Trade Costs, Entry Costs, and the Spatial Distribution of Chinese Manufacturing Firms*

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March 19, 2025

Abstract

This paper examines sectoral growth patterns across Chinese provinces during the country's economic takeoff in the early 2000s, following major policy reforms, including trade liberalization, infrastructure improvements, business climate changes, and the relaxation of rural-to-urban migration restrictions. To analyze how these factors interact to shape the spatial distribution of economic activity, we develop a spatial general equilibrium model based on the Melitz-Chaney framework. Our model extends the heterogeneous firm approach to a multi-sector, multi-region setting, incorporating rich sectoral and regional interactions. We calibrate the model using Chinese data and conduct counterfactual simulations to disentangle the key mechanisms driving regional development. Our findings show that the expansion of manufacturing employment is the primary driver of firm distribution and economic growth. While reductions in domestic trade costs intensify competition and discourage firm entry, improvements in the business climate lower entry costs and encourage new firms. Together, these factors shape China's economic growth and specialization. Finally, we quantify the combined impact of manufacturing employment, trade costs, and entry costs on welfare changes.

Keywords: Spatial Distribution of Firms, Trade Costs, Entry Costs, Melitz-Chaney Model, China's Manufacturing

JEL Classification: F12, R12, L60

*We thank Hayato Kato and Motoaki Takahashi for their valuable feedback during the early stages of this project. We also appreciate the insightful comments and constructive suggestions from participants at the Chair of Macroeconomics at the University of Freiburg, the 26th Göttingen Workshop on International Economics, the 11th International Workshop on Regional, Urban, and Spatial Economics in Nanjing, China, and the 2024 CES China Annual Conference in Hangzhou, China. Any remaining errors are our own.

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1 Introduction

China's rapid economic transformation since the early 2000s is one of the most significant developments in modern economic history. As the country emerged as a global manufacturing hub, a growing body of research has explored the key drivers behind this shift. WTO accession in 2001 and subsequent trade liberalization played a crucial role in integrating China into the global market and fostering industrial specialization (Lu and Yu, 2015; Brandt et al., 2017; Erten and Leight, 2021). Beyond reductions in international trade costs, large-scale infrastructure projects—such as the expansion of the highway network—have enhanced domestic market integration (Zheng and Kahn, 2013; Faber, 2014; Baum-Snow et al., 2017; Lin, 2017; Qin, 2017). Additionally, labor market reforms, including the relaxation of rural-to-urban migration restrictions under the *Hukou* system (Au and Henderson, 2006; Fan, 2019; Tombe and Zhu, 2019; Ma and Tang, 2020; Fang and Huang, 2022; Zi, 2025), have contributed to the expansion of manufacturing employment. Another key factor is the increasingly business-friendly environment, characterized by streamlined administrative processes, tax incentives, and the establishment of special economic zones (Montinola et al., 1995; Li and Zhou, 2005; Zhang, 2011). The relaxation of restrictions on private enterprises has further encouraged firm entry and growth.

Collectively, these changes have reshaped China's industrial landscape, particularly the spatial distribution of firms. While much of the literature emphasizes the rapid growth of coastal regions as export powerhouses (Zheng et al., 2015; Liu and Ma, 2023; Ma and Tang, 2024), firm expansion has varied significantly across industries. Sectors reliant on imports and exports, such as steel, tend to cluster in coastal areas to capitalize on proximity to international ports. In contrast, labor-intensive industries, such as electronics, have increasingly moved inland to take advantage of lower labor costs.

This paper develops a unified quantitative framework to analyze the spatial distribution of manufacturing firms and its underlying mechanisms. The model builds on the general equilibrium framework of trade with heterogeneous firms *a la* Melitz-Chaney (Melitz, 2003; Chaney, 2008), extending it to incorporate multiple sectors (Caliendo and Parro, 2014) and multiple regions within a country (Redding, 2016). This structure allows us to measure the effects of changes in international and domestic trade costs, firm entry costs, and labor market frictions on the spatial distribution of economic activity. We quantify the model using detailed establishment-level data and interregional input-output tables from 2002 to 2007, a period of significant economic reforms. We calibrate key structural parameters and economic fundamentals, including national manufacturing employment, trade costs, and entry costs.

We conduct counterfactual analysis by solving the model in relative changes using exact hat algebra, following Dekle et al. (2008). Using 2002 as the base year, we introduce shocks to the model and simulate the economy under various counterfactual scenarios. First, we

simulate the Chinese economy before the major reforms and then examine the impact of expanding manufacturing employment. Second, we assess the role of trade liberalization by adjusting international trade costs to their post-WTO accession levels and evaluate the effects of infrastructure development by setting domestic trade costs to their 2007 levels. Finally, we analyze the implications of an increasingly business-friendly environment by simulating the economy under the 2007 sunk entry costs for firms. Throughout these counterfactual exercises, we measure how changes in manufacturing employment, trade costs, and entry costs shape the spatial distribution of economic activity.

This paper makes three key contributions to the literature. First, it develops a unified framework that integrates trade frictions, labor mobility, sectoral heterogeneity, and firms' sunk entry costs to explain the spatial distribution of firms. Building on Fujita et al. (2001), who highlight how market integration influences firms' location decisions, our model extends the insights of Redding and Sturm (2008) and Tombe and Zhu (2019) by incorporating both international and domestic trade barriers alongside labor mobility within a general equilibrium setting. This approach explicitly captures the interactions between these forces and highlights three key mechanisms: (1) how trade liberalization and infrastructure improvements lower trade costs and drive regional firm relocation, (2) how sectoral heterogeneity shapes industry responses—e.g., labor-intensive sectors shift inland for lower wages, while trade-dependent sectors remain coastal (e.g., Liu and Ma, 2023)—labor-intensive sectors move inland for lower wages, while trade-dependent sectors remain coastal—and the role of local business environments, including administrative processes, tax incentives, and entry barriers, in shaping the spatial distribution of firms and playing the role of change of welfare.

Second, this study sheds light on the role of regional characteristics—particularly the local business climate—in shaping firm location decisions. An influential early theory about the takeoff of the Chinese economy emphasizes "Chinese-style federalism," where local governments spur economic growth by fostering entrepreneurship and attracting investment through development zones, tax breaks, subsidies, and low-cost land (Montinola et al., 1995; Li and Zhou, 2005). While recent research has largely focused on trade shocks and infrastructure development, such as WTO accession and improved transportation networks (e.g., Baldwin and Okubo, 2006; Henderson et al., 2018; Ma and Tang, 2020; Tombe and Zhu, 2019), these two perspectives have almost always been studied in isolation. Our framework bridges this gap by integrating both views, examining how regional heterogeneity in business environment amplifies or mitigates the effects of broader policy changes. This approach provides a more comprehensive understanding of the interplay between trade liberalization, infrastructure development, and regional disparities in business policies and promotions in China.

Third, our analysis highlights how sectoral specialization evolves in response to manufacturing expansion, declining trade costs, and lower entry barriers amid China's economic and policy shifts. We show that different sectors react uniquely to these changes, with regions becoming

increasingly specialized as firms cluster in locations that offer comparative advantages. This finding aligns with Imbs and Wacziarg (2003), who emphasize sector-specific effects of trade liberalization, and Baum-Snow et al. (2017), who examine how infrastructure improvements drive firm relocation. Moreover, our model captures how these factors contribute to increasing specialization in manufacturing, reflecting mechanisms similar to those discussed by Glaeser et al. (1992), where economic growth is reinforced by the concentration of industries in favorable environments. By integrating these factors, our framework provides a richer understanding of how regional characteristics and policy shifts shape the evolving geography of sectoral specialization in China.

The remainder of the paper is structured as follows: Section 2 presents motivating evidence. Section 3 introduces the model framework. Section 4 quantifies the model and performs counterfactual analysis. Finally, Section 5 concludes.

2 Motivating Evidence

2.1 Development of China after 2000

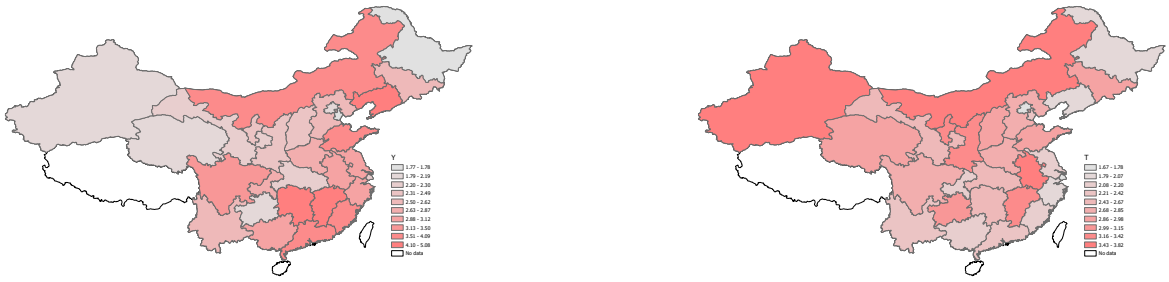
Since the early 2000s, China's economic transformation has been marked by significant shifts in the spatial distribution of economic activity. A key turning point was the country's accession to the World Trade Organization (WTO) in 2001, which accelerated its integration into the global economy. This integration had profound implications for trade and investment patterns across the country.

At the same time, China undertook extensive infrastructure development, particularly in high-speed rail and highway networks. Improved connectivity facilitated the movement of goods and services, allowing firms to expand their market reach. Between 2002 and 2007, international trade costs for non-agricultural sectors fell by 8%, while domestic trade costs declined by 11% (Tombe and Zhu, 2019). These trade cost reductions intensified market competition, forcing less productive firms to exit and enabling more competitive firms to expand, reshaping the geographic distribution of manufacturing activity.

Another major driver of economic reallocation was the relaxation of the *Hukou* system, which historically restricted rural-to-urban migration. Recent reforms have eased these restrictions, allowing more rural workers to move to urban areas and fueling growth in manufacturing employment. The resulting increase in labor supply enabled firms to scale production, reduce costs, and compete more effectively in both domestic and international markets.

Equally important, though often underestimated, is the role of regional development policies. In the early stages of economic reform, state-owned enterprises (SOEs) dominated the market, while private firms faced significant entry barriers due to strict regulations and limited access to resources. As reforms deepened and the business climate improved, these

Figure 1: Change of GDP and Number of Establishments



GDP Number of Establishments

Note: We aggregated firm-level data to calculate the number of establishments and regional GDP for both 2002 and 2007. The map visualizes the 2007 figures relative to the 2002 baseline, with darker shades representing higher values, highlighting regions with more significant growth.

restrictions were gradually lifted, leading to a surge in private-sector participation. Local governments, operating within a system of *Chinese-style federalism*, actively promoted economic growth by establishing development zones, offering tax incentives, and providing subsidies and cheap land. Development zones, in particular, offered streamlined administrative support and well-integrated infrastructure, creating a business-friendly environment that encouraged entrepreneurship and investment.

The combined effects of trade liberalization, infrastructure expansion, rural-to-urban migration, and regional development policies led to a notable reallocation of economic activity across regions. Coastal provinces experienced rapid growth, driven by foreign direct investment and the establishment of export-oriented manufacturing plants. By 2007, the six largest exporting provinces—Guangdong, Fujian, Jiangsu, Shanghai, Shandong, and Zhejiang—were all in coastal areas, collectively accounting for 79.7% of China's total exports. Figure 1 further highlights that the regions with the highest GDP growth from 2002 to 2007 were predominantly coastal, solidifying their role as key hubs in China's manufacturing landscape.

While much of the focus has been on coastal growth, inland regions have also experienced significant industrial expansion. Since 2004, manufacturing output in these provinces has risen substantially (Zheng et al., 2015), driven by declining trade and entry costs, government-led initiatives such as the Western Development Program, and ongoing infrastructure improvements that enhanced market accessibility. Lower labor costs in these regions further incentivized firms to establish operations there. Figure 1 illustrates this shift, showing a growing concentration of manufacturing establishments in inland areas compared to coastal regions.

