,t}\left(\tilde{\rho}_{V,t}\right)^{1-\theta} + N^*_{X,t}\left[(1+\tau^{IM})\tilde{\rho}^*_{X,t}\right]^{1-\theta}$
	$1 = N^*_{D,t}\left(\tilde{\rho}^*_{D,t}\right)^{1-\theta} + N^*_{V,t}\left(\tilde{\rho}^*_{V,t}\right)^{1-\theta} + N_{X,t}\left[(1+\tau^{IM*})\tilde{\rho}_{X,t}\right]^{1-\theta}$
Aggregate accounting	$C_t + N_{E,t}\tilde{v}_t = w_{l,t}L + w_{h,t}H + N_t\tilde{d}_t + T_t$
	$C^*_t + N^*_{E,t}\tilde{v}^*_t = w^*_{l,t}L^* + w^*_{h,t}H^* + N^*_t\tilde{d}^*_t + T^*_t$
Total profits	$N_t\tilde{d}_t = N_{D,t}\tilde{d}_{D,t} + N_{V,t}\tilde{d}_{V,t} + N_{X,t}\tilde{d}_{X,t}$
	$N^*_t\tilde{d}^*_t = N^*_{D,t}\tilde{d}^*_{D,t} + N^*_{V,t}\tilde{d}^*_{V,t} + N^*_{X,t}\tilde{d}^*_{X,t}$
Number of firms	$N_t = N_{D,t} + N_{V,t}$
	$N^*_t = N^*_{D,t} + N^*_{V,t}$
Offshoring profit links	$\tilde{d}_{V,t} = \frac{k}{k-(\theta-1)}\left(\frac{z_{V,t}}{\tilde{z}_{D,t}}\right)^{\theta-1}\tilde{d}_{D,t} + \frac{\theta-1}{k-(\theta-1)}f_V\frac{Q_t}{Z^*_t}\left(\frac{w^*_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w^*_{h,t}}{\alpha}\right)^{\alpha}$
	$\tilde{d}^*_{V,t} = \frac{k}{k-(\theta-1)}\left(\frac{z^*_{V,t}}{\tilde{z}^*_{D,t}}\right)^{\theta-1}\tilde{d}^*_{D,t} + \frac{\theta-1}{k-(\theta-1)}f^*_V\frac{Q^{-1}_t}{Z_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$
Export profit links	$\tilde{d}_{X,t} = \frac{\theta-1}{k-(\theta-1)}\frac{f_X}{Z_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$
	$\tilde{d}^*_{X,t} = \frac{\theta-1}{k-(\theta-1)}\frac{f^*_X}{Z^*_t}\left(\frac{w^*_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w^*_{h,t}}{\alpha}\right)^{\alpha}$
Average productivity	$\tilde{z}_{D,t} = \left(\frac{k}{k-(\theta-1)}\right)^{\frac{1}{\theta-1}} z_{\min} z_{V,t}\left[\frac{z_{V,t}^{k-(\theta-1)} - z_{\min}^{k-(\theta-1)}}{z_{V,t}^{k} - z_{\min}^{k}}\right]^{\frac{1}{\theta-1}}$
	$\tilde{z}^*_{D,t} = \left(\frac{k}{k-(\theta-1)}\right)^{\frac{1}{\theta-1}} z_{\min} z^*_{V,t}\left[\frac{{z^*_{V,t}}^{k-(\theta-1)} - z_{\min}^{k-(\theta-1)}}{{z^*_{V,t}}^{k} - z_{\min}^{k}}\right]^{\frac{1}{\theta-1}}$
	$\tilde{z}_{V,t} = \left(\frac{k}{k-(\theta-1)}\right)^{\frac{1}{\theta-1}} z_{\min}\left(\frac{N_t}{N_{V,t}}\right)^{1/k}$
	$\tilde{z}^*_{V,t} = \left(\frac{k}{k-(\theta-1)}\right)^{\frac{1}{\theta-1}} z_{\min}\left(\frac{N^*_t}{N^*_{V,t}}\right)^{1/k}$
	$\tilde{z}_{X,t} = \left(\frac{k}{k-(\theta-1)}\right)^{\frac{1}{\theta-1}} z_{\min}\left(\frac{N_t}{N_{X,t}}\right)^{1/k}$
	$\tilde{z}^*_{X,t} = \left(\frac{k}{k-(\theta-1)}\right)^{\frac{1}{\theta-1}} z_{\min}\left(\frac{N^*_t}{N^*_{X,t}}\right)^{1/k}$

Table A.1. Model equations, continued

Offshoring cutoff productivity	$z_{V,t} = z_{\min}\left(\frac{N_t}{N_{V,t}}\right)^{1/k}$
	$z^*_{V,t} = z_{\min}\left(\frac{N^*_t}{N^*_{V,t}}\right)^{1/k}$
Average prices at N	$\tilde{\rho}_{D,t} = \frac{\theta}{\theta-1}\frac{1-s_D}{Z_t\tilde{z}_{D,t}}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$
	$\tilde{\rho}_{V,t} = \frac{\theta}{\theta-1}\frac{1}{\tilde{z}_{V,t}}\left(\frac{(1+\tau^{IM})\tau^V Q_t w^*_{l,t}}{Z^*_t(1-\alpha)}\right)^{1-\alpha}\left(\frac{w_{h,t}}{Z_t\alpha}\right)^{\alpha}$
	$\tilde{\rho}_{X,t} = \frac{\theta}{\theta-1}\frac{\tau Q_t^{-1}}{Z_t\tilde{z}_{X,t}}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$
Average prices at S	$\tilde{\rho}^*_{D,t} = \frac{\theta}{\theta-1}\frac{1-s^*_D}{Z^*_t\tilde{z}^*_{D,t}}\left(\frac{w^*_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w^*_{h,t}}{\alpha}\right)^{\alpha}$
	$\tilde{\rho}^*_{V,t} = \frac{\theta}{\theta-1}\frac{1}{\tilde{z}^*_{V,t}}\left(\frac{w^*_{l,t}}{Z^*_t(1-\alpha)}\right)^{1-\alpha}\left(\frac{(1+\tau^{IM*})\tau^{V*}Q_t^{-1}w_{h,t}}{Z_t\alpha}\right)^{\alpha}$
	$\tilde{\rho}^*_{X,t} = \frac{\theta}{\theta-1}\frac{\tau^* Q_t}{Z^*_t\tilde{z}^*_{X,t}}\left(\frac{w^*_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w^*_{h,t}}{\alpha}\right)^{\alpha}$
Average profits at N	$\tilde{d}_{D,t} = \frac{1}{\theta}\tilde{\rho}_{D,t}^{1-\theta}C_t$
	$\tilde{d}_{V,t} = \frac{1}{\theta}\tilde{\rho}_{V,t}^{1-\theta}C_t - f_V\frac{Q_t}{Z^*_t}\left(\frac{w^*_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w^*_{h,t}}{\alpha}\right)^{\alpha}$
	$\tilde{d}_{X,t} = \frac{1}{\theta}(1+\tau^{IM*})^{-\theta}\tilde{\rho}_{X,t}^{1-\theta}C^*_t Q_t - \frac{f_X}{Z_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$
Average profits at S	$\tilde{d}^*_{D,t} = \frac{1}{\theta}\tilde{\rho}_{D,t}^{*1-\theta}C^*_t$
	$\tilde{d}^*_{V,t} = \frac{1}{\theta}\tilde{\rho}_{V,t}^{*1-\theta}C^*_t - f^*_V\frac{Q_t^{-1}}{Z_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$
	$\tilde{d}^*_{X,t} = \frac{1}{\theta}(1+\tau^{IM})^{-\theta}\tilde{\rho}_{X,t}^{*1-\theta}C_t Q_t^{-1} - \frac{f^*_X}{Z^*_t}\left(\frac{w^*_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w^*_{h,t}}{\alpha}\right)^{\alpha}$
High-skilled demand by N	$\tilde{h}_{D,t} = \frac{1}{Z_t\tilde{z}_{D,t}}\left(\frac{\alpha}{1-\alpha}\frac{w_{l,t}}{w_{h,t}}\right)^{1-\alpha}\tilde{\rho}_{D,t}^{-\theta}C_t$
	$\tilde{h}_{V,t} = \frac{1}{Z_t^{\alpha}Z_t^{*1-\alpha}\tilde{z}_{V,t}}\left(\frac{\alpha}{1-\alpha}\frac{(1+\tau^{IM})\tau^V Q_t w^*_{l,t}}{w_{h,t}}\right)^{1-\alpha}\tilde{\rho}_{V,t}^{-\theta}C_t$
	$\tilde{h}_{X,t} = \frac{\tau}{Z_t\tilde{z}_{X,t}}\left(\frac{\alpha}{1-\alpha}\frac{w_{l,t}}{w_{h,t}}\right)^{1-\alpha}\left[(1+\tau^{IM*})\tilde{\rho}_{X,t}\right]^{-\theta}C^*_t$
High-skilled demand by S	$\tilde{h}^*_{D,t} = \frac{1}{Z^*_t\tilde{z}^*_{D,t}}\left(\frac{\alpha}{1-\alpha}\frac{w^*_{l,t}}{w^*_{h,t}}\right)^{1-\alpha}\tilde{\rho}_{D,t}^{*-\theta}C^*_t$
	$\tilde{h}^*_{V,t} = \frac{1}{Z_t^{\alpha}Z_t^{*1-\alpha}\tilde{z}^*_{V,t}}\left(\frac{\alpha}{1-\alpha}\frac{w^*_{l,t}}{(1+\tau^{IM*})\tau^{V*}Q_t^{-1}w_{h,t}}\right)^{1-\alpha}\tilde{\rho}_{V,t}^{*-\theta}C^*_t$
	$\tilde{h}^*_{X,t} = \frac{\tau^*}{Z^*_t\tilde{z}^*_{X,t}}\left(\frac{\alpha}{1-\alpha}\frac{w^*_{l,t}}{w^*_{h,t}}\right)^{1-\alpha}\left[(1+\tau^{IM})\tilde{\rho}^*_{X,t}\right]^{-\theta}C_t$