Table 1: Growth in Output and Number of Establishments

	All Manufacturing	**Food**	**Chemicals**	**Metals**	**Machinery**	**Electronics**
			GDP (1 trillion CNY)			
2002	0.29	0.06	0.05	0.05	0.05	0.04
2007	0.91	0.19	0.14	0.15	0.16	0.15
Δ	0.62	0.13	0.09	0.10	0.11	0.10
$\%\Delta$	211.06%	198.50%	194.87%	222.48%	233.11%	241.09%
			Establishments (1k)			
2002	117.16	27.80	19.66	21.93	17.56	11.86
2007	261.12	59.95	42.60	46.28	46.56	28.62
Δ	143.96	32.15	22.94	24.36	29.00	16.76
$\%\Delta$	122.88%	115.66%	116.65%	111.07%	165.21%	141.36%
			Sectoral Specialization Index			
2002		0.96	0.87	1.27	0.77	0.19
2007		1.17	1.05	1.30	0.85	0.20
Δ		0.21	0.18	0.03	0.08	0.01
$\%\Delta$		21.96%	20.54%	2.62%	10.93%	6.11%

Note: We consolidate the manufacturing industry into six sectors (5 specific sectors+1 other sector) and use *Chinese Industrial Enterprise Database* to calculate the outcomes, which will be discussed in detail in the calibration section. In Appendix B, we provide another way to measure specialization across regions by Herfindahl-Hirschman Index.

2.2 Descriptive Evidence

To illustrate these trends, we first examine descriptive evidence on GDP growth and the expansion of business establishments across different sectors. As shown in Table 1, between 2002 and 2007, manufacturing GDP grew by 211.06%, while the number of establishments increased by 122.88%, reflecting remarkable industrial expansion. Sectoral differences further highlight the complexity of China's economic landscape. Among all industries, electronics and machinery manufacturing experienced the most rapid growth. These variations suggest that firms responded differently to changes in trade costs, rural-to-urban migration, and entry barriers, shaping the evolving distribution of economic activity.[1]

To provide a more detailed representation of the spatial distribution of economic activity, we compute the index of specialization, which measures the extent to which an industry is concentrated in specific regions rather than evenly distributed across the country. Following

[1]In Appendix A, we also illustrate the spatial patterns of growth in two specific sectors (electronics and steel) and highlight two major corporations within these industries: Foxconn in electronics and Angang in steel.

Ellison and Glaeser (1997), we compute the specialization level of each sector as follows:

$$G^j = \sum_n \left(\frac{Y_n^j}{Y_n} - \frac{Y_n}{Y_C} \right)^2$$

where Y_n^j denotes the GDP of industry j in region n, Y_n represents the total GDP of region n, and Y_C is the overall GDP of China. A higher value of this measure indicates that an industry's GDP is more heavily concentrated in certain regions rather than being evenly spread nationwide. Table 1 presents the specialization levels for each industry. By 2007, specialization had increased across all industries compared to 2002, indicating a more geographically concentrated distribution of economic activities.

These patterns highlight the evolving spatial distribution of economic activity in China and underscore the importance of understanding how factors such as trade liberalization, infrastructure expansion, local business climate, and labor mobility interact to shape the country's manufacturing landscape.

3 Quantitative Model

To gain deeper insights into the spatial distribution of manufacturing firms, we build a model to examine the effects of factors such as trade costs, manufacturing employment, and firm entry costs. This approach allows us to identify the key drivers behind firm concentration in specific regions, providing a clearer understanding of how these forces shape the economic landscape.

3.1 Environment

We consider a world consisting of two countries: China and the rest of the world (RoW). China is divided into N regions, which are represented by subscripts m and n $(= 1, 2, \ldots, N)$, while the RoW is denoted by subscript 0. For simplicity, the term "region" will refer to both Chinese regions and the RoW, with C used to refer to China and 0 for the RoW when specifying the countries. Labor is the only primary factor of production, and its endowment is fixed in each country. Within each country, labor is perfectly mobile across regions. The economy includes J manufacturing sectors, indexed by superscripts i and j.

3.2 Consumer Preferences

In each country, there is an ex-ante identical continuum of workers indexed by ω. The mass of workers in China and the RoW is fixed and represented by L_C and L_0, respectively.

A worker ω's preference for residing in the region n depends on the goods consumption index (c_n) and an idiosyncratic amenity shock (b_n), which affects their utility from living in

that region:

$$u_n(\omega) = b_n(\omega)\, c_n(\omega). \tag{1}$$

As the RoW consists of a single region, we normalize $b_0(\omega) = 1$ for all workers ω. The goods consumption index c_n is defined as the Cobb-Douglas bundle of sectoral final goods c_n^j,

$$c_n(\omega) = \prod_j \left(\frac{c_n^j(\omega)}{\alpha^j} \right)^{\alpha^j} \quad \text{with } \alpha^j \in (0,1) \text{ and } \sum_j \alpha^j = 1, \tag{2}$$

where $c_n^j(\omega)$ is worker ω's consumption of final good j in region n and α^j is the expenditure share on final good j. From (1) and (2), we obtain the indirect utility of worker ω residing in region n:

$$v_n(\omega) = b_n(\omega) \frac{e_n(\omega)}{P_n}.$$

where $e_n(\omega)$ is the worker's expenditure on goods and P_n is the consumer price index dual to (2),

$$P_n = \prod_j \left(P_n^j\right)^{\alpha^j}, \tag{3}$$

where P_n^j is the price of sectoral final good j in region n.

The idiosyncratic amenity shocks $b_n(\omega)$ capture heterogeneous preferences for living in each region in China. Following Redding (2016), we assume that the shocks are drawn independently across Chinese regions and workers from a Fréchet distribution:

$$b_n(\omega) \sim G_n(b) = \exp\left(-B_n b^{-\eta}\right),$$

where the location parameter B_n determines average amenities for region n and the shape parameter η governs the dispersion of amenities across individuals.

Workers choose the location that maximizes their utility after observing the realization of idiosyncratic amenity shocks. The optimization problem is given by,

$$\max_{n \in \{1,2,\ldots,N\}} v_n(\omega) = b_n(\omega) \frac{\mathbb{E}\left[e_n(\omega)\right]}{P_n}.$$

A worker forms an expectation of expenditure $e_n(\omega)$ because the sector in which the worker engages at the destination location is not determined at the time of location choice.

3.3 Worker's Occupational Choice

After workers sort into locations, they self-select into sectors *à la* Roy (1951). We assume that the labor market is segmented by region and sector. Wage income of a worker ω who chooses sector j in region n is given by,

$$w_n^j(\omega) = w_n^j a_n^j(\omega), \tag{4}$$

where w_n^j is wage per efficiency unit and $a_n^j(\omega)$ is the idiosyncratic efficiency of worker ω in sector j in terms of the efficiency unit of labor.

Following the stochastic formulation of Roy's assignment framework (e.g., Burstein et al., 2019), we assume that each worker draws idiosyncratic efficiency shocks across occupations, i.i.d. from the Fréchet distribution,

$$a^j(\omega) \sim H^j(a) = \exp\left(-A^j a^{-\iota}\right),$$

where the location parameter A^j governs the average efficiency of workers working in sector j and the shape parameter ι determines the dispersion of shocks across draws. Each worker chooses the sector that maximizes the wage income:[2]

$$\max_j w_n^j(\omega) = w_n^j a_n^j(\omega).$$

3.4 Intermediate Good Producers

In every region, there exists a continuum of intermediate good producers (firms), each of which produces a unique differentiated variety. Firms are heterogeneous in their core productivity *à la* Melitz (2003). Let φ_n^j be the productivity of a firm in sector j located in region n. We will use the firm's productivity as an index of the firm (variety). The Production function of a firm φ_n^j in sector j based at region n is given by,

$$y_n^j(\varphi_n^j) = \varphi_n^j \left(\frac{\ell_n^j(\varphi_n^j)}{\beta^j}\right)^{\beta^j} \left(\frac{m_n^j(\varphi_n^j)}{1-\beta^j}\right)^{1-\beta^j},$$

where $\ell_n^j(\varphi_n^j)$ is labor input in terms of efficiency unit, $m_n^j(\varphi_n^j)$ is the composite intermediate inputs, and β^j is the cost share of labor input in total production cost. Following the sectoral input-output linkage formulated by Caliendo and Parro (2014), we assume that firms use

[2]We adopt the self-selection of workers into sectors to circumvent potential corner solutions of the model, i.e., each region having only a subset of sectors in general equilibrium. The Fréchet-Roy apparatus adds the extra curvature in the model so that every sector-region pair is populated with a positive mass of workers. See Kucheryavyy et al. (2023) for further discussions on corner solutions in multi-sector monopolistic competition models.

sectoral final goods (defined below) from all sectors as intermediate inputs, such that,

$$m_n^j(\varphi_n^j) = \prod_{i\in\{1,2,\ldots,J\}} \left(\frac{m_n^{ji}(\varphi_n^j)}{\gamma^{ji}}\right)^{\gamma^{ji}}, \tag{5}$$

where $m_n^{ji}(\varphi_n^j)$ is the quantity of final good i used to produce variety φ_n^j and γ^{ji} is the intermediate input elasticity related.

Solving the cost minimization problem of a firm gives the marginal cost of production as $c_n^j(\varphi_n^j) = \frac{c_n^j}{\varphi_n^j}$, where c_n^j is the cost of input bundle defined as,

$$c_n^j = \left(w_n^j\right)^{\beta^j} \left(\Xi_n^j\right)^{1-\beta^j}, \tag{6}$$

where w_n^j is the wage per efficiency unit in sector j, and Ξ_n^j is the composite price index of intermediate inputs, dual to (5),

$$\Xi_n^j = \prod_{i\in\{1,2,\ldots,J\}} \left(P_n^i\right)^{\gamma^{ji}}, \tag{7}$$

where P_n^i is the price index of final good j.

A firm in sector j based in region n needs to incur two types of costs to serve the market in region m. The first cost is the variable iceberg trade costs, and the second is a fixed cost, which will be introduced below. To ship one unit of sector j good from n to m, a firm needs to ship τ_{mn}^j units of the goods. $\tau_{mn}^j \geq 1$ and we assume $\tau_{nn}^j = 1$ for all m, n and the triangular inequality holds. The marginal cost of serving goods from n to m net of iceberg trade costs is $c_{mn}^j(\varphi_n^j) = \frac{c_{mn}^j}{\varphi_n^j}$, where

$$c_{mn}^j = \tau_{mn}^j c_n^j. \tag{8}$$

3.5 Final Good Producers

In each sector and region, there is a final good producer that purchases and aggregates all of the varieties sold to the market. As in Caliendo et al. (2023), we consider the nested CES aggregator,

$$Y_n^j = \left(\left(\tilde{Y}_{nC}^j\right)^{\frac{\rho^j-1}{\rho^j}} + \left(\tilde{Y}_{n0}^j\right)^{\frac{\rho^j-1}{\rho^j}}\right)^{\frac{\rho^j}{\rho^j-1}}, \tag{9}$$

where $\tilde{Y}^j_{nC}$ is the composite of China-sourced varieties,

$$\tilde{Y}^j_{nC} = \left(\sum_{m \in \{1,2,\ldots,N\}} \int_{\phi \in \Omega^j_{nm}} \left(q^j_{nm}(\phi) \right)^{\frac{\sigma^j - 1}{\sigma^j}} d\phi \right)^{\frac{\sigma^j}{\sigma^j - 1}},$$

and $\tilde{Y}^j_{n0}$ is the composite of RoW-sourced varieties,

$$\tilde{Y}^j_{n0} = \left(\int_{\phi \in \Omega^j_{n0}} \left(q^j_{n0}(\phi) \right)^{\frac{\sigma^j - 1}{\sigma^j}} d\phi \right)^{\frac{\sigma^j}{\sigma^j - 1}}.$$