Table A.1. Model equations, continued

Low-skilled demand by N	$\tilde{l}_{D,t} = \frac{1}{Z_t \tilde{z}_{D,t}} \left(\frac{1-\alpha}{\alpha}\frac{w_{h,t}}{w_{l,t}}\right)^{\alpha} \tilde{\rho}_{D,t}^{-\theta} C_t$
	$\tilde{l}_{V,t} = \frac{1}{Z_t^{\alpha} Z_t^{*1-\alpha} \tilde{z}_{V,t}} \left(\frac{1-\alpha}{\alpha}\frac{w_{h,t}}{(1+\tau^{IM})\tau^{V} Q_t w_{l,t}^*}\right)^{\alpha} \tilde{\rho}_{V,t}^{-\theta} C_t$
	$\tilde{l}_{X,t} = \frac{\tau}{Z_t \tilde{z}_{X,t}} \left(\frac{1-\alpha}{\alpha}\frac{w_{h,t}}{w_{l,t}}\right)^{\alpha} \left[(1+\tau^{IM*})\tilde{\rho}_{X,t}\right]^{-\theta} C_t^*$
Low-skilled demand by S	$\tilde{l}_{D,t}^* = \frac{1}{Z_t^* \tilde{z}_{D,t}^*} \left(\frac{1-\alpha}{\alpha}\frac{w_{h,t}^*}{w_{l,t}^*}\right)^{\alpha} \tilde{\rho}_{D,t}^{*-\theta} C_t^*$
	$\tilde{l}_{V,t}^* = \frac{1}{Z_t^{\alpha} Z_t^{*1-\alpha} \tilde{z}_{V,t}^*} \left(\frac{1-\alpha}{\alpha}\frac{(1+\tau^{IM*})\tau^{V*} Q_t^{-1} w_{h,t}}{w_{l,t}^*}\right)^{\alpha} \tilde{\rho}_{V,t}^{*-\theta} C_t^*$
	$\tilde{l}_{X,t}^* = \frac{\tau^*}{Z_t^* \tilde{z}_{X,t}^*} \left(\frac{1-\alpha}{\alpha}\frac{w_{h,t}^*}{w_{l,t}^*}\right)^{\alpha} \left[(1+\tau^{IM})\tilde{\rho}_{X,t}^*\right]^{-\theta} C_t$
Labor market clearing (H)	$H = N_{D,t}\tilde{h}_{D,t} + N_{X,t}\tilde{h}_{X,t} + N_{V,t}\tilde{h}_{V,t} + \tau^{V*} N_{V,t}^* \tilde{h}_{V,t}^*$
	$+ \left(N_{E,t}\frac{f_E}{Z_t} + N_{X,t}\frac{f_X}{Z_t} + N_{V,t}^*\frac{f_V^*}{Z_t}\right)\left(\frac{\alpha w_{l,t}}{(1-\alpha) w_{h,t}}\right)^{1-\alpha}$
	$H^* = N_{D,t}^*\tilde{h}_{D,t}^* + N_{X,t}^*\tilde{h}_{X,t}^* + \left(N_{E,t}^*\frac{f_E^*}{Z_t^*} + N_{X,t}^*\frac{f_X^*}{Z_t^*} + N_{V,t}\frac{f_V}{Z_t^*}\right)\left(\frac{\alpha w_{l,t}^*}{(1-\alpha) w_{h,t}^*}\right)^{1-\alpha}$
Gov budget constraints	$\tau^{V}\tau^{IM} N_{V,t} w_{l,t}^* \tilde{l}_{V,t} Q_t + \tau^{IM} N_{X,t}^* \tilde{\rho}_{X,t}^* [(1+\tau^{IM})\tilde{\rho}_{X,t}^*]^{-\theta} C_t - T_t$
	$= s_E N_{E,t}\frac{f_E}{Z_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha} + s_D N_{D,t}\tilde{\rho}_{D,t}^{-\theta} C_t \frac{1}{Z_t \tilde{z}_{D,t}}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$
	$\tau^{V*}\tau^{IM*} N_{V,t}^* w_{h,t} \tilde{h}_{V,t}^* Q_t^{-1} + \tau^{IM*} N_{X,t} \tilde{\rho}_{X,t} [(1+\tau^{IM*})\tilde{\rho}_{X,t}]^{-\theta} C_t^* - T_t^*$
	$= s_E^* N_{E,t}^*\frac{f_E^*}{Z_t^*}\left(\frac{w_{l,t}^*}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}^*}{\alpha}\right)^{\alpha} + s_D^* N_{D,t}^*\tilde{\rho}_{D,t}^{*-\theta} C_t^* \frac{1}{Z_t^* \tilde{z}_{D,t}^*}\left(\frac{w_{l,t}^*}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}^*}{\alpha}\right)^{\alpha}$
Balance of payments	$N_{X,t}\tilde{\rho}_{X,t}\left((1+\tau^{IM*})\tilde{\rho}_{X,t}\right)^{-\theta} C_t^* Q_t + \tau^{V*} N_{V,t}^* w_{h,t}\tilde{h}_{V,t}^* - \tau^{V} N_{V,t} w_{l,t}^* \tilde{l}_{V,t} Q_t$
	$-N_{X,t}^*\tilde{\rho}_{X,t}^*\left((1+\tau^{IM})\tilde{\rho}_{X,t}^*\right)^{-\theta} C_t$
	$= N_{V,t} f_V \frac{Q_t}{Z_t^*}\left(\frac{w_{l,t}^*}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}^*}{\alpha}\right)^{\alpha} - N_{V,t}^* f_V^* \frac{1}{Z_t}\left(\frac{w_{l,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{h,t}}{\alpha}\right)^{\alpha}$

The above equations constitute a system of 57 equations in 57 endogenous variables: C_t, r_t, $\tilde{v}_t$, $\tilde{d}_t$, $w_{l,t}$, $w_{h,t}$, N_t, $N_{E,t}$, $N_{D,t}$, $N_{V,t}$, $N_{X,t}$, $\tilde{\rho}_{D,t}$, $\tilde{\rho}_{V,t}$, $\tilde{\rho}_{X,t}$, T_t, $\tilde{d}_{D,t}$, $\tilde{d}_{V,t}$, $\tilde{d}_{X,t}$, $\tilde{z}_{D,t}$, $z_{V,t}$, $\tilde{z}_{V,t}$, $\tilde{z}_{X,t}$, $\tilde{h}_{D,t}$, $\tilde{h}_{V,t}$, $\tilde{h}_{X,t}$, $\tilde{l}_{D,t}$, $\tilde{l}_{V,t}$, $\tilde{l}_{X,t}$, their Southern counterparts and the real exchange rate Q_t.

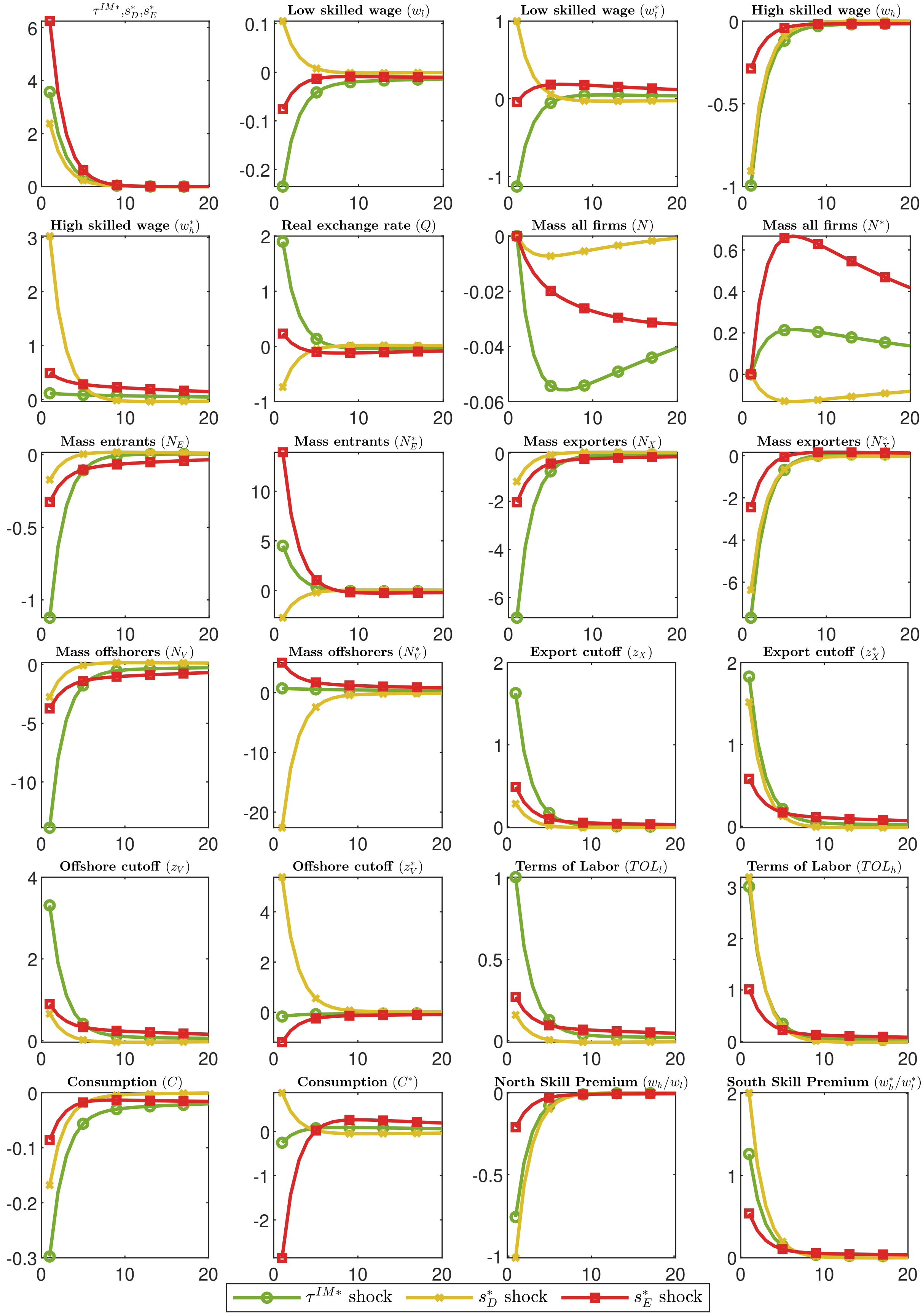


Figure A.1. Impulse responses of North and South variables to NPV 1% of world consumption shock to individual policy instruments in the South. The policy instrument is presented as absolute percentage points, while all other variables are presented as percentage deviations from the initial steady state (all after multiplication by 100).

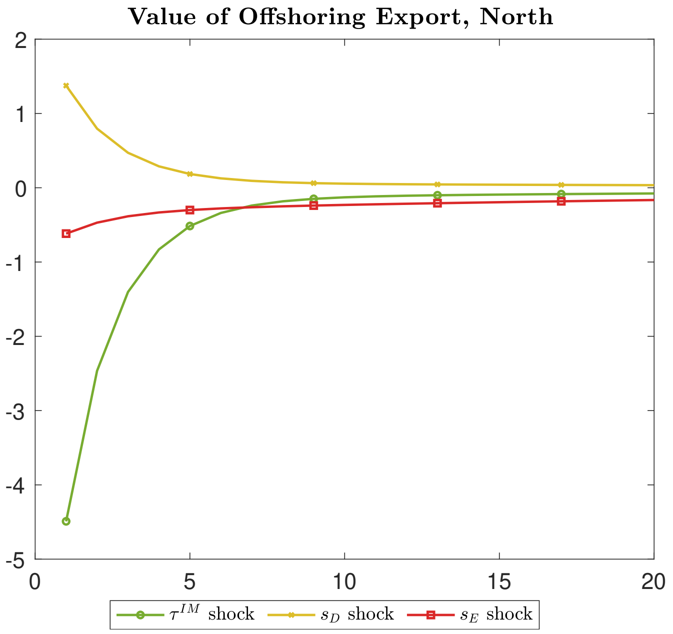


Figure A.2. Impulse response of of North's value of offshoring export to NPV 1% of world consumption shock to individual policy instruments in the North. The policy instrument is presented as absolute percentage points, while all other variables are presented as percentage deviations from the initial steady state (all after multiplication by 100).

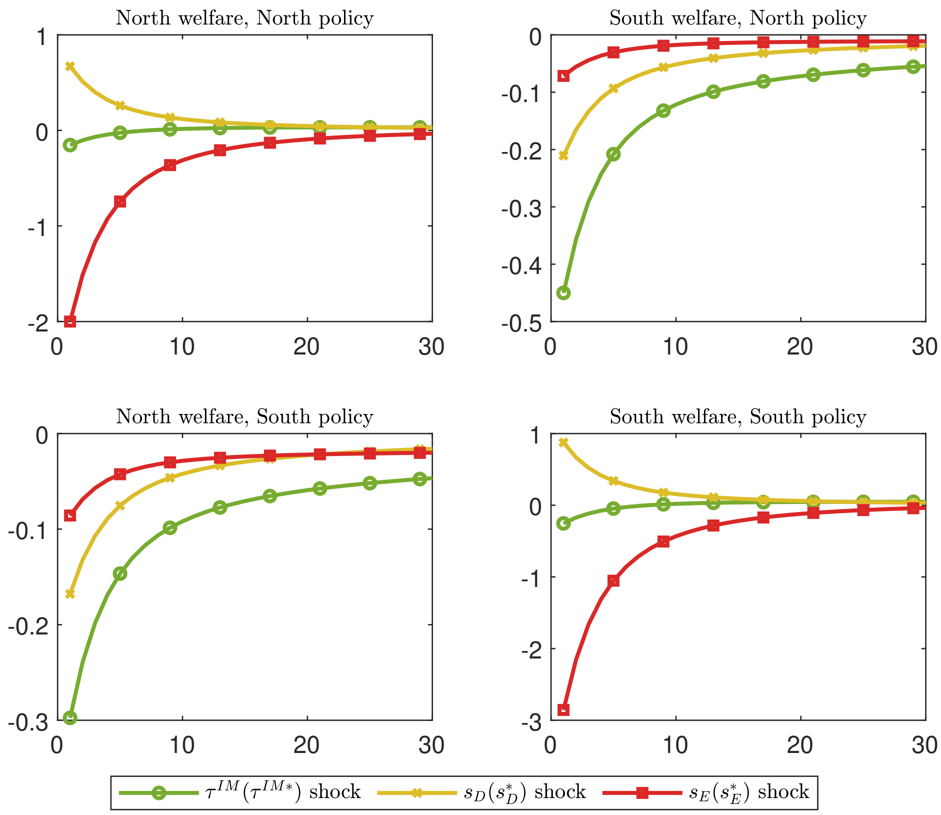


Figure A.3. Consumption equivalent welfare changes over varying time horizons. These are following NPV 1% of world consumption shock to individual policy instruments in the North/South (all after multiplication by 100).

B Solution Methods

We adopt an iterative approach to solve for the steady state of the model and a local approximation for the policy shocks. In this section, we first derive analytical expressions of the offshoring and export cutoffs. We then leverage these expressions in developing our solution algorithm.

B.1 Derivation of Cutoffs

We can derive the cutoffs of the Northern firms as a function of the model parameters and aggregates. Specifically, note that the period profits for a domestic firm are

$$\begin{aligned}
d_{D,t}(z) &= \frac{1}{\theta}\{\rho_{D,t}^{1-\theta}\}C_t \\
&= \frac{1}{\theta}\left\{\left(\frac{\theta}{\theta-1}\right)\left(\frac{1-s_D}{zZ_t}\right)\left(\frac{w_{L,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{H,t}}{\alpha}\right)^{\alpha}\right\}^{1-\theta} C_t \\
&= \frac{1}{\theta}\left(\frac{\theta}{\theta-1}\right)^{1-\theta}\left(\frac{1-s_D}{zZ_t}\right)^{1-\theta}\left(\frac{w_{L,t}}{1-\alpha}\right)^{(1-\alpha)(1-\theta)}\left(\frac{w_{H,t}}{\alpha}\right)^{\alpha(1-\theta)} C_t
\end{aligned}$$

and those for offshoring firms are

$$\begin{aligned}
d_{V,t}(z) =& \frac{1}{\theta}\left\{\rho_{V,t}(z)^{1-\theta}C_t\right\} - f_V\left(\frac{Q_t}{Z_t^*}\right)\left(\frac{w_{L,t}^*}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{H,t}^*}{\alpha}\right)^{\alpha} \\
=& \frac{1}{\theta}\left\{\frac{\theta}{\theta-1}\frac{1}{z}\left[\frac{(1+\tau^{IM})\tau^V Q_t w_{L,t}^*}{Z_t^*(1-\alpha)}\right]^{1-\alpha}\left(\frac{w_{H,t}}{Z_t\alpha}\right)^{\alpha}\right\}^{1-\theta} C_t \\
& - f_V\left(\frac{Q_t}{Z_t^*}\right)\left(\frac{w_{L,t}^*}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{H,t}^*}{\alpha}\right)^{\alpha} \\
=& \frac{1}{\theta}\left(\frac{\theta}{\theta-1}\right)^{1-\theta}\left(\frac{1}{z}\right)^{1-\theta}\left[\frac{(1+\tau^{IM})\tau^V Q_t w_{L,t}^*}{Z_t^*(1-\alpha)}\right]^{(1-\alpha)(1-\theta)}\left(\frac{w_{H,t}}{Z_t\alpha}\right)^{\alpha(1-\theta)} C_t \\
& - f_V\left(\frac{Q_t}{Z_t^*}\right)\left(\frac{w_{L,t}^*}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{H,t}^*}{\alpha}\right)^{\alpha}.
\end{aligned}$$