$q^j_{nm}(\phi)$ is the demand for variety ϕ produced in region m and sold in n. σ^j is the elasticity of substitution across varieties produced within a country. Ω^j_{nm} is the set of varieties produced in m and sold in n, which is determined in equilibrium. ρ^j is the elasticity of substitution between domestic and foreign-produced varieties. The proximity to international markets is crucial for trade-dependent sectors, as it affects production costs. Firms closer to international markets benefit from lower trade costs. Additionally, agglomeration effects, where firms cluster in specific regions, further reduce production costs and improve competitiveness. By solving a firm's profit maximization problem, we get the firm's pricing rule,

$$p^j_{nm}(\varphi^j_m) = \mu^j c^j_{nm}(\varphi^j_m), \tag{10}$$

where $\mu^j = \frac{\sigma^j}{\sigma^j - 1}$ is markup for sector j. Furthermore, by denoting $r_{nm}(\varphi^j_m)$ by the firm's revenue, we can show that the firm's operating profit is a constant share of revenue,

$$\begin{aligned} \varpi^j_{nm}(\varphi^j_m) &= r^j_{nm}(\varphi^j_m) - q^j_{nm}(\varphi^j_m) c^j_{nm}(\varphi^j_m) \\ &= \frac{1}{\sigma^j} r^j_{nm}(\varphi^j_m). \end{aligned}$$

Price index of the sectoral final good dual to (9) is given by

$$P^j_n = \left(\left(\tilde{P}^j_{nC} \right)^{1-\rho^j} + \left(\tilde{P}^j_{n0} \right)^{1-\rho^j} \right)^{\frac{1}{1-\rho^j}}, \tag{11}$$

where $\tilde{P}^j_{nC}$ and $\tilde{P}^j_{n0}$ are, respectively, given by,

$$\tilde{P}^j_{nC} = \left(\sum_{m \in \{1,2,\ldots,N\}} \int_{\phi \in \Omega^j_{nm}} \left(p^j_{nm}(\phi) \right)^{1-\sigma^j} d\phi \right)^{\frac{1}{1-\sigma^j}}, \tag{12}$$

and

$$\tilde{P}_{n0}^{j}=\left(\int_{\phi\in\Omega_{n0}^{j}}\left(p_{nm}^{j}(\phi)\right)^{1-\sigma^{j}}d\phi\right)^{\frac{1}{1-\sigma^{j}}}.$$

The nested CES structure of the final good aggregator implies that the expenditure share on goods sourced from Chinese regions is given by,

$$g_{nC}^{j}=\frac{\left(\tilde{P}_{nC}^{j}\right)^{1-\rho^{j}}}{\left(P_{n}^{j}\right)^{1-\rho^{j}}},\tag{13}$$

and the share on RoW-sourced goods is,

$$g_{n0}^{j}=\frac{\left(\tilde{P}_{n0}^{j}\right)^{1-\rho^{j}}}{\left(P_{n}^{j}\right)^{1-\rho^{j}}},\tag{14}$$

Furthermore, we can get the expenditure share on goods sourced from a Chinese region m in total spending on China-sourced goods as,

$$\lambda_{nm}^{j}=\frac{\left(\tilde{\zeta}_{nm}^{j}\right)^{1-\sigma^{j}}}{\left(\tilde{P}_{nC}^{j}\right)^{1-\sigma^{j}}}.\tag{15}$$

where

$$\zeta_{nm}^{j}=\left(\int_{\phi\in\Omega_{nm}^{j}}\left(p_{nm}^{j}(\phi)\right)^{1-\sigma^{j}}d\phi\right)^{\frac{1}{1-\sigma^{j}}},\tag{16}$$

for $n\in\{0,1,...,N\}$ and $m\neq 0$. Using ζ_{nm}^{j}, we can re-express (12) as,

$$\tilde{P}_{nC}^{j}=\left(\sum_{m\in\{1,2,...,N\}}(\zeta_{nm}^{j})^{1-\sigma^{j}}\right)^{\frac{1}{1-\sigma^{j}}}.\tag{17}$$

3.6 Sunk Entry Costs and Fixed Costs to Serve Each Market

Firms entering the market in sector j in region m need to pay the sunk entry cost to draw its productivity. Specifically, firms need to hire f_{m}^{Ej} efficiency unit of labor from the local market of sector j. Moreover, to serve in market n, firms need to pay the fixed cost, again in terms of local efficiency unit of labor, f_{nm}^{j}. Fixed cost of serving the home market is presumably lower than the ones of serving the other regions, i.e., $f_{nm}^{j}\geq f_{mm}^{j}$. A firm's profit from serving

market m net of fixed cost is given by,

$$\pi_{nm}(\varphi_n^j) = \varpi_{nm}^j(\varphi_m^j) - f_{nm}^j w_{nm}^j.$$

Since $\pi_{nm}(\varphi_n^j)$ is monotonically increasing in productivity φ_n^j, there is a unique productivity cutoff ϕ_n^j, which indicates the productivity of the least productive firms serving from m to n, defined by

$$\pi_{nm}(\phi_n^j) = 0. \tag{18}$$

Firm's profit net of sunk entry cost is given by,

$$\sum_{n\in\{0,1,2,\ldots,N\}} \pi_{nm}(\varphi_m^j) - f_m^{jE} w_m^j.$$

Here, the sunk entry cost captures the initial investment a firm must make to enter the market, including the cost of hiring efficiency units of labor in the local market. It is a one-time cost that is independent of future production and sales. In addition to labor costs, it reflects factors like local infrastructure, regulations, and the overall business environment. These costs act as barriers to entry, as only firms with sufficient productivity can overcome them and enter the market.

3.7 Aggregation and General Equilibrium

Price Indices and Goods Market Clearing

Following Chaney (2008), we suppose that ex-ante identical entrants draw productivity from Pareto distribution with the cumulative distribution function $G^j(\phi) = \Pr\left(\varphi^k < \phi\right) = 1 - \phi^{\theta^j}$ and the probability density function $g^j(\phi) = \frac{d}{d\phi}G^j(\phi)$ where $\varphi^j > 1$. Shape parameter θ^j differs across sectors. Let T_n^j be the mass of entrants, which is determined by the free entry in an equilibrium. Sales of firm φ_m^j based in region m selling to region n can be expressed as:

$$r_{nm}^j(\varphi_m^j) = \begin{cases} \left(p_{nm}^j(\varphi_m^j)\right)^{1-\sigma^j} X_{nC}^j \left(\tilde{P}_{nC}^j\right)^{\sigma^j-1} & \text{for } m \neq 0 \\ \left(p_{n0}^j(\varphi_0^j)\right)^{1-\sigma^j} X_{n0}^j \left(\tilde{P}_{n0}^j\right)^{\sigma^j-1} & \text{for } m = 0 \end{cases},$$

where X_{nC}^j is the total expenditure on China-sourced goods in region n and X_{n0}^j is the total expenditure on the ROW-sourced goods. From (18), cutoff productivity above which firms

serve market in region n from region m is given by,

$$\phi_{nm}^{j} = \begin{cases} \left(\frac{\sigma^j w_m^j f_{nm}^j (\mu^j c_{nm}^j)^{\sigma^j - 1}}{X_{nC}^j \left(\tilde{P}_{nC}^j\right)^{\sigma^j - 1}} \right)^{\frac{1}{\sigma^j - 1}} & \text{for } m \neq 0 \\ \left(\frac{\sigma^j w_0^j f_{n0}^j (\mu^j c_{n0}^j)^{\sigma^j - 1}}{X_{n0}^j \left(\tilde{P}_{n0}^j\right)^{\sigma^j - 1}} \right)^{\frac{1}{\sigma^j - 1}} & \text{for } m = 0 \end{cases}. \tag{19}$$

In our model, competition affects the selection of firms through the productivity cutoff ϕ_{nm}^j, which determines which firms can profitably enter and serve a market. Wage efficiency w_m^j, fixed costs f_{nm}^j, and production costs c_{nm}^j raise the cutoff productivity required for firms to serve. In addition, higher expenditures and a lower price index in region n reduce the cutoff. These factors drive a competitive selection effect, where only firms with higher productivity can survive and compete, while less productive firms are forced to exit the market.

Using the zero cutoff productivity defined by (19), we define the average productivity of firms selling goods from m to n as,

$$\begin{aligned} \overline{\phi}_{mn}^j &= \left(\frac{1}{1 - G^j(\phi_{mn}^j)} \int_{\phi_{mn}^j} \phi^{\sigma^j - 1} dG^j(\phi) \right)^{\frac{1}{\sigma^j - 1}} \\ &= \left(\frac{\theta^j}{\theta^j + 1 - \sigma^j} (\phi_{mn}^j)^{\sigma^j - 1} \right)^{\frac{1}{\sigma^j - 1}}. \end{aligned} \tag{20}$$

Furthermore, the mass of firms selling from n to m is given by

$$T_{nm}^j = (1 - G^j(\phi_{nm}^j)) T_m^j = \left(\phi_{nm}^j\right)^{-\theta^j} T_m^j. \tag{21}$$

By combining equations (10), (16), (20), and (21), we can solve for the price index of goods sourced from Chinese region m sold in region n as,

$$\zeta_{nm}^j = \frac{\mu^j \left(T_{nm}^j\right)^{\frac{1}{1-\sigma^j}} c_{nm}^j}{\overline{\phi}_{nm}^j} \quad \text{for } m \neq 0. \tag{22}$$

and the price index of goods sourced from the RoW and sold in region n as,

$$\tilde{P}_{n0}^j = \frac{\mu^j \left(T_{n0}^j\right)^{\frac{1}{1-\sigma^j}} c_{n0}^j}{\overline{\phi}_{n0}^j}. \tag{23}$$

Spending on final goods j is the sum of expenditure by workers as final consumption and by firms as an intermediate input. Let HE_n^j be the worker expenditure and ME_n^j be the firm

expenditure. Total spending on final good j is given by,

$$X_n^j = HE_n^j + ME_n^j. \tag{24}$$

Spending on China-sourced goods in region n is given by,

$$X_{nC} = g_{nC}^j X_n^j, , \tag{25}$$

where g_C^j is the expenditure share on China-sourced goods in total spending on final goods defined by (13). Analogously, we can express the spending on the RoW-sourced goods as,

$$X_{n0} = (1 - g_{nC}^j) X_n^j. \tag{26}$$

Now, the bilateral trade flow, i.e., the total spending on goods sourced from m and sold in n can be expressed as,

$$X_{nm} = \begin{cases} \lambda_{nm} X_{nC} & \text{for } m \neq 0 \\ X_{n0} & \text{for } m = 0 \end{cases}. \tag{27}$$

Goods market clearing condition, expressed as the total sales of firms selling from region m being equal to the sum of total spending on the goods across all destination regions, is given by,

$$Y_n^j = \sum_{m=0,1,\ldots,N} X_{mn}^j. \tag{28}$$

Intermediate input demand can be expressed using the aggregate sales Y_n^j as,

$$ME_n^j = \sum_{i=1}^{J} \frac{Y_n^i}{\mu^i} (1 - \beta^i) \gamma^{ij}. \tag{29}$$

Free Entry of Firms

We suppose that firms enter the market until the ex-ante expected profit is zero, i.e.,

$$\mathbb{E}\left[\sum_{n \in \{0,1,2,\ldots,N\}} \pi_{nm}(\varphi_m^j) \right] = f_m^{jE} w_m^j,$$

where the expectation is taken over the productivity. This suggests that, in equilibrium, the aggregate profit will be zero. To derive the zero-profit condition determining the mass of entrants T_m^j, we first show that the total spending for fixed costs by firms serving from region

m to n, F_{nm}^j, is the constant fraction of the aggregate sales, i.e.,

$$\begin{aligned} F_{nm}^j &= T_{nm}^j w_m^j f_{nm}^j \\ &= \frac{\theta^j + 1 - \sigma^j}{\sigma^j \theta^j} X_{nm}^j. \end{aligned} \tag{30}$$

Since the operating profit of the firm is a constant share of revenue, by combining the result from (30), we can show that the total profit of firms producing in region m, net of fixed cost payment, is also a constant share of total sales, i.e.,

$$\begin{aligned} \Pi_m^j &= \sum_{n \in \{0,1,2,\ldots\}} \left(\int_{\phi_{nm}^j}^{\infty} \pi_{nm}^j(\varphi) \tilde{g}_m^j(\varphi) d\varphi \right) \\ &= \sum_{n \in \{0,1,2,\ldots\}} \left(\frac{1}{\sigma^j} X_{nm}^j - F_{nm}^j \right) \\ &= \left(\frac{\sigma^j - 1}{\sigma^j \theta^j} \right) Y_m^j. \end{aligned}$$

Free entry of firms in equilibrium implies that the total profit of firms in the region m (net of fixed costs) is equal to the payment for the sunk entry cost. This gives the mass of entrants entering region m in sector j,

$$\begin{aligned} \left(\frac{\sigma^j - 1}{\sigma^j \theta^j} \right) Y_m^j &= T_m^j w_m^j f_m^{jE} \\ \Leftrightarrow \quad T_m^j &= \frac{\left(\frac{\sigma^j - 1}{\sigma^j \theta^j} \right) Y_m^j}{w_m^j f_m^{jE}}. \end{aligned} \tag{31}$$

Here, we argue that sunk entry costs directly influence firm entry. Higher sunk entry costs raise the entry threshold, requiring firms to have higher productivity to cover these costs. While lower sunk entry costs reduce the entry threshold, allowing more firms to enter. As shown by (31) that the number of entrants, T_m^j, is inversely proportional to sunk entry costs, meaning that higher sunk entry costs lead to fewer entrants.