So an expression for the cutoff $z_{V,t}$ comes from $d_{D,t}(z) = d_{V,t}(z)$

$$
\begin{aligned}
&\Rightarrow \frac{1}{\theta}\left(\frac{\theta}{\theta-1}\right)^{1-\theta}\left(\frac{1-s_D}{z_{V,t}Z_t}\right)^{1-\theta}\left(\frac{w_{L,t}}{1-\alpha}\right)^{(1-\alpha)(1-\theta)}\left(\frac{w_{H,t}}{\alpha}\right)^{\alpha(1-\theta)} C_t \\
&= \frac{1}{\theta}\left(\frac{\theta}{\theta-1}\right)^{1-\theta}\left(\frac{1}{z_{V,t}}\right)^{1-\theta}\left[\frac{(1+\tau^{IM})\tau^V Q_t w^*_{L,t}}{Z^*_t(1-\alpha)}\right]^{(1-\alpha)(1-\theta)}\left(\frac{w_{H,t}}{Z_t\alpha}\right)^{\alpha(1-\theta)} C_t \\
&- f_V\left(\frac{Q_t}{Z^*_t}\right)\left(\frac{w^*_{L,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w^*_{H,t}}{\alpha}\right)^{\alpha} \\
z_{V,t}^{\theta-1} &= \frac{f_V\left(\frac{Q_t}{Z^*_t}\right)\left(\frac{w^*_{L,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w^*_{H,t}}{\alpha}\right)^{\alpha}\left[\frac{1}{\theta}\left(\frac{\theta}{\theta-1}\right)^{1-\theta} C_t\right]^{-1}}{\left[\frac{(1+\tau^{IM})\tau^V Q_t w^*_{L,t}}{Z^*_t(1-\alpha)}\right]^{(1-\alpha)(1-\theta)}\left(\frac{w_{H,t}}{Z_t\alpha}\right)^{\alpha(1-\theta)} - \left(\frac{1-s_D}{Z_t}\right)^{1-\theta}\left(\frac{w_{L,t}}{1-\alpha}\right)^{(1-\alpha)(1-\theta)}\left(\frac{w_{H,t}}{\alpha}\right)^{\alpha(1-\theta)}}.
\end{aligned}
$$

Then similarly, the exporting profits are given by

$$
d_{X,t}(z) = \frac{1}{\theta}(1+\tau^{IM*})^{-\theta}\rho_{X,t}(z)^{1-\theta}C^*_t Q_t - \frac{f_X}{Z_t}\left(\frac{w_{L,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{H,t}}{\alpha}\right)^{\alpha}
$$

where the cutoff is then given as $d_{X,t}(z) = 0$

$$
\begin{aligned}
&\frac{(1+\tau^{IM*})^{-\theta}}{\theta}\left\{\frac{\theta}{\theta-1}\frac{\tau Q_t^{-1}}{z_{X,t}Z_t}\left(\frac{w_{L,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{H,t}}{\alpha}\right)^{\alpha}\right\}^{1-\theta} C^*_t Q_t - \frac{f_X}{Z_t}\left(\frac{w_{L,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{H,t}}{\alpha}\right)^{\alpha} = 0 \\
&\Rightarrow z_{X,t}^{\theta-1} = \frac{\frac{f_X}{Z_t}\left(\frac{w_{L,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{H,t}}{\alpha}\right)^{\alpha}}{\frac{1}{\theta}(1+\tau^{IM*})^{-\theta}\left\{\frac{\theta}{\theta-1}\frac{\tau Q_t^{-1}}{Z_t}\left(\frac{w_{L,t}}{1-\alpha}\right)^{1-\alpha}\left(\frac{w_{H,t}}{\alpha}\right)^{\alpha}\right\}^{1-\theta} C^*_t Q_t}.
\end{aligned}
$$

Similarly, we can derive the offshoring and export cutoff (z^*_V, z^*_X) expression of southern firms. These cutoffs share a similar set of parameters and aggregates, which will be our starting point to solve the model iteratively.

B.2 Computational Algorithms

Steady State. The solution for the steady state is iterative, taking aggregate variables as inputs and then solving different parts of the problem in sequence.[24]

1. Conjecture objects $\widehat{\Psi} = \left(\hat{Q}, \hat{C}, \hat{C}^*, \hat{w}_L, \hat{w}^*_L, \hat{w}^*_H\right)$. Fix $\hat{w}_H = 1$, (can then treat the fixed cost of entry as a free parameter below).

2. Find the associated cutoffs z_V, z_X, z^*_V, z^*_X.

[24] Such is a common approach in macro models of firm dynamics, (e.g. see Spencer (2022), Jha, Rodriguez-Lopez and Spencer (2023)). See Spencer (Forthcoming) for a review of solution methods used in the firm dynamics and horizontal/vertical multinational activity literature.

3. Find the average productivity levels $\tilde{z}_D, \tilde{z}_V, \tilde{z}_X, \tilde{z}^*_D, \tilde{z}^*_V, \tilde{z}^*_X$.

4. Find average real price levels $\tilde{\rho}_D, \tilde{\rho}_V, \tilde{\rho}_X, \tilde{\rho}^*_D, \tilde{\rho}^*_V, \tilde{\rho}^*_X$.

5. Find average profits $\tilde{d}_D, \tilde{d}_V, \tilde{d}_X, \tilde{d}^*_D, \tilde{d}^*_V, \tilde{d}^*_X$.

6. Find high skilled demand $\tilde{h}_D, \tilde{h}_V, \tilde{h}_X, \tilde{h}^*_D, \tilde{h}^*_V, \tilde{h}^*_X$ and low skilled demand $\tilde{l}_D, \tilde{l}_V, \tilde{l}_X, \tilde{l}^*_D, \tilde{l}^*_V, \tilde{l}^*_X$.

7. Compute the value of entry $\tilde{v}$. Then back-out the fixed cost of entry (given the wage normalization) as $f_E = \tilde{v}\frac{1}{1-s_e}Z\left(\frac{1-\alpha}{w_L}\right)^{1-\alpha}\left(\frac{\alpha}{w_H}\right)^{\alpha}$. Then set $f^*_E = f_E$.

8. Using the average labor demand levels found above, find the masses of firms N and N^* that clear the high skilled labor market in each country.

9. Aggregate to find total profits and entry costs as well as government tax collections.

10. Compute the following metrics of distance

$$\Delta^C = |C - \hat{C}|$$
$$\Delta^{C*} = |C^* - \hat{C}^*|$$
$$\Delta^Q = |BOP|$$
$$\Delta^L = |L - L^D|$$
$$\Delta^{L*} = |L^* - L^{D*}|$$
$$\Delta^{H*} = |H^* - H^{D*}|$$

where Δ^C captures the difference of consumption good supply C and that conjectured, Δ^{C*} is the same but for the foreign country, BOP is the balance of payments, Δ^L captures the distance of the low skilled labor market clearing (supply L equals demand L^D), Δ^{L*} is the analogue for the South and Δ^{H*} is the distance of high skilled labor in the South H^* meeting the corresponding demand H^{D*}.

11. Update the conjecture of $\widehat{\Psi}$ in accordance with the distance metrics and repeat the process until convergence.

Transitional Dynamics. To compute the economy's response to aggregate policy shocks, we use a local approximation around the deterministic steady state. After solving for the heterogeneous firm stationary equilibrium, we take a first-order (MIT-shock) approximation of the equilibrium conditions around this steady state. This is now standard in models with heterogeneous agents and high-dimensional state spaces (e.g. Bendetti-Fasil, Impullitti, Licandro, Sedlácek and Spencer (2024)). Because the full cross-sectional distribution is an infinite-dimensional state variable, a global method is computationally infeasible. A common alternative is the approximate aggregation method of Krusell and Smith (1998). In contrast, our linearisation approach is substantially faster and provides an accurate characterisation of transitional dynamics for the small-to-moderate shocks we study.

C Additional Results

C.1 More results on consumption decomposition

We follow Demidova and Rodríguez-Clare (2009)to rewrite consumption for each period as

$$
\begin{aligned}
C = {} & Y_P \times \frac{Y_C}{Y_P} \times M^{\frac{1}{\theta-1}} \\
& \times \left[\left(\frac{N_D}{M}\right)^{\frac{1}{\theta}} \left(\frac{Y_D}{Y_C} \frac{N_D \left[\int_{z_{\min}}^{z_V} y(z)^{\frac{(\theta-1)}{\theta}} \frac{1}{G(z_V)} g(z) dz \right]^{\frac{\theta}{\theta-1}}}{Y_D} \right)^{\frac{\theta-1}{\theta}} \right. \\
& + \left(\frac{N_V}{M}\right)^{\frac{1}{\theta}} \left(\frac{Y_V}{Y_C} \frac{N_V \left[\int_{z_V}^{\infty} y(z)^{\frac{(\theta-1)}{\theta}} \frac{1}{1-G(z_V)} g(z) dz \right]^{\frac{\theta}{\theta-1}}}{Y_V} \right)^{\frac{\theta-1}{\theta}} \\
& \left. + \left(\frac{N_X^*}{M}\right)^{\frac{1}{\theta}} \left(\frac{Y_X^*}{Y_C} \frac{N_X^* \left[\int_{z_X^*}^{\infty} y^*(z)^{\frac{(\theta-1)}{\theta}} \frac{1}{1-G(z_X^*)} g(z) dz \right]^{\frac{\theta}{\theta-1}}}{Y_X^*} \right)^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}
\end{aligned}
$$

The total quantity produced at home, Y_P, is composed of home's domestic production ($Y_D \equiv \int_{\Omega_D} y(\omega) d\omega$), offshoring production that is accomplished at home ($Q_V \equiv \alpha Y_V = \alpha \int_{\Omega_V} y(\omega) d\omega$, high-skilled task), and home's export ($Y_X \equiv \int_{\Omega_X} y(\omega) d\omega$), each of which is defined as follow:

$$
Y_D = \frac{N_D}{G(z_V)} \int_{z_{\min}}^{z_V} \rho_D^{-\theta}(z) C g(z) dz = C N_D \frac{k}{k-\theta} \frac{z_{\min}^{\theta-k} - z_V^{\theta-k}}{z_V^k - z_{\min}^k} z_{\min}^k z_V^k \left[\frac{\theta}{\theta-1} \frac{1-s_D}{Z} \left(\frac{w_l}{1-\alpha}\right)^{1-\alpha} \left(\frac{w_h}{\alpha}\right)^{\alpha} \right]^{-\theta}
$$

$$
Q_V = \frac{\alpha N_V}{1-G(z_V)} \int_{z_V}^{\infty} \rho_V^{-\theta}(z) C g(z) dz = C N_V \frac{\alpha k}{k-\theta} z_V^{\theta} \left[\frac{\theta}{\theta-1} \left(\frac{(1+\tau^{IM})\tau^V Q w_l^*}{Z^*(1-\alpha)} \right)^{1-\alpha} \left(\frac{w_h}{Z\alpha}\right)^{\alpha} \right]^{-\theta}
$$

$$Y_X = \frac{\tau N_X}{1-G(z_X)} \int_{z_X}^{\infty} [(1+\tau^{IM*})\rho_X(z)]^{-\theta} C^* g(z) dz = C^* N_X \frac{\tau k}{k-\theta} z_X^{\theta} \left[\frac{\theta}{\theta-1} \frac{\tau(1+\tau^{IM*})}{ZQ} \left(\frac{w_l}{1-\alpha}\right)^{1-\alpha} \left(\frac{w_h}{\alpha}\right)^{\alpha} \right]^{-\theta}$$

The total quantity consumed at home, Y_C, comes from home domestically produced varieties (Y_D, same as above), offshored varieties ($Y_V \equiv \int_{\Omega_V} y(\omega) d\omega$) and foreign exports ($Y_X^* \equiv \int_{\Omega_X^*} y^*(\omega) d\omega$), each of which is defined as follow:

$$Y_V = \frac{N_V}{1-G(z_V)} \int_{z_V}^{\infty} \rho_V^{-\theta}(z) C g(z) dz = C N_V \frac{k}{k-\theta} z_V^{\theta} \left[\frac{\theta}{\theta-1} \left(\frac{(1+\tau^{IM})\tau^V Q w_l^*}{Z^*(1-\alpha)} \right)^{1-\alpha} \left(\frac{w_h}{Z\alpha}\right)^{\alpha} \right]^{-\theta}$$

$$Y_X^* = \frac{N_X^*}{1-G(z_X^*)} \int_{z_X^*}^{\infty} [(1+\tau^{IM})\rho_X^*(z)]^{-\theta} C g(z) dz = C N_X^* \frac{k}{k-\theta} z_X^{*\theta} \left[\frac{\theta}{\theta-1} \frac{\tau^*(1+\tau^{IM})}{Z^* Q^{-1}} \left(\frac{w_l^*}{1-\alpha}\right)^{1-\alpha} \left(\frac{w_h^*}{\alpha}\right)^{\alpha} \right]^{-\theta}$$

The **trade-adjusted terms of trade**, $\frac{Y_C}{Y_P}$, can be seen more clearly through the following rewritting:

$$\frac{Y_C}{Y_P} = \frac{\frac{Y_X}{Y_P} R_X / Y_X}{\frac{Y_X^*}{Y_C} R_X^* / Y_X^*} \times \frac{R_X^*}{R_X}$$

where the first term is the trade-adjusted average TOT, and the second term can be viewed as a wedge via the balance of payments condition. More specifically, notice that R_X stands for the total revenue of export, Y_X stands for the total quantity of export, so their ration gives us the average export price. Together with the average TOT definition in Ghironi and Melitz (2005), $\tilde{\text{TOT}} \equiv Q\tilde{\rho}_X / \tilde{\rho}_X^*$, we have

$$\frac{Y_C}{Y_P} = \frac{\frac{Y_X}{Y_P}}{\frac{Y_X^*}{Y_C}} \times \tilde{\text{TOT}} \times \frac{1}{\tau} \times (1 - \Theta)$$

where $\Theta = \frac{\left[N_V f_V \frac{Q}{Z^*} \left(\frac{w_l^*}{1-\alpha}\right)^{1-\alpha} \left(\frac{w_h^*}{\alpha}\right)^{\alpha} - N_V^* f_V^* \frac{1}{Z} \left(\frac{w_l}{1-\alpha}\right)^{1-\alpha} \left(\frac{w_h}{\alpha}\right)^{\alpha} + \tau^V N_V w_l^* \tilde{l}_V Q - \tau^{V*} N_V^* w_h \tilde{h}_V^* \right]}{N_X \tilde{\rho}_X [(1+\tau^{IM*})\tilde{\rho}_X]^{-\theta} C^* Q}$. Notice that Θ will be zero in the absence of offshoring, the whole equation will collapse to the same trade-adjusted average TOT as the one in Ghironi and Melitz (2005) and Demidova and Rodríguez-Clare (2009), in the presence of import tariffs.

The term $(M)^{\frac{1}{\theta-1}}$ is a **love of variety index**, with M stands for the total number of varieties that home consumers enjoy, including domestic varieties ($N = N_D + N_V$) and foreign exported varieties (N_X^*). This term can be further decomposed as the following via log-linearization:

$$\widehat{M^{\frac{1}{\theta-1}}} = \underbrace{\frac{1}{\theta-1} \frac{N}{M} \hat{N}}_{\text{domestic variety channel}} + \underbrace{\frac{1}{\theta-1} \frac{N_X^*}{M} \hat{N}_X^*}_{\text{imported variety channel}}$$

where "hats" denote log deviations from steady state. Tariff tends to have opposing effect on these two channels which affect the love of variety effect; it immediately reduces the imported variety by raising the foreign export cutoff while gradually raising the domestic variety through encouraging firm entry.

The last term is a **curvature term** that governs both the within and cross country heterogeneity, which can be simplified to the following expression

$$\frac{k-\theta}{k}\left(\frac{k}{k-\theta+1}\right)^{\frac{\theta}{\theta-1}}\left[\left(\frac{N_D}{M}\right)^{\frac{1}{\theta}}\left(\frac{Y_D}{Y_C}\right)^{\frac{\theta-1}{\theta}}\Gamma+\left(\frac{N_V}{M}\right)^{\frac{1}{\theta}}\left(\frac{Y_V}{Y_C}\right)^{\frac{\theta-1}{\theta}}+\left(\frac{N_X^*}{M}\right)^{\frac{1}{\theta}}\left(\frac{Y_X^*}{Y_C}\right)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}$$

where $\Gamma = \left(\frac{z_{\min}^{\theta-k-1}-z_V^{\theta-k-1}}{z_V^k-z_{\min}^k}z_V^k z_{\min}^k\right)/\left(\frac{z_{\min}^{\theta-k}-z_V^{\theta-k}}{z_V^k-z_{\min}^k}z_V^k z_{\min}^k\right)^{\frac{\theta-1}{\theta}}$. Note that if $k\to\infty$, the first part of curvature term approaches 1. This implies that if productivity dispersion falls, eventually the productivity distribution will become degenerate, and there is no within-country heterogeneity. In addition, if $\theta\to\infty$, this terms also approaches 1, suggesting if the elasticity of substitution across varieties is infinite, the differences of varieties also vanishes. In addition, it is straightforward to verify that if $z_V\to z_{\min}$[25], Γ is monotonically decreasing in z_V and approaching $\left(\frac{\theta-k-1}{\theta-k}\right)^{\frac{\theta-1}{\theta}}$, which then will also approach to 1 in the absence of any price heterogeneity within and cross countries ($k\to\infty$ or $\theta\to\infty$), then the household would consume same quantity of each good so that the term in the bracket equal to 1. Therefore,

$$\begin{aligned}C = Y_P \times &\left[\frac{\frac{Y_X}{Y_P}}{\frac{Y_X^*}{Y_C}}\times \tilde{\text{TOT}}\times\frac{1}{\tau}\times(1-\Theta)\right]\times M^{\frac{1}{\theta-1}}\\ &\times\frac{k-\theta}{k}\left(\frac{k}{k-\theta+1}\right)^{\frac{\theta}{\theta-1}}\left[\left(\frac{N_D}{M}\right)^{\frac{1}{\theta}}\left(\frac{Y_D}{Y_C}\right)^{\frac{\theta-1}{\theta}}\Gamma+\left(\frac{N_V}{M}\right)^{\frac{1}{\theta}}\left(\frac{Y_V}{Y_C}\right)^{\frac{\theta-1}{\theta}}+\left(\frac{N_X^*}{M}\right)^{\frac{1}{\theta}}\left(\frac{Y_X^*}{Y_C}\right)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}\end{aligned}$$

Note that in the absence of offshoring, the above equation collapses to

$$\begin{aligned}C = Y_P \times &\left[\frac{\frac{Y_X}{Y_P}}{\frac{Y_X^*}{Y_C}}\times \tilde{\text{TOT}}\times\frac{1}{\tau}\right]\times M^{\frac{1}{\theta-1}}\\ &\times\frac{k-\theta}{k}\left(\frac{k}{k-\theta+1}\right)^{\frac{\theta}{\theta-1}}\left[\left(\frac{N_D}{M}\right)^{\frac{1}{\theta}}\left(\frac{Y_D}{Y_C}\right)^{\frac{\theta-1}{\theta}}+\left(\frac{N_X^*}{M}\right)^{\frac{1}{\theta}}\left(\frac{Y_X^*}{Y_C}\right)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}\end{aligned}$$

[25]This could come from the two countries have identical labor endowments and that there are no wage differentials between countries, and the offshoring fixed cost is approaching zero. These two conditions effectively shuts down the offshoring channel in our model.

which is almost identical with the decomposition in Demidova and Rodríguez-Clare (2009).