Regional and Sectoral Sorting and Labor Market Clearing

We now explain the aggregate results for workers' regional and sectoral sorting backward. Given the wage per efficiency unit across sectors, by taking advantage of Fréchet distributed efficiency shock, we can get a probability that a randomly chosen worker in region n chooses sector j as,

$$\Lambda_n^j = \frac{A^j (w_n^j)^\iota}{\sum_i A^i (w_n^i)^\iota}. \tag{32}$$

Then, by the law of large numbers, we can get the measure of workers choosing sector j as

$$L_n^j = \Lambda_n^j L_n \tag{33}$$

where L_n is the measure of workers residing in region n, which we define next. Since the efficiency shock is drawn i.i.d. from Fréchet distribution, we can show that the average wage, conditional on individuals choosing the sectors that offer the highest wages, will be equalized across sectors. The average wage is given by,

$$\begin{aligned}
\overline{w}_n^j &= \mathbb{E}\left[w_n^j a_n^j(\omega) \middle| w_n^j a_n^j(\omega) \geq \max_{i \neq j} w_n^j a_n^j(\omega) \right] \\
&= \Gamma(1 - 1/\iota) \left(\sum_i A^i (w_n^i)^\iota \right)^{1/\iota} \\
&\equiv \overline{w}_n.
\end{aligned} \tag{34}$$

Due to the free entry of firms, the source of the worker income is wages. Therefore, worker expenditure can be expressed, using the average wage (34), by

$$E_n = L_n \overline{w}_n, \tag{35}$$

and sectoral spending is given by

$$E_n^j = \alpha^j E_n. \tag{36}$$

We next describe the aggregate result of the regional sorting of workers. When individuals choose the region according to (4), efficiency shock draws have not yet been realized. Therefore, workers form an expectation of expenditure in each destination. Since the average wage is equalized across sectors, the expected expenditure can be expressed as the average wage, i.e.,

$$\mathbb{E}\left[e_n(\omega) \right] = \sum_i \Lambda_n^j \overline{w}_n = \overline{w}_n.$$

Therefore, a randomly sampled worker ω will choose region n with a probability

$$\psi_n = \frac{B_n \left(\frac{\overline{w}_n}{P_n} \right)^\eta}{\sum_{m \in \{1,2.,..,N\}} B_m \left(\frac{\overline{w}_m}{P_m} \right)^\eta}, \tag{37}$$

by taking advantage of Fréchet distributed amenity shocks. And by the law of large number,

we can get the measure of workers reading in each region in China as,

$$L_n^j = \psi_n L_C \quad \text{for } n \neq 0, \tag{38}$$

where L_C is the measure of workers in China, which is given in the model.

Finally, we will show the labor market clearing conditions,

$$\begin{aligned} L_n^j \overline{a}_n^j w_n^j &= \beta^j \frac{Y_n^j}{\mu^j} + \frac{1}{\sigma^j} Y_n^j \\ &= \left(\frac{\beta^j (\sigma^j - 1) + 1}{\sigma^j} \right) Y_n^j, \end{aligned} \tag{39}$$

where the left-hand side of the equation is labor supply in terms of value, and the right-hand side is the labor demand, which is the sum of demand for labor as variable costs and as fixed and sunk entry costs. $\overline{a}_n^j$ is the average efficiency of individuals choosing sector j, which can be solved as $\overline{a}_n^j = \overline{w}_n / w_n^j$.

Welfare

Following Redding (2016), the welfare is represented by the expected utility for a worker across regions, which is given by the following expression:

$$W_C = \overline{U} = \Gamma \left(\frac{\eta - 1}{\eta} \right) \left(\sum_n B_n \left(\frac{\overline{w}_n}{P_n} \right)^{\eta} \right)^{\frac{1}{\eta}}, \tag{40}$$

where $\Gamma(\cdot)$ denotes the gamma function and $\frac{\overline{w}_n}{P_n}$ represents real wage. A higher real wage indicates that workers can purchase more goods with their income, leading to an increase in welfare. Consequently, regions with higher real wages contribute more significantly to overall welfare.

General Equilibrium

A general equilibrium of the model is a vector of wages $\{w_n^j\}_{n=0,\ldots,N}^j$, price indices $\{\tilde{P}_{n0}^j\}_{n=0,\ldots,N}^j$, $\{\tilde{P}_{nC}^j\}_{n=0,\ldots,N}^j$, labor allocation $\{L_n^j\}_{n=0,\ldots,N}^j$, measure of entrants$\{T_n^j\}_{n=0,\ldots,N}^j$, and cutoff productivity $\{\phi_{mn}^j\}_{m,n=0,\ldots,N}^j$ that satisfy equilibrium conditions (3), (6), (7), (8), (11), (13), (14), (15), (17), (19), (20), (21), (22), (23), (24), (25), (26), (27), (28), (29), (31), (32), (33), (34), (35), (36), (37), (38), and (39).

3.8 Equilibrium in Relative Changes

In the quantification below, we employ the exact hat algebra in the spirit of Dekle et al. (2008). This allows us to fit the model perfectly to the data and conduct the counterfactual exercises

while circumventing the calibration of the fundamentals, including trade costs and fixed and sunk entry costs. For a generic variable x, we define the "hat" notation,

$$\hat{x} = \frac{x'}{x},$$

where x is the variable in the baseline equilibrium and x' is the one in the counterfactual equilibrium.

For given structural parameters, θ^j, σ^j, ι, η, α^j, β^j, γ^{ji}, and ρ^i, and for given fundamentals in relative changes, $\{\hat{L}_n\}$, $\{\hat{\tau}_n\}$, $\{\hat{A}^j\}$, $\{\hat{B}_n\}$, $\{\hat{f}^j_{nm}\}$, and $\{\hat{f}^{Ej}_n\}$, a general equilibrium in relative changes is given by a vector of wages $\{\hat{w}^j_n\}^j_{n=0,\ldots,N}$, price indices $\{\hat{\tilde{P}}^j_{n0}\}^j_{n=0,\ldots,N}$, $\{\hat{\tilde{P}}^j_{nC}\}^j_{n=0,\ldots,N}$, labor allocation $\{\hat{L}^j_n\}^j_{n=0,\ldots,N}$ measure of entrants$\{\hat{M}^j_n\}^j_{n=0,\ldots,N}$, and cutoff productivity $\{\hat{\phi}^j_{mn}\}^j_{m,n=0,\ldots,N}$ that satisfy the following conditions: change in consumer price index implied by (3)

$$\hat{P}_n = \prod_j \left(\hat{P}^j_n\right)^{\alpha^j},$$

change in cost of input bundle implied by (6)

$$\hat{c}^j_n = \left(\hat{w}^j_n\right)^{\beta^j} \left(\hat{\Xi}^j_n\right)^{1-\beta^j},$$

change in the cost of composite intermediate inputs implied by (7)

$$\hat{\Xi}^j_n = \prod_{i\in\{1,2,\ldots,J\}} \left(\hat{P}^i_n\right)^{\gamma^{ji}},$$

change in marginal cost of serving to region m from region n for firm with $\varphi^j_m = 1$ implied by (8)

$$\hat{c}^j_{mn} = \hat{\tau}^j_{mn}\hat{c}^j_n,$$

change in final good price index implied by (11)

$$\hat{P}^j_n = \left(g^j_{nC}\left(\hat{\tilde{P}}^j_{nC}\right)^{1-\rho^j} + (1-g^j_{nC})\left(\hat{\tilde{P}}^j_{n0}\right)^{1-\rho^j}\right)^{\frac{1}{1-\rho^j}},$$

change expenditure share on China-sourced goods implied by (13)

$$\hat{g}_{nC}^{j} = \frac{\left(\hat{\hat{P}}_{nC}^{j}\right)^{1-\rho^{j}}}{\left(\hat{P}_{n}^{j}\right)^{1-\rho^{j}}},$$

change in expenditure share on RoW-sourced goods implied by (14)

$$\hat{g}_{n0}^{j} = \frac{\left(\hat{\hat{P}}_{n0}^{j}\right)^{1-\rho^{j}}}{\left(\hat{P}_{n}^{j}\right)^{1-\rho^{j}}},$$

change expenditure share on goods sourced from Chinese region m in total spending on China-sourced goods implied by (15)

$$\hat{\lambda}_{nm}^{j} = \frac{\left(\hat{\hat{\zeta}}_{nm}^{j}\right)^{1-\sigma^{j}}}{\left(\hat{\hat{P}}_{nC}^{j}\right)^{1-\sigma^{j}}},$$

change price index for China-sourced good implied by (17)

$$\hat{\hat{P}}_{nC}^{j} = \left(\sum_{m\in\{1,2,\ldots,N\}} s_{nm}^{j}(\hat{\zeta}_{nm}^{j})^{1-\sigma^{j}}\right)^{\frac{1}{1-\sigma^{j}}},$$

change in cutoff productivity for each pair of regions implied by (19)

$$\hat{\phi}_{nm}^{j} = \begin{cases} \left(\frac{\hat{w}_{m}^{j}\hat{f}_{nm}^{j}(\hat{c}_{nm}^{j})^{\sigma^{j}-1}}{\hat{X}_{nC}^{j}\left(\hat{\hat{P}}_{nC}^{j}\right)^{\sigma^{j}-1}}\right)^{\frac{1}{\sigma^{j}-1}} & \text{for } m \neq 0 \\ \left(\frac{\hat{w}_{0}^{j}\hat{f}_{n0}^{j}(\hat{c}_{n0}^{j})^{\sigma^{j}-1}}{\hat{X}_{n0}^{j}\left(\hat{\hat{P}}_{n0}^{j}\right)^{\sigma^{j}-1}}\right)^{\frac{1}{\sigma^{j}-1}} & \text{for } m = 0 \end{cases},$$

change in average productivity implied by (20)

$$\hat{\bar{\phi}}_{mn}^{j} = (\hat{\phi}_{mn}^{j})$$

change in mass of firms serving from region m to region n implied by (21)

$$\hat{T}_{nm}^{j} = \left(\hat{\phi}_{nm}^{j}\right)^{-\theta^{j}} \hat{T}_{m}^{j}$$

change in price index of goods sourced from Chinese region m and sold in n implied by (22)

$$\hat{\zeta}_{nm}^{j} = \frac{\left(\hat{T}_{nm}^{j}\right)^{\frac{1}{1-\sigma^{j}}} \hat{c}_{nm}^{j}}{\hat{\bar{\phi}}_{nm}^{j}} \quad \text{for } m \neq 0.$$

change in price index of goods sourced from the RoW implied by (23)

$$\hat{\tilde{P}}_{n0}^{j} = \frac{\left(\hat{T}_{n0}^{j}\right)^{\frac{1}{1-\sigma^{j}}} \hat{c}_{n0}^{j}}{\hat{\bar{\phi}}_{n0}^{j}}$$

change in total spending implied by (24)

$$\hat{X}_{n}^{j} = \frac{HE_{n}^{j}}{X_{n}^{j}} \hat{HE}_{n}^{j} + \frac{ME_{n}^{j}}{X_{n}^{j}} \hat{ME}_{n}^{j},$$