C.2 Decomposition of Curvature Term

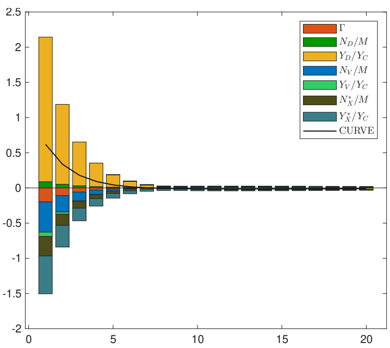
We log-linearize the curvature term (CURVE) around its steady-state value as below:

$$\begin{aligned}\widehat{\text{CURVE}}_t = \ & \omega_D \left[\frac{\theta}{\theta-1}\hat{\Gamma}_t + \frac{1}{\theta-1}(\hat{N}_{D,t} - \hat{M}_t) + (\hat{Y}_{D,t} - \hat{Y}_{C,t})\right] \\ & + \omega_V \left[\frac{1}{\theta-1}(\hat{N}_{V,t} - \hat{M}_t) + (\hat{Y}_{V,t} - \hat{Y}_{C,t})\right] \\ & + \omega_{X^*} \left[\frac{1}{\theta-1}(\hat{N}^*_{X,t} - \hat{M}_t) + (\hat{Y}^*_{X,t} - \hat{Y}_{C,t})\right]\end{aligned}$$

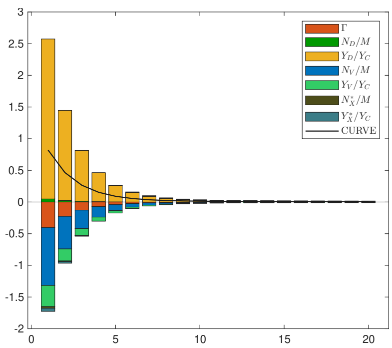
where the steady-state shares ω_j are defined as:

$$\omega_D = \frac{\Gamma\left(\frac{N_D}{M}\right)^{\frac{1}{\theta}}\left(\frac{Y_D}{Y_C}\right)^{\frac{\theta-1}{\theta}}}{\text{CURVE}}, \quad \omega_V = \frac{\left(\frac{N_V}{M}\right)^{\frac{1}{\theta}}\left(\frac{Y_V}{Y_C}\right)^{\frac{\theta-1}{\theta}}}{\text{CURVE}}, \quad \omega_{X^*} = \frac{\left(\frac{N^*_X}{M}\right)^{\frac{1}{\theta}}\left(\frac{Y^*_X}{Y_C}\right)^{\frac{\theta-1}{\theta}}}{\text{CURVE}}$$

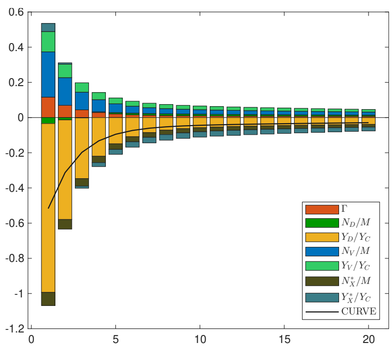
and CURVE is the steady-state value of curvature term. The decomposition of CURVE is presented below:



(a) Tariff shock



(b) Subsidy D shock



(c) Subsidy E shock

Figure A.4. Decomposition of CURVE in consumption

C.3 Fixing Offshoring Cutoff

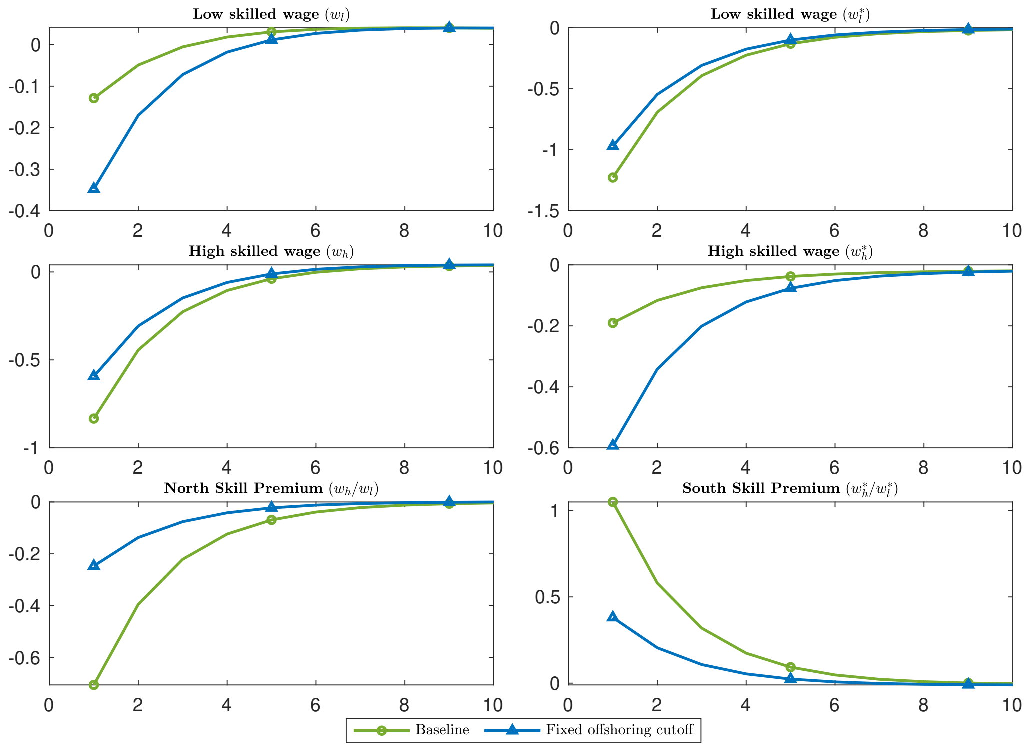


Figure A.5. Tariff shock from the North under baseline and holding offshoring cutoff fixed.

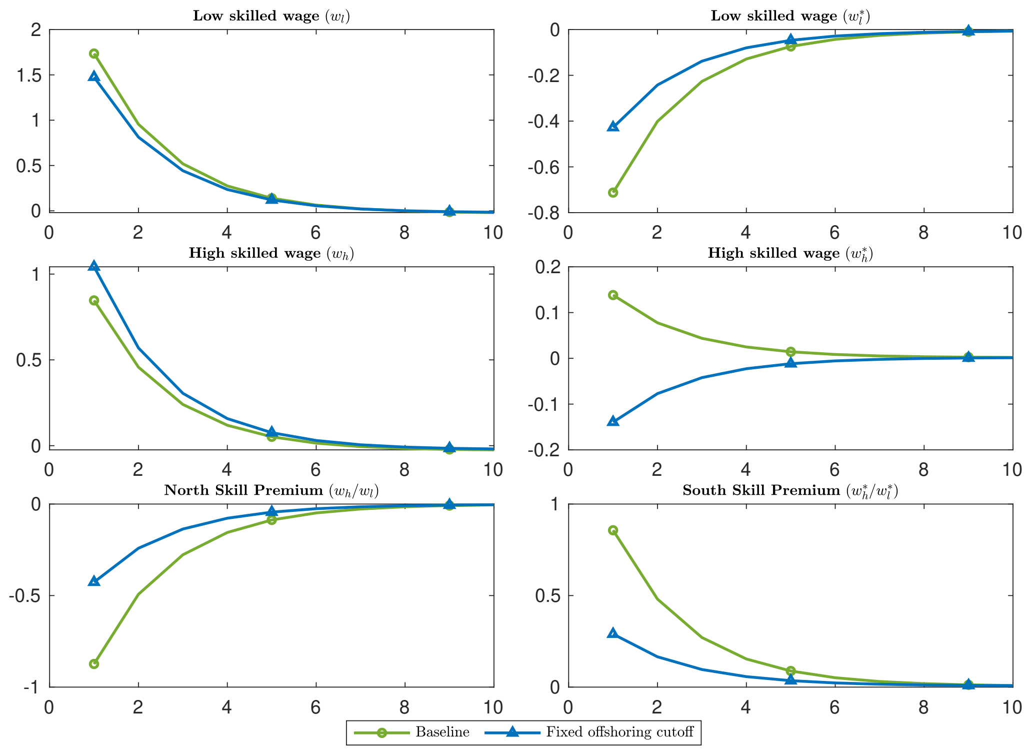


Figure A.6. Production subsidy shock from the North under baseline and holding offshoring cutoff fixed.