change in total spending on China-sourced goods implied by (25)

$$\hat{X}_{nC}^{j} = \hat{g}_{nC}^{j} \hat{X}_{n}^{j},$$

total spending on RoW-sourced goods (26)

$$\hat{X}_{n0}^{j} = \hat{g}_{n0}^{j} \hat{X}_{n}^{j},$$

change in total sales from m to n implied by (27)

$$\hat{X}_{nm}^{j} = \begin{cases} \hat{\lambda}_{nm}^{j} \hat{X}_{nC}^{j} & \text{for } m \neq 0 \\ \hat{X}_{n0}^{j} & \text{for } m = 0 \end{cases},$$

change in total sales of firms in region n implied by(28)

$$\hat{Y}_{n}^{j} = \sum_{m=0,1,\ldots,N} \frac{X_{mn}^{j}}{Y_{n}^{j}} \hat{X}_{mn}^{j},$$

change in total spending on intermediate input from sector j implied by (29)

$$\hat{ME}_{n}^{j} = \sum_{i=1}^{J} \frac{ME_{n}^{ij}}{ME_{n}^{j}} \hat{Y}_{n}^{i},$$

change in mass of entrants implied by (31)

$$\hat{T}_m^j = \frac{\hat{Y}_m^j}{\hat{w}_m^j \hat{f}_m^{jE}},$$

change in sectoral choice probability implied by (32)

$$\hat{\Lambda}_n^j = \frac{\hat{A}^j (\hat{w}_n^j)^\iota}{\sum_i \Lambda_n^j \hat{A}^i (\hat{w}_n^i)^\iota},$$

change in mass of workers in each sector and region implied by (33)

$$\hat{L}_n^j = \hat{\Lambda}_n^j \hat{L}_n,$$

change in average wage implied by (34)

$$\hat{\overline{w}}_n = \left(\sum_i \Lambda_n^j \hat{A}^i (\hat{w}_n^i)^\iota \right)^{1/\iota},$$

change in workers spending implied by (35)

$$\hat{HE}_n = \hat{L}_n \hat{\overline{w}}_n,$$

change in worker sectoral spending implied by (36)

$$\hat{HE}_n^j = \hat{HE}_n,$$

change in worker's location choice probability implied by (37)

$$\hat{\psi}_n = \frac{\hat{B}_n \left(\frac{\hat{\overline{w}}_n}{\hat{P}_n} \right)^\eta}{\sum_{m \in \{1,2.,..,N\}} \psi_m \hat{B}_m \left(\frac{\hat{\overline{w}}_m}{\hat{P}_m} \right)^\eta},$$

change in mass of workers in each region in China implied by (38)

$$\hat{L}_n^j = \hat{\psi}_n \hat{L}_C \quad \text{for } n \neq 0$$

change wages implied by (39)

$$\hat{w}_n^j = \frac{\hat{Y}_n^j}{\hat{L}_n^j \hat{\overline{a}}_n^j},$$

where $\hat{\overline{a}}_n^j = \hat{\overline{w}}_n / \hat{w}_n^j$,

and change wages implied by (40)

$$\hat{W}_C = \left(\sum_n \psi_n \left(\frac{\hat{\overline{w}}_n}{\hat{P}_n} \right)^{\eta} \right)^{\frac{1}{\eta}}.$$

4 Quantification

We bring the model to the data for the Chinese economy and the RoW. We consider 29 provinces of Mainland China listed in Table 2 and six manufacturing sectors listed in Table 3.[3] The sectoral classification follows the input-output tables, which we discuss in detail below.

Table 2: List of the Chinese Provinces

#	Region	#	Region
1	Beijing	16	Henan
2	Tianjin	17	Hubei
3	Hebei	18	Hunan
4	Shanxi	19	Guangdong
5	Inner Mongolia	20	Guangxi
6	Liaoning	21	Chongqing
7	Jilin	22	Sichuan
8	Heilongjiang	23	Guizhou
9	Shanghai	24	Yunnan
10	Jiangsu	25	Yunnan
11	Zhejiang	26	Gansu
12	Anhui	27	Qinghai
13	Fujian	28	Ningxia
14	Jiangxi	29	Xinjiang
15	Shandong		

4.1 Data

We use the *Chinese Industrial Enterprises Database* (CIED) from 2002–2007 to calibrate structural parameters and construct baseline equilibrium outcomes. The dataset covers over 180,000 manufacturing establishments per year in mainland China with sales exceeding 5 million Chinese Yuan (approximately 0.68 million US dollars), a threshold that applies only to privately owned firms. It includes basic establishment information such as location, industry, ownership type, and number of workers. Additionally, it provides revenue and production costs, which we use to identify structural parameters of the model.

[3] Due to data limitations, we have excluded Hainan Island and Tibet from our study.

Table 3: List of Manufacturing Sectors

Abbrev	Sector	MRIO 2002	MRIO 2007	WIOD
Food	Food and Textile	3, 4	6, 7, 8	C10-C15
Chemicals	Chemical and Petroleum	7, 8	11, 12	C19-C20
Metals	Metals and Mineral Processing	9, 10, 11	13, 14, 15	C23-C25
Machinery	Machinery and Equipment	12, 13	16, 17	C28-C30
Electronics	Electrical and Electronic	14, 15, 16	18, 19, 20	C26-C27
Others	Paper, Wood, and Other	5, 6, 17	9, 10, 21	C16-C18, C21-C22, C31-C33

We use the *Chinese Enterprise Registration Data* (CERD) from 2002–2007 to calibrate sunk entry shocks. This database contains comprehensive registration and deregistration records for all establishments in China.

We also use the *Chinese Multi-Regional Input-Output* (MRIO) tables for 2002 and 2007, as well as the *World Input-Output Database* (WIOD) to construct bilateral trade flows across regions and calibrate production function parameters. Bilateral trade flows are then used to compute trade shares and infer iceberg trade costs, as described below.

A limitation of the MRIO is that it lacks sectoral-level import and export data for each Chinese region. To address this, we complement the IO tables with the *China Customs Data* in 2002 and 2007 and construct import and export values for Chinese regions disaggregated by sector and region.[4]

4.2 Calibration

We conduct counterfactual analyses using the exact hat algebra, which allows us to compute equilibrium without identifying fundamentals such as fixed costs, amenity shock, and wage efficiency shock. Below, we outline the calibration of structural parameters and baseline equilibrium outcomes, followed by the construction of shocks to fundamentals in the counterfactual.

Structural Parameters

Cobb-Douglas preference parameters are directly observable from the input-output table. We compute the expenditure shares α^j for both China and the RoW using the 2002 WIOD, based on the final spending on each sector. Table 4 summarizes the results.

We estimate the elasticity of substitution across varieties, σ^j. A firm's profit maximization implies that revenue is proportional to total variable costs. Guided by this relationship, we

[4]The dataset includes HS codes for each transaction. We use the concordance table provided by the WTO website.

Table 4: Parameters for α^j

	Sector	α^j
Chinese Regions	Food	0.358
	Chemicals	0.019
	Metals	0.042
	Machinery	0.318
	Electronics	0.183
	Others	0.079
RoW	Food	0.325
	Chemicals	0.079
	Metals	0.038
	Machinery	0.279
	Electronics	0.141
	Others	0.137

estimate the following regression using CIED data:

$$r^j_{nlt} = \mu^j \times tvc^j_{nlt} + \epsilon^j_{nlt},$$

where r^j_{nlt} denotes the revenue of firm l in sector j in region n in year t, tvc^j_{nlt} represents total variable costs (sum of total wage payments and intermediate input purchases), and ϵ^j_{nlt} is the measurement error. Table 5 presents the results.

Table 5: Estimates of σ^j

	μ^j	Standard Error	σ^j
Food	1.217	0.001	5.608
Chemicals	1.226	0.001	5.420
Metals	1.215	0.001	5.648
Machinery	1.199	0.001	6.031
Electronics	1.195	0.001	6.132
Others	1.213	0.001	5.690

We use WIOD data to calibrate labor share β^j and intermediate input shares γ^{ji}. Table 6 summarizes the results.

For the Pareto shape parameter θ^j, we calibrate it to match $\frac{\sigma^j\theta^j}{\sigma^j-1} = 5.55$ following (Chaney, 2008; Eaton et al., 2011; Caliendo et al., 2023). Finally, we calibrate the elasticity of substitution ρ^j between domestic and foreign inputs following Hillberry and Hummels (2013), Feenstra et al. (2018), and Caliendo et al. (2023), who support the "rule of two," where the ratio of σ^j to ρ^j is 2.

Table 6: Parameters in Cobb-Douglas Production Function

		Labor	Intermediate Input Shares					
	Sector		**Food**	**Chemicals**	**Metals**	**Machinery**	**Electronics**	**Others**
Chinese Regions	Food	0.279	0.722	0.121	0.029	0.024	0.011	0.093
	Chemicals	0.225	0.030	0.722	0.063	0.046	0.033	0.107
	Metals	0.262	0.011	0.106	0.700	0.066	0.023	0.094
	Machinery	0.274	0.013	0.042	0.322	0.440	0.090	0.094
	Electronics	0.225	0.005	0.056	0.217	0.048	0.554	0.120
	Others	0.329	0.053	0.287	0.066	0.027	0.021	0.545
RoW	Food	0.310	0.658	0.093	0.062	0.022	0.013	0.152
	Chemicals	0.284	0.035	0.730	0.062	0.019	0.016	0.138
	Metals	0.348	0.009	0.076	0.764	0.047	0.033	0.072
	Machinery	0.315	0.015	0.026	0.246	0.521	0.091	0.102
	Electronics	0.345	0.008	0.049	0.182	0.048	0.607	0.105
	Others	0.388	0.042	0.220	0.099	0.041	0.041	0.558

Table 7: Pareto Shape Parameter and Elasticity of Substitution between Domestic and Foreign Inputs

Sector	θ^j	ρ^j
Food	5.436	2.941
Chemicals	5.395	2.835
Metals	5.455	2.991
Machinery	5.515	3.163
Electronics	5.513	3.159
Others	5.375	2.787

Regarding the shape parameter of the Fréchet amenity shock, η, we follow the approach of Doi and Suzuki (2025) and Suzuki (2023), who estimated an elasticity of 0.64 and 0.49, respectively, between Japanese prefectures. For comparison, Balboni (2025) report an elasticity of 0.33 for Vietnam, Fajgelbaum et al. (2019) report an elasticity of 1.5 for U.S. states, while Tombe and Zhu (2019) find an elasticity of 1.8 for eight regions in China, depending on the specification used. However, since we are working with Chinese provinces which generally exhibit more heterogeneity and local differences in economic characteristics, the location elasticity is expected to be lower than the values reported for broader regions.

Here, we index variables by the time subscript t. From the equilibrium 37, we have

$$\begin{aligned}\psi_{nt} =& \frac{B_n \left(\frac{\overline{w}_{nt}}{P_{nt}}\right)^{\eta}}{\sum_{m\in\{1,2.,..,N\}} B_m \left(\frac{\overline{w}_{mt}}{P_{mt}}\right)^{\eta}} \\ =& \frac{B_n \left(\frac{\overline{w}_{nt}}{P_{nt}}\right)^{\eta}}{\Phi_t},\end{aligned}$$

where Φ_t is the "multilateral resistance" term. After taking logs, we have the following moment condition:

$$\ln(\psi_{nt}) = \eta \ln\left(\frac{\overline{w}_{nt}}{P_{nt}}\right) + \ln(B_n) + \ln(\Phi_t) + \upsilon_{nt},$$

where we consider the unobserved amenity shock $\ln(B_n)$ as the region fixed effects, while the unobserved multilateral resistance term Φ_t as time fixed effects. Any unobserved shocks to the probability of choosing a location may influence average wages. For example, if a positive shock to a region draws more workers, the increased labor supply could drive down average wages. This would lead to downward bias in the parameter estimates under OLS. On the other hand, unobserved factors such as technological advancements or economic booms could drive up wages, resulting in upward bias in the OLS estimates. To address potential endogeneity, we construct an instrumental variable $\frac{\overline{w}_{n,t-1}}{P_{n,t-1}}$ to mitigate this issue, assuming that past real wages are correlated with current real wages but not directly affected by current errors.

We used CIED to calculate the average wages and location choice probabilities for each region from 2002 to 2007, and we employed the industrial price index from the Wind Financial Terminal. The data assumes that the price index for each region was 1 in 1978 (the year China first officially opened up to the world), allowing for comparisons both across regions and over time.

Table 8 presents the estimation results. The OLS estimate of η is higher than the IV estimate, consistent with the previous discussion. The IV estimate is 0.787, which we adopt as the baseline parameter value.

Table 8: Location Choice Elasticity (IV)

	OLS	IV
$\ln\left(\frac{\overline{w}_{nt}}{P_{nt}}\right)$	0.877	0.787
	(0.048)	(0.326)
Region FE	✓	✓
Year FE	✓	✓
First Stage		
$\ln\left(\frac{\overline{w}_{n,t-1}}{P_{n,t-1}}\right)$		0.393
		(0.086)
F-statistics		549.56
Observations	180	180

The sectoral choice elasticities are externally calibrated. We refer to the approach of Fan (2019), who used Chinese data to regress the log wage of stayers on regional fixed effects,

individual characteristics, and industry fixed effects. This regression yielded two parameters for low-skilled and high-skilled workers, with values of 2.5 and 2.73, respectively. For our analysis, we adopted the value of 2.5.

Baseline Outcomes

For counterfactual, we set 2002 as the base year and construct baseline equilibrium variables, including the expenditure share on China-sourced goods g_{nC}^j, domestic trade share s_{nm}^j, worker spending share $\frac{HE_n^j}{X_n^j}$, firm spending share $\frac{ME_n^j}{X_n^j}$, intermediate input spending share $\frac{ME_n^{ij}}{ME_n^j}$, regional sales share $\frac{X_{nm}^j}{Y_n^j}$, sectoral choice probability Λ_n^j, and location choice probability ψ_n. We derive these values using MRIO data, supplemented with the Customs Data and CIED.

Shocks to Fundamentals

We assess how Chinese regional economies would have evolved if manufacturing employment, trade costs, and entry costs experienced the shocks from big reforms.

To do so, we first treat the relative difference in manufacturing employment within Chinese regions as a shock in the counterfactual scenario. In our setup, China's total manufacturing employment L_C is exogenously given. However, during the same period, China experienced significant rural-to-urban migration and a large-scale shift of labor from agriculture to industry. To quantify this shift, we use CIED data to calculate the number of workers nationwide in both 2002 and 2007. From this, we compute the relative change in manufacturing employment between the two years, which is given by, $\frac{L_{C,2007}}{L_{C,2002}} = 2.5$, which reflects the increase in manufacturing employment during this period, capturing the labor market changes associated with migration and industrialization.

Following Head and Ries (2001), we assume symmetric trade costs ($\tau_{nm}^j = \tau_{mn}^j$) and domestic trade costs normalized to 1 ($\tau_{nn}^j = 1$)[5] and express bilateral trade costs τ_{nm}^j using bilateral trade flows X_{nm}^j:

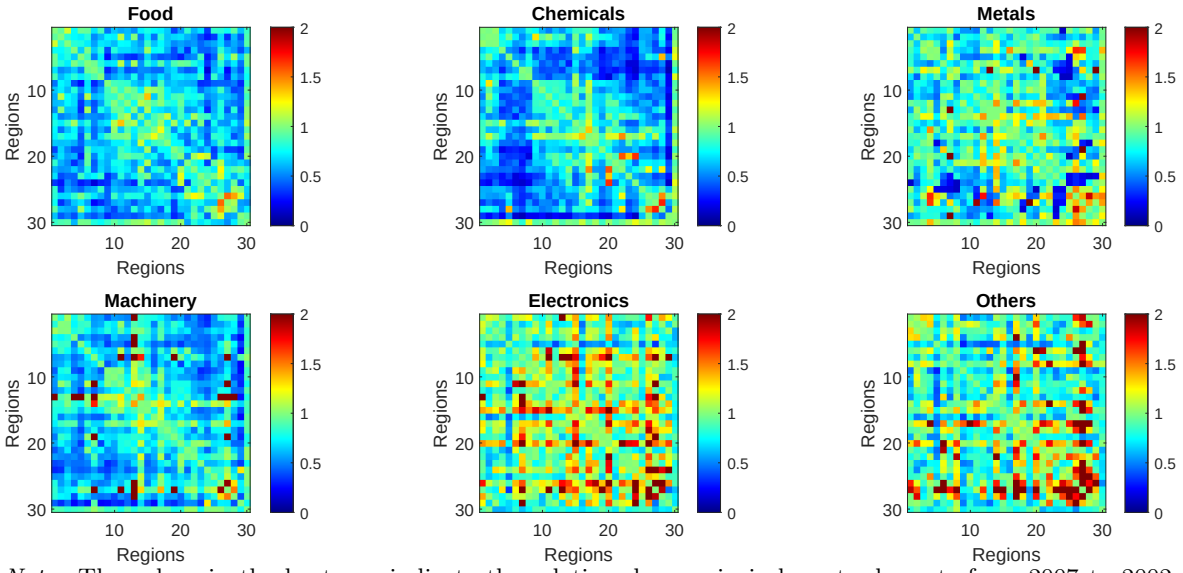
$$\tau_{nm}^j = \left(\frac{X_{nm}^j X_{mn}^j}{X_{nn}^j X_{mm}^j} \right)^{\frac{1}{2(1-\sigma^j)}}.$$

Figure 2 presents the relative changes in iceberg trade costs, $\hat{\tau}_{mn}^j = \tau_{mn,2007}^j / \tau_{mn,2002}^j$. Values below 1 (blue) indicate declining trade costs over the period, reflecting infrastructure improvements and trade liberalization. The numbers on the axes represent the 29 Chinese provinces and the RoW. Among the results for these six sectors, most regions experienced a reduction in trade costs. However, trade costs in the electronics manufacturing sector have

[5] As a robustness check, we also calibrate trade costs using a gravity model as in Eaton and Kortum (2002), finding a close correlation (0.96) between the two methods.

increased.

Figure 2: Chang in Trade Cost Ratio between 2002 and 2007



Note: The values in the heatmap indicate the relative changes in iceberg trade costs from 2007 to 2002, $\tau^j_{nm,2007}/\tau^j_{nm,2002}$.

Finally, we consider a counterfactual scenario where entry costs stay at their post-reform levels. From the equilibrium condition 31, the relative change in the sunk entry cost can be expressed as

$$\hat{f}^{jE}_m = \frac{\hat{Y}^j_m}{\hat{T}^j_m \hat{w}^j_m} = \frac{\frac{Y^j_{m,2007}}{Y^j_{m,2002}}}{\frac{T^j_{m,2007}}{T^j_{m,2002}} \frac{w^j_{m,2007}}{w^j_{m,2002}}},$$

where $Y^j_{m,2007}$ and $Y^j_{m,2002}$ represent sector j's output in region m in years 2007 and 2002, respectively. Similarly, $T^j_{m,2007}$ and $T^j_{m,2002}$ denote the mass of entrants in these years, while $w^j_{m,2007}$ and $w^j_{m,2002}$ capture the wage efficiency. We assume that wage efficiency w^j_m and the mass of entrants T^j_m are proportional to the observed average wage of employees and the number of active establishments in the dataset. We then calculate the number of active establishments in each region annually, T^j_{mm}, by cumulatively summing the registered establishments year by year and subtracting the number of deregistered establishments for each corresponding year from CERD. We obtain data on total output Y^j_m and average wage of employees from CIED.

Figure 3 presents the relative changes in sunk entry costs. Values below 1 (blue) indicate declining sunk entry costs over the period, reflecting local business climate improvements. The six sectors on the vertical axis are listed in Table 3, while the 29 regions on the horizontal axis correspond to Table 2. We observe that for most regions and industries, entry costs have

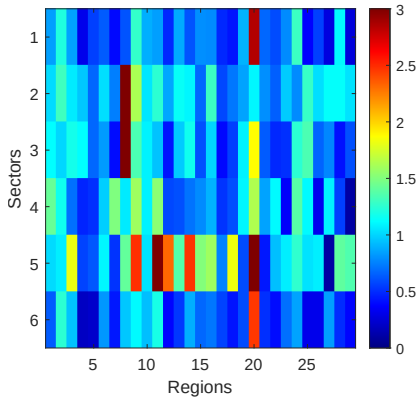


Figure 3: Chang in Sunk Entry Costs between 2002 and 2007

decreased. However, in Heilongjiang (Region 5) and Xinjiang (Region 20), entry costs have notably increased in certain industries. This is due to slower GDP growth compared to wage and enterprise growth in these more remote regions. Additionally, entry costs in many regions for the electronics manufacturing sector have increased, which is consistent with the rise in trade costs for this sector that we observed earlier. This could be attributed to higher regional entry barriers, such as stricter regulations, limited access to skilled labor, and higher costs of establishing production facilities, may have contributed. Moreover, the electronics sector might face sector-specific challenges, such as the need for more sophisticated infrastructure, which could increase entry costs in certain regions.

4.3 Counterfactuals

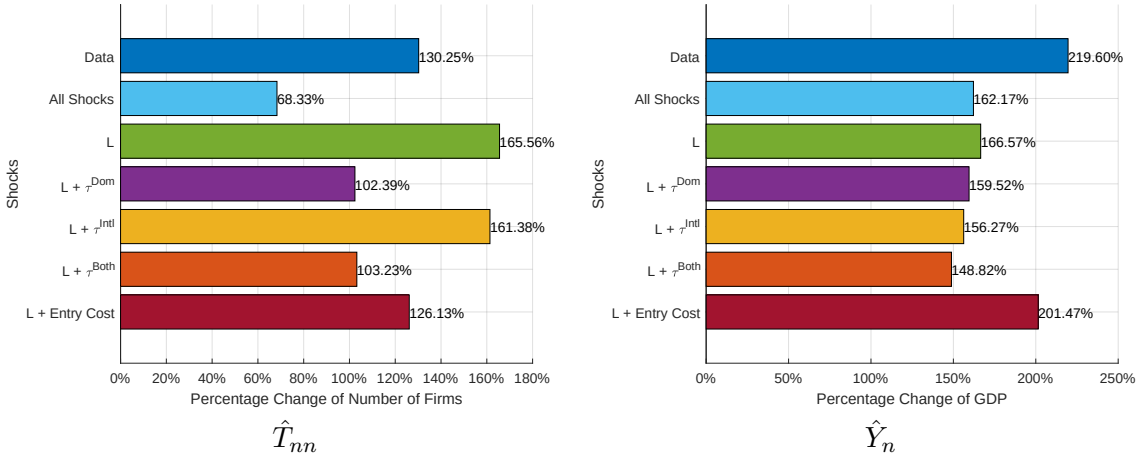
Nationwide Counterfactual Outcomes

Using 2002 as the base year, we conduct counterfactual analyses to assess the role of trade costs, sunk entry costs, and manufacturing employment in shaping the spatial distribution of economic activity during China's economic reforms. For example, by applying the shock $\hat{\tau_{mn}}^j = \frac{\tau^j_{mn,2007}}{\tau^j_{mn,2002}}$ for $m, n \neq 0$, we simulate how regional economies would have looked if domestic trade costs had remained at their 2007 levels while keeping all other factors unchanged at 2002 levels.

The results of changes in number of active firms at the nation-level are shown on the left in Figure 4. Using the observed data, we first show that the number of firms increased by 130.25% from 2002 to 2007. However, when we introduce shocks to manufacturing employment, trade costs, and sunk entry costs simultaneously, our counterfactual results show a firm growth of only 68.33%. The gap between the counterfactual and the actual data remains significant, which may partly stem from unaccounted fixed costs and other unobserved shocks.

From the green bar, we can see that the expansion of manufacturing employment is the

Figure 4: Changes in Number of Firms and GDP in Data and Counterfactuals



primary driver, leading to a firm increase of 165.56%, which exceeds both the observed 130.25% and the counterfactual 68.33%. This is because, in our model, an increase in labor supply allows more firms to enter the market.