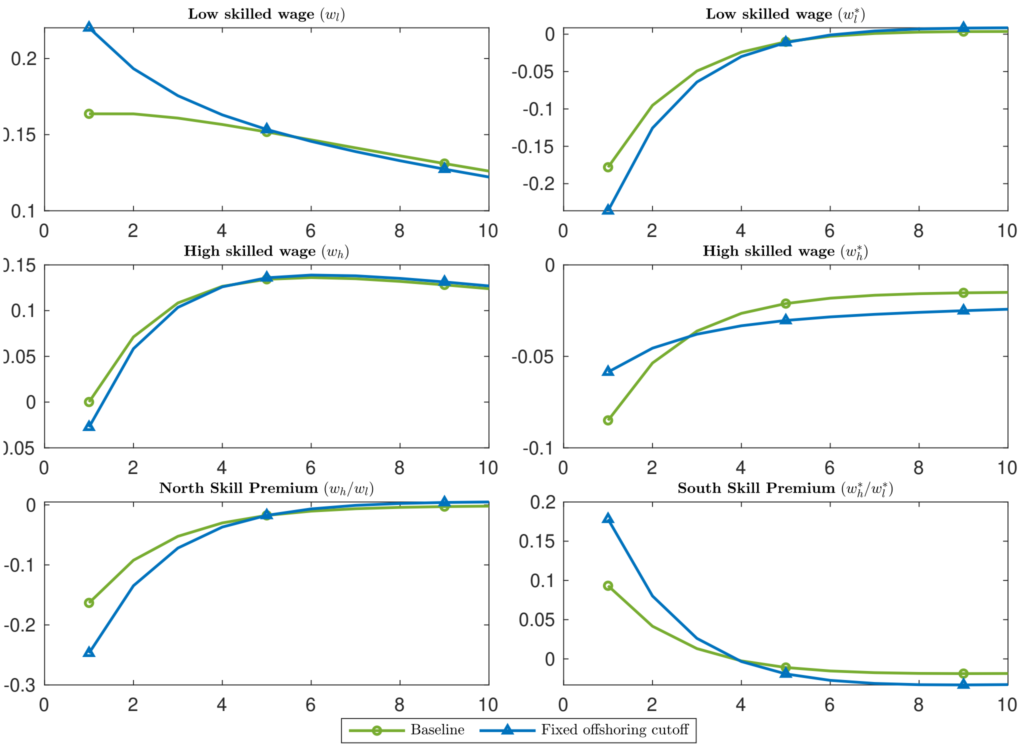


Figure A.7. Entry subsidy shock from the North under baseline and holding offshoring cutoff fixed.

D Robustness Checks

D.1 Persistence of policy shocks

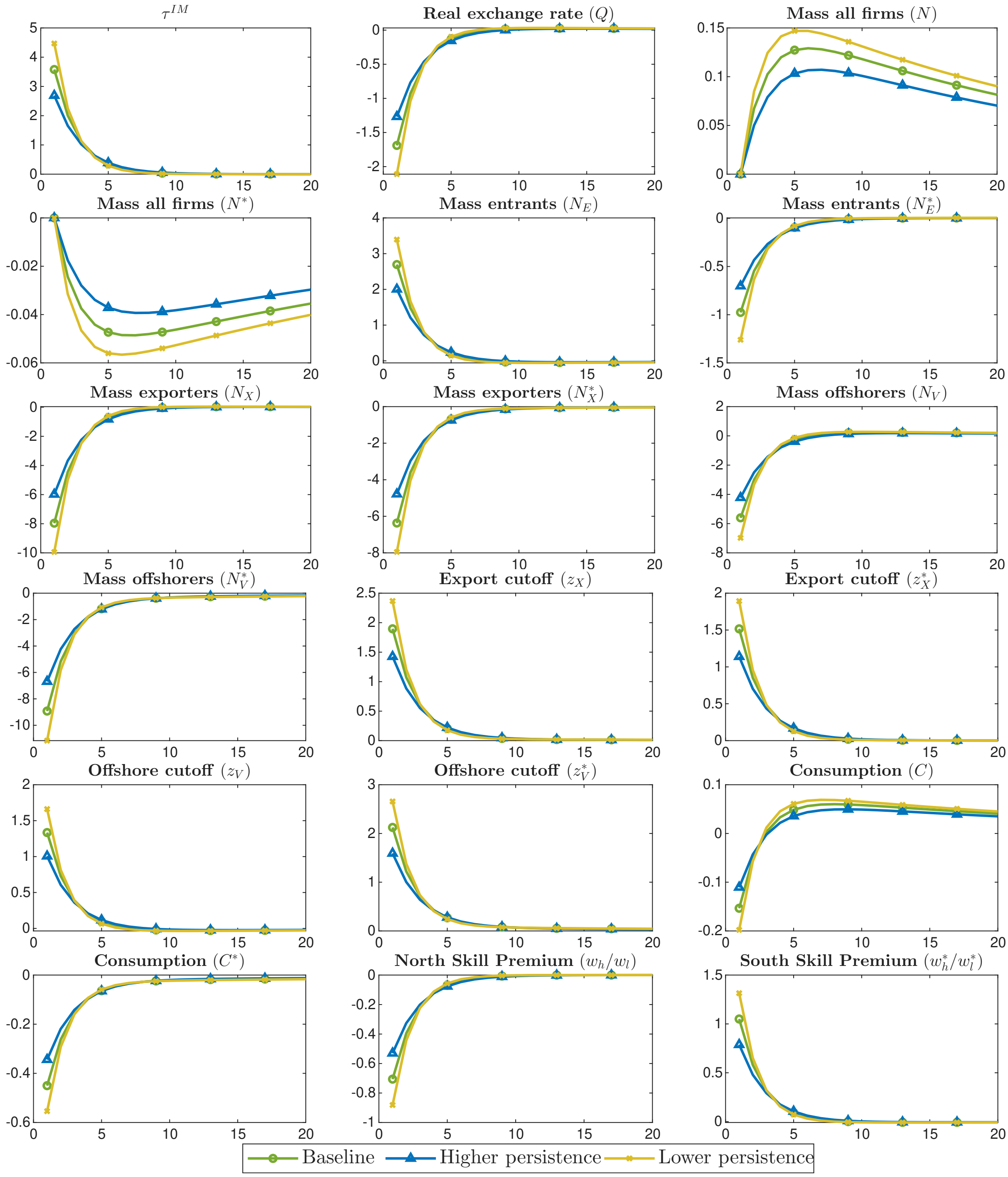


Figure A.8. Impulse responses of North and South variables to North tariff shock with varying persistence of policy process