However, when we introduce shocks to domestic trade costs, lowering trade costs increases competition among firms and the number of firms increased by 102.39%. This aligns with the core idea of Melitz (2003): more open regions face fiercer competition,where the competition from imports is larger than the expansion of export opportunities, pushing out low-productivity firms while allowing productive ones to survive and less productive ones quit. When we introduce shocks to international trade costs, the number of firms increased by 161.38% whcih is close to the result after only giving the shock to manufacturing employment. Compared to domestic trade, the competitive pressure brought by international trade is relatively smaller, as domestic trade costs play a more significant role in shaping market dynamics (Tombe and Zhu, 2019). At this point, the competition from imports is smaller than the expansion of export opportunities.

When we introduce a sunk entry cost shock, the number of firms increases by 126.13%. This is because lower entry costs reduce the barriers for new firms to enter the market, promoting greater market participation and contributing to an increase in firm numbers. The overall pattern highlights how different types of shocks affect market entry and competition in distinct ways, with expansion of manufacturing employment and reduction of entry cost reductions encouraging firm growth, while competition from domestic trade tends to consolidate the market around more productive firms.

Turing to the right panel of Figure 4, we show the changes in GDP. The impacts of different shocks on GDP are highly similar to the results of different shocks on number

of firms. Expansion of manufacturing employment remains the primary driver. Lower trade costs combine the effects of competition from imports and the expansion of export opportunities. However, we find that reducing entry costs leads to the most significant GDP growth, reaching 201.47%. This is because lower entry costs encourage more firms to enter the market, intensifying competition and driving efficiency gains. As a result, increased firm entry boosts overall productivity and contributes to sustained economic growth.

When sunk entry costs fall, the effects on GDP are more nuanced. Lower entry costs encourage more firms to enter the market, intensifying competition. While this increase in firm numbers can drive innovation and efficiency, the heightened competition may also lead to mixed outcomes—some firms thrive and contribute positively to GDP, while others may struggle to survive in a more competitive environment. Overall, the net effect on GDP depends on how well firms adapt to these changing market conditions.

Regional and Sectoral Counterfactual Outcomes

We focus on two representative provinces: Liaoning (northeastern coastal) and Sichuan (southwestern inland). We report the percentage changes from the base year in the number of firms $\hat{T}_{nn}^{j}$. To support our conclusions, we also examine changes in manufacturing employment $\hat{L}_n$, sectoral GDP $\hat{Y}_n^j$, and the productivity cutoff $\hat{\bar{\phi}}_{nn}^{j}$. The results are shown in Tables 9 and 10.

Overall, after incorporating all shocks—shocks to manufacturing employment, trade costs, and entry costs—the changes in the number of firms predicted by the model closely align with those observed in the data. In Liaoning, the number of firms increases by 97.6%, compared to a 107.3% increase in the data, while in Sichuan, the model predicts a 141.72% increase, whereas the data show a 175.72% increase. Looking more closely at the sector level, we find that the predicted changes in the number of firms across sectors after giving all shocks in Liaoning also closely match the data. This suggests that the model effectively captures changes in firm numbers at both the regional and sector levels.

The differential impact of each shock closely aligns with the overall national-level results. In both Liaoning and Sichuan, we find that an increase in manufacturing employment is the primary driver of firm growth. In contrast, a reduction in trade costs leads to a decline in the number of firms, as it combines the effects of increased competition from imports and the expansion of export opportunities. Lowering entry costs, however, results in a significant increase in the number of firms.

Next, we highlight the differences between coastal and inland regions. When domestic trade costs decrease, the decline in the number of firms is more pronounced in Sichuan than in Liaoning (Liaoning: 166.71% $\rightarrow$ 108.68% $<$ Sichuan: 171.67% $\rightarrow$ 109.24%). As an inland province, Sichuan's firms rely more on the local market compared to those in Liaoning.

Table 9: Liaoning (Northeastern Coastal)

Sector	Data	ALL	L	$L+\tau^{Dom}$	$L+\tau^{Int}$	$L+\tau^{Both}$	$L+f^{E}$
				Manufacturing Employment			
Total	**95.93%**	**158.73%**	**152.00%**	**166.67%**	**149.86%**	**164.01%**	**150.45%**
				Number of Active Firms			
Food	132.00%	77.62%	163.45%	86.87%	160.90%	86.65%	142.21%
Chemicals	91.26%	100.41%	165.19%	143.74%	162.81%	140.36%	149.09%
Metals	124.90%	113.08%	161.49%	117.38%	159.43%	115.48%	157.25%
Machinery	103.30%	105.35%	169.67%	80.75%	163.48%	79.68%	170.03%
Electronics	73.58%	74.33%	190.89%	120.76%	182.45%	110.11%	141.26%
Others	99.21%	95.93%	158.46%	120.32%	151.99%	115.76%	138.33%
Total	**107.30%**	**97.60%**	**166.71%**	**108.68%**	**162.28%**	**105.74%**	**152.31%**
				Sectoral GDP			
Food	451.19%	54.08%	158.05%	50.11%	132.39%	40.26%	206.55%
Chemicals	335.72%	458.99%	185.65%	586.82%	159.45%	532.14%	152.29%
Metals	307.30%	326.49%	192.24%	392.97%	165.02%	350.12%	214.83%
Machinery	397.71%	175.87%	188.23%	151.97%	155.16%	133.14%	218.35%
Electronics	196.61%	3.64%	151.06%	17.96%	209.37%	26.45%	92.30%
Others	480.48%	75.96%	159.88%	91.99%	158.81%	84.73%	148.72%
Total	**357.93%**	**192.39%**	**175.48%**	**221.55%**	**161.71%**	**199.09%**	**182.28%**
				Productivity Cutoff			
Food		2.26%	-2.03%	-7.73%	-2.68%	-7.73%	10.18%
Chemicals		16.28%	-0.30%	16.36%	-0.82%	16.31%	-3.12%
Metals		13.75%	0.38%	11.63%	-0.19%	11.32%	4.48%
Machinery		2.45%	-0.44%	2.09%	-1.15%	1.99%	0.56%
Electronics		-13.46%	-4.22%	-14.21%	1.08%	-11.27%	-8.27%
Others		-1.64%	-1.57%	-6.41%	-0.09%	-5.55%	1.68%

Note: The table shows changes in outcomes from 2002 to 2007. Firm numbers ($\hat{T}_{nn}^{j}$), GDP ($\hat{Y}_{n}^{j}$), productivity cutoff ($\hat{\bar{\phi}}_{nn}^{j}$), and manufacturing employment ($\hat{L}_{n}$) are reported, with "Data" reflecting observed results from the CERD and CIED. The following table is the same.

Table 10: Sichuan (Southwestern Inland)

Sector	Data	ALL	L	$L+\tau^{Dom}$	$L+\tau^{Int}$	$L+\tau^{Both}$	$L+f^{E}$
				Manufacturing Employment			
Total	**50.34%**	**191.99%**	**167.70%**	**149.90%**	**156.11%**	**140.12%**	**229.02%**
				Number of Active Firms			
Food	203.60%	115.46%	169.79%	89.12%	156.95%	82.36%	226.92%
Chemicals	125.32%	153.69%	170.89%	104.34%	158.87%	93.89%	231.17%
Metals	178.77%	163.88%	170.57%	125.46%	156.78%	113.36%	225.50%
Machinery	130.52%	96.29%	174.29%	91.10%	164.46%	82.59%	220.40%
Electronics	97.78%	184.30%	196.93%	163.98%	182.55%	151.63%	264.52%
Others	223.75%	177.16%	168.01%	127.17%	155.26%	117.75%	236.17%
Total	**175.72%**	**141.72%**	**171.67%**	**109.24%**	**159.11%**	**99.83%**	**229.27%**
				Sectoral GDP			
Food	338.09%	200.68%	210.99%	115.78%	175.79%	101.34%	450.80%
Chemicals	241.45%	351.35%	214.29%	163.53%	170.35%	125.82%	523.50%
Metals	196.23%	352.35%	214.75%	148.05%	170.79%	120.08%	524.11%
Machinery	238.31%	131.75%	216.03%	146.18%	170.96%	110.99%	426.98%
Electronics	172.38%	200.99%	222.66%	220.83%	154.09%	146.76%	411.20%
Others	369.28%	255.28%	211.36%	105.24%	171.22%	82.90%	513.23%
Total	**249.68%**	**261.75%**	**214.81%**	**149.70%**	**169.78%**	**116.22%**	**480.50%**
				Productivity Cutoff			
Food		11.29%	-0.35%	3.16%	0.28%	4.33%	8.31%
Chemicals		14.50%	-0.23%	5.55%	-0.23%	5.41%	8.72%
Metals		20.22%	-0.18%	2.46%	-0.05%	3.03%	15.39%
Machinery		-3.55%	-0.35%	5.41%	-0.57%	5.14%	-3.62%
Electronics		-2.60%	-1.40%	4.30%	-2.89%	2.05%	-3.57%
Others		18.21%	-0.20%	-1.19%	0.09%	-0.79%	18.58%

Consequently, the reduction in local trade costs intensifies market competition in Sichuan, leading to the exit of less efficient firms and a larger overall decline in firm numbers.

However, when we lower international trade costs, Sichuan again experiences a greater decline in the number of firms (Liaoning: $166.71\% \rightarrow 162.28\% <$ Sichuan: $171.67\% \rightarrow 159.11\%$). This may seem counterintuitive, given that Liaoning, as a coastal province, is more engaged in international trade. While lower international trade costs increase export opportunities, they also heighten competition from foreign firms. Nevertheless, firms in Liaoning are generally more competitive in global markets and thus better equipped to adapt to these changes, resulting in a smaller decline in firm numbers compared to Sichuan. This pattern is further supported by changes in regional GDP. Since firms in coastal regions tend to be more productive, the reduction in both domestic and international trade costs leads to a greater decline in Sichuan's GDP compared to Liaoning's.

Furthermore, we find that the model captures each region's development of its core sectors. If all shocks are applied, the metals sector in Liaoning would experience the largest increase in the number of firms, rising by 113.08%. This is because metals is a key pillar industry in Liaoning, and as a coastal region, it provides new metals firms with easier access to international trade.

Meanwhile, in Sichuan, the electronics manufacturing sector would see a significant increase under the same shocks. Sichuan, as one of China's most populous provinces, offers lower labor costs compared to coastal regions. Since electronics manufacturing is labor-intensive, this sector tends to expand inland in response to cost advantages. As more less prodictive small firms entered, the productivity cutoff thus declined by 13.46%.

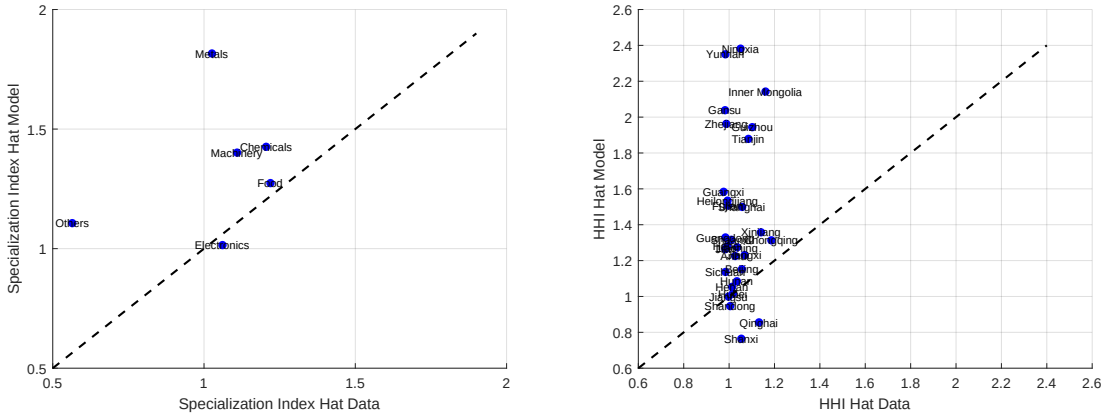
Taken together, these patterns align with our earlier findings in the descriptive evidence and model captures the change of number of firms.