D.2 Elasticity of substitution

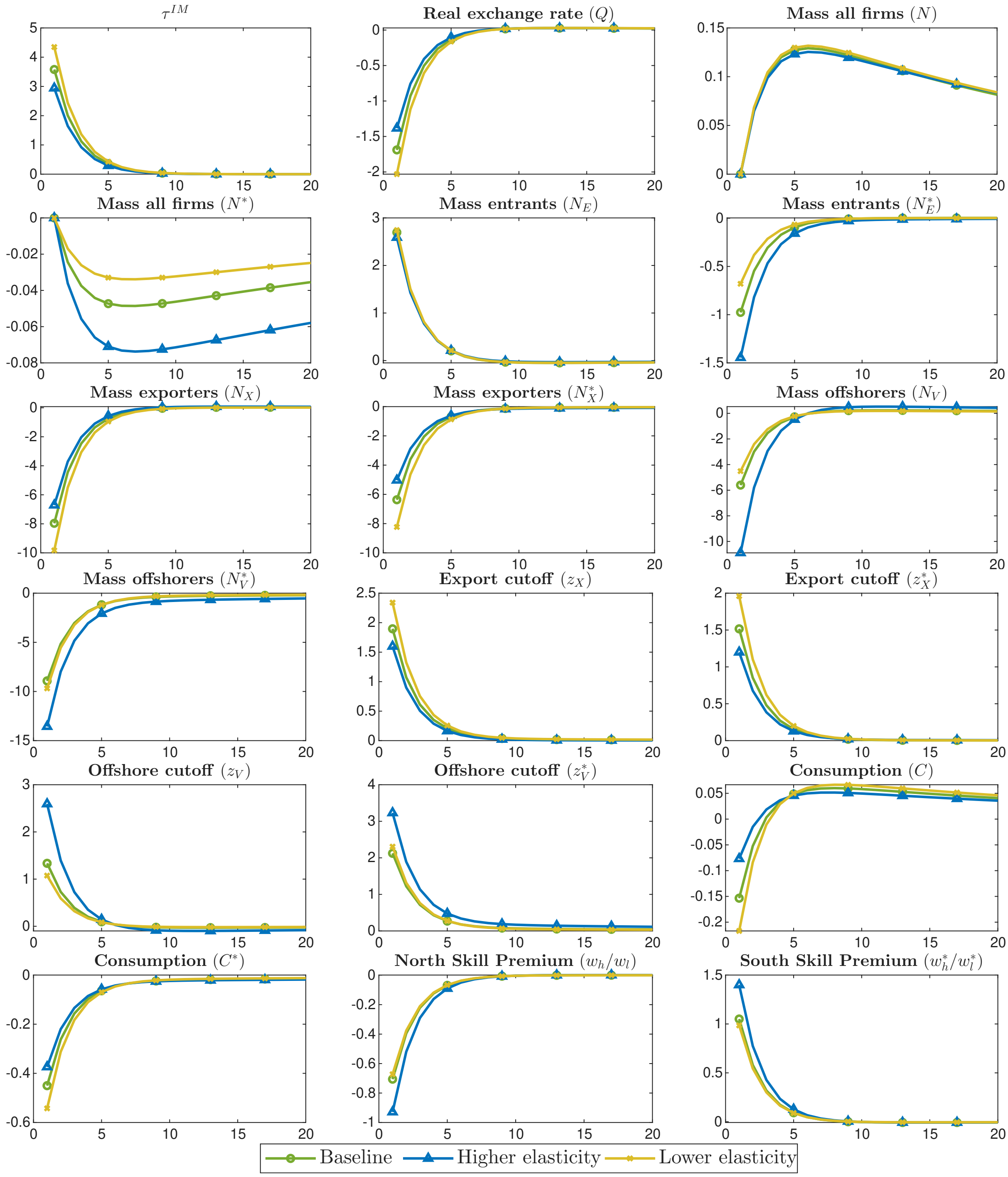


Figure A.9. Impulse responses of North and South variables to North tariff shock with varying elasticity of substitution.

D.3 Productivity dispersion

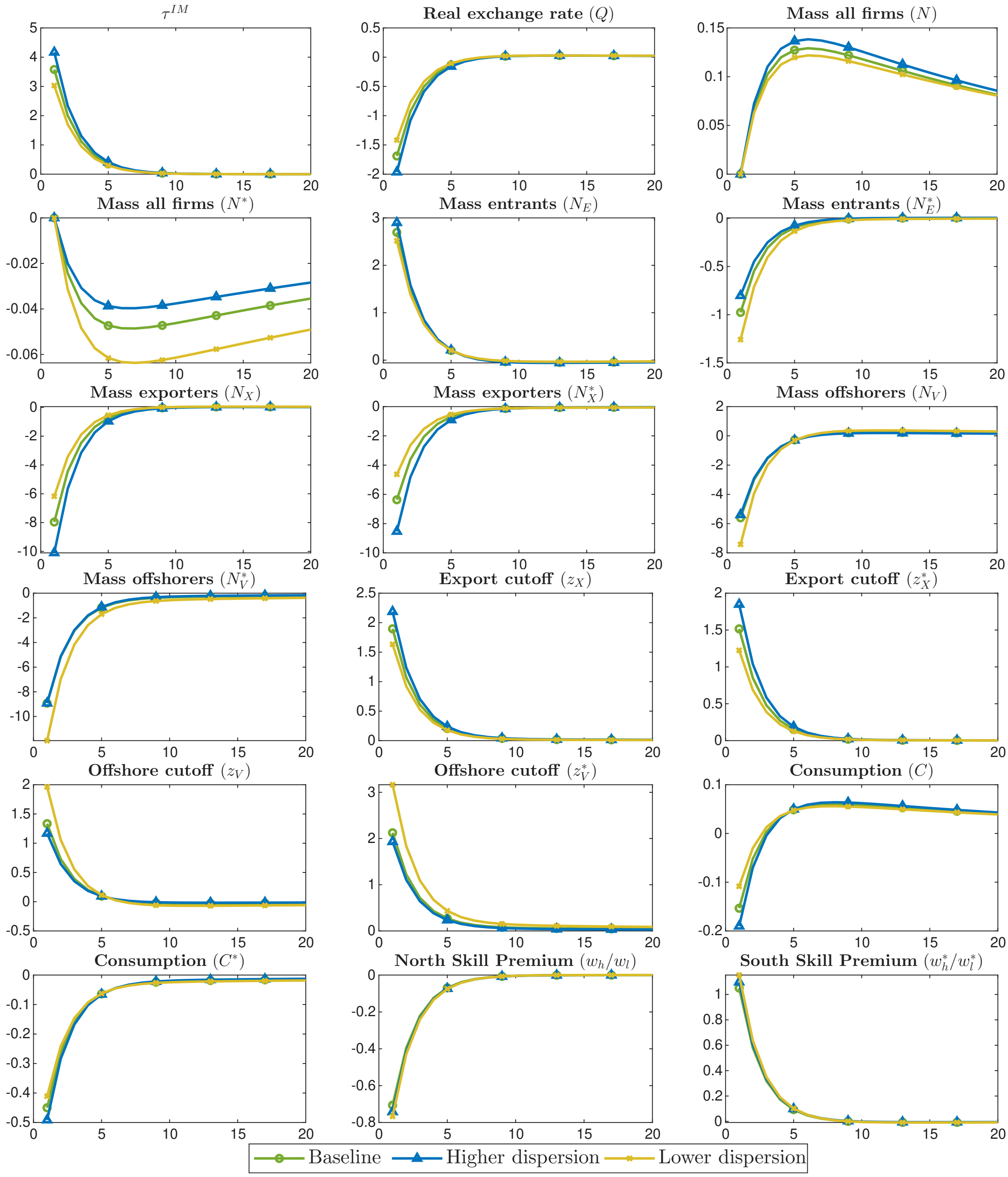


Figure A.10. Impulse responses of North and South variables to North tariff shock with varying productivity dispersion.

D.4 Skill intensity

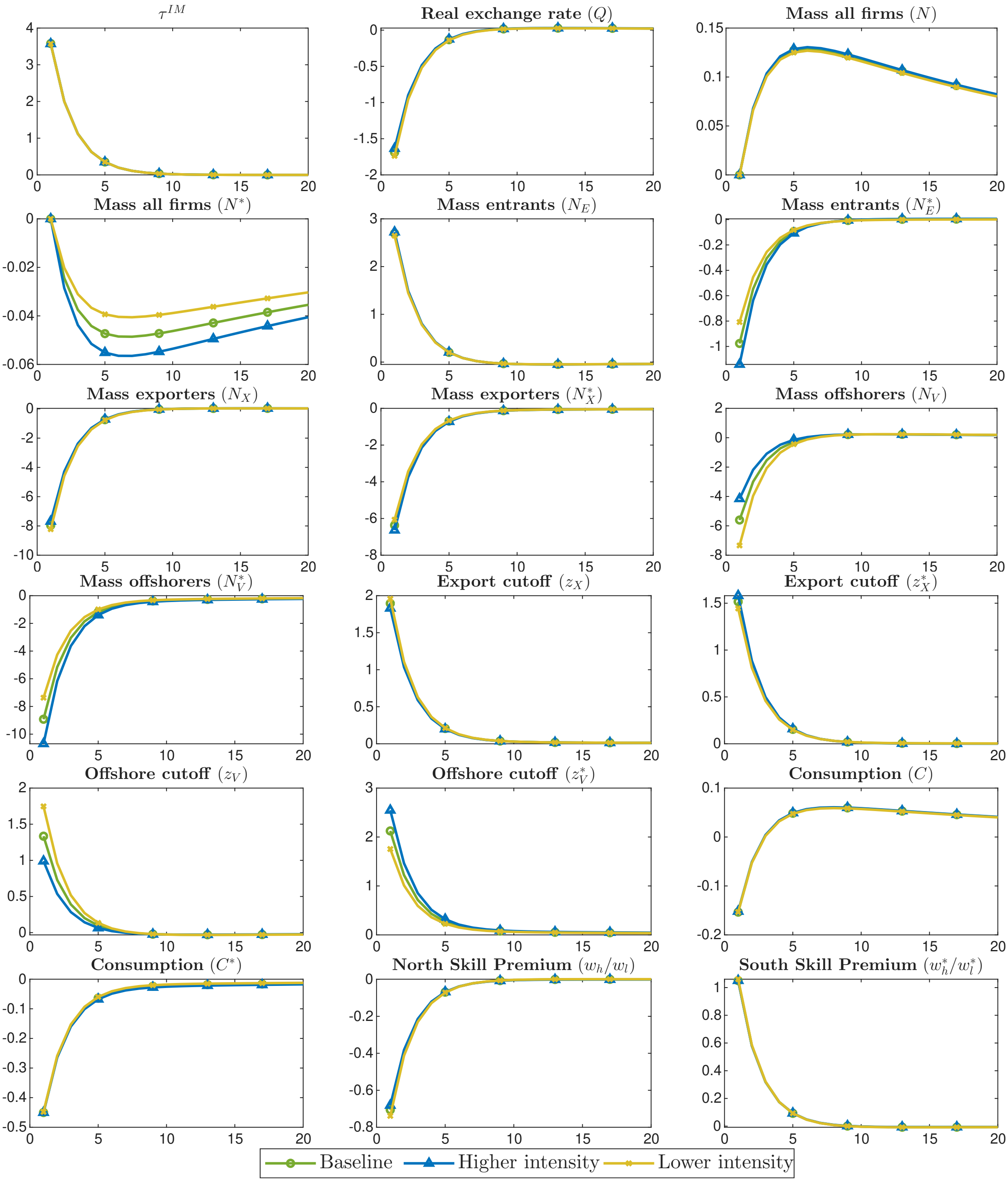


Figure A.11. Impulse responses of North and South variables to North tariff shock with varying skill intensity.