Specialization

The changes in the spatial distribution of firms are closely linked to specialization, as industries tend to concentrate in regions where they have a comparative advantage, driven by factors such as labor costs, trade accessibility, and local market conditions. Figure 5 shows the changes in the specialization index and HHI after applying all shocks. The y-axis represents the model's simulated results, while the x-axis shows the results calculated using CIED.

Overall, we find that after expanding manufacturing employment, and reducing trade and entry costs, both the sector-level specialization index and the regional-level HHI have increased. Although the model over-predicts the results, with the model's outcomes lying above the 45-degree line compared to the data, it still demonstrates that these factors contribute to an increase in the specialization of Chinese manufacturing.

Figure 5: Changes of Specialization



$\hat{G}^j$ $H\hat{H}I_n$

Welfare

We measure drivers of the change of welfare, as shown in Table 11 reveals how each shock contributes to the overall welfare change. The baseline scenario with all shocks included shows a welfare increase of 162.93%. When the domestic trade cost shock is removed, welfare drops to 114.50%, indicating a 8.42% reduction. This significant impact shows reduced domestic trade costs enhance competition, driving less productive firms out of the market and allowing more productive firms to thrive. In contrast, eliminating the international trade cost shock only reduces welfare to 145.58%. This suggests that while international competition and expanded export opportunities are beneficial, domestic trade liberalization plays a much larger role in boosting welfare.

The largest impact comes from the labor supply shock. When this shock is excluded, welfare increases by 40.48%, translating to a massive 121.38% drop. This finding underscores the critical role of labor availability in driving firm entry and economic expansion. The sunk entry cost shock also has a notable effect: without it, welfare is 142.55%. Lower entry costs make it easier for new firms to enter the market, increasing competition and contributing to welfare improvements.

Table 11: Drivers of the Change of Welfare

	All Shocks	w/o L	w/o τ^{Dom}	w/o τ^{Int}	w/o τ^{Both}	w/o f^E
	162.93%	41.55%	114.50%	156.58%	108.08%	142.55%
Δ	0.00%	121.38%	48.42%	6.35%	54.85%	20.37%

5 Conclusion

This study examines how reductions in international and domestic trade costs, firm entry costs, and the expansion of manufacturing employment have influenced the spatial distribution of firms and economic activity in China. To analyze these dynamics, we develop a unified quantitative framework that incorporates multiple sectors and regions with heterogeneity. We calibrate the model to the data and conduct counterfactual simulations to assess the effects of rural-to-urban migration, sectoral heterogeneity, local business climate, and shifts in both international and domestic trade costs on firm location and overall welfare.

Our counterfactual analysis reveals that reductions in domestic trade costs have a greater impact on firm distribution than changes in international trade costs. The combined effects of increased manufacturing employment, lower trade costs, and reduced entry barriers drive substantial firm growth, particularly in inland regions such as Sichuan. In contrast, coastal regions experience relatively slower firm growth due to intensified competition, despite benefiting from expanded international trade opportunities.

Moreover, manufacturing employment growth emerges as the primary driver of firm expansion, while lower entry costs significantly contribute to GDP growth. Notably, removing the reduction in domestic trade costs leads to a decline in welfare, underscoring the critical role of domestic trade liberalization in enhancing market efficiency and overall economic well-being. Taken together, our findings highlight the central role of manufacturing employment, entry costs, and domestic trade costs in shaping the spatial distribution of Chinese manufacturing and driving welfare gains.

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Appendix

A More Evidence on Geography

Figure A1 illustrates the spatial distribution of establishments in two representative sectors. In the early 2000s, foreign investment in electronics primarily flowed into coastal regions. However, by 2005, many electronics firms began relocating inland to capitalize on cheaper labor costs. In contrast, steel companies, which heavily depend on imported raw materials, continued to cluster in coastal areas.

Figure A2 illustrate establishment of particular company groups. For the Foxconn group (one of the largest electronic manufacturing companies in the world), we observed a shift from a coastal dominance to a more balanced distribution between coastal and inland regions. Meanwhile, the distribution of Angang group (China's largest steel manufacturing company) transitioned from a more dispersed pattern to a clear concentration in coastal regions. This evidence underscores the regional and sectoral heterogeneity in the spatial distribution of firms.

B More Evidence on Specialization

We compute the Herfindahl-Hirschman Index (HHI) for each region following $HHI_n = \sum_j (\frac{Y_n^j}{Y_n})^2$, which captures the concentration of the six manufacturing sectors within each region. The HHI is defined as the sum of the squared market shares of all manufacturing sectors, as shown in Table A1. The maximum possible value of HHI is 1, which occurs when a single industry holds 100% of the market share, while all other sectors have a market share of zero. The results in Table A1 suggests that the concentration of manufacturing sectors increased the most in the western region, with an HHI growth of 6.24%, while the northeastern region experienced the least change, with only a 0.34% increase, indicating a relatively stable industrial distribution from 2002 to 2007.

Table A1: Regional HHI

Year	Central	Eastern	Northeastern	Western
2002	0.186	0.200	0.192	0.209
2007	0.188	0.208	0.193	0.222
Δ	0.003	0.007	0.001	0.013
$\%\Delta$	1.60%	3.64%	0.34%	6.24%

"Fit" of The Model

Here, we present the simulation results of our model. By introducing shocks (manufacturing employment, trade costs, and sunk entry costs) to the baseline year 2002, we assess how

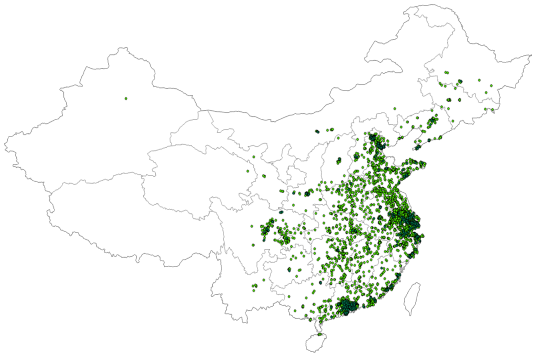
Figure A1: New Entrants



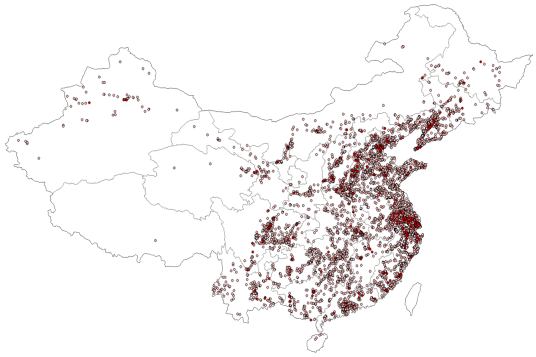
(a) Electronics 1998



(b) Steel 1998



(c) Electronics 2013



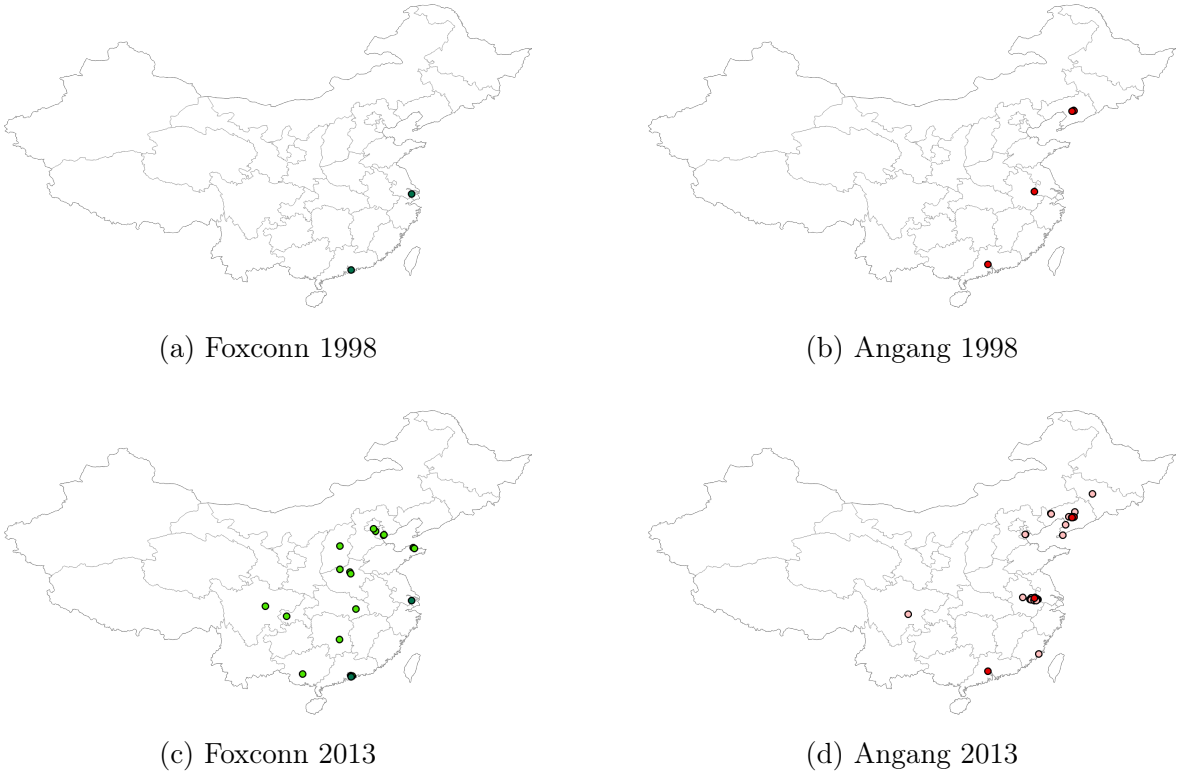
(d) Steel 2013

Note: The maps display the spatial distribution of new entrants in 2013 for both the electronics and steel industries. The top left panel shows the electronics industry in 1998, the top right panel shows the steel industry in 1998, the bottom left panel shows the electronics industry in 2013, and the bottom right panel shows the steel industry in 2013. Light colors indicate new entrants in 2013, while dark colors represent establishments that existed in 1998.

Table A2: HHI

		2002	2007	Δ	%Δ
Eastern	**Mean**	0.186	0.188	0.003	1.60%
	Beijing	0.177	0.187	0.010	5.64%
	Tianjin	0.171	0.185	0.015	8.50%
	Hebei	0.198	0.196	-0.001	-0.73%
	Shanghai	0.172	0.182	0.010	5.73%
	Jiangsu	0.183	0.182	-0.001	-0.69%
	Zhejiang	0.185	0.183	-0.002	-1.25%
	Fujian	0.205	0.204	-0.001	-0.52%
	Shandong	0.194	0.195	0.001	0.76%
	Guangdong	0.185	0.182	-0.003	-1.61%
Central	**Mean**	0.200	0.208	0.007	3.64%
	Shanxi	0.279	0.294	0.015	5.39%
	Anhui	0.175	0.179	0.005	2.69%
	Jiangxi	0.174	0.186	0.012	6.84%
	Henan	0.192	0.194	0.003	1.33%
	Hubei	0.201	0.205	0.003	1.68%
	Hunan	0.182	0.188	0.006	3.43%
Western	**Mean**	0.209	0.222	0.013	6.24%
	Inner Mongolia	0.215	0.249	0.034	16.05%
	Guangxi	0.192	0.187	-0.005	-2.41%
	Chongqing	0.224	0.266	0.042	18.62%
	Sichuan	0.185	0.182	-0.003	-1.58%
	Guizhou	0.195	0.215	0.020	10.21%
	Yunnan	0.207	0.204	-0.003	-1.64%
	Shaanxi	0.180	0.182	0.002	1.00%
	Gansu	0.220	0.216	-0.004	-1.79%
	Qinghai	0.259	0.293	0.034	13.17%
	Ningxia	0.205	0.215	0.010	5.06%
	Xinjiang	0.224	0.256	0.031	14.05%
Northeastern	**Mean**	0.192	0.193	0.001	0.34%
	Liaoning	0.182	0.188	0.006	3.56%
	Jilin	0.194	0.190	-0.003	-1.65%
	Heilongjiang	0.199	0.198	-0.001	-0.68%

Figure A2: Establishment of Particular Company Groups



(a) Foxconn 1998 (b) Angang 1998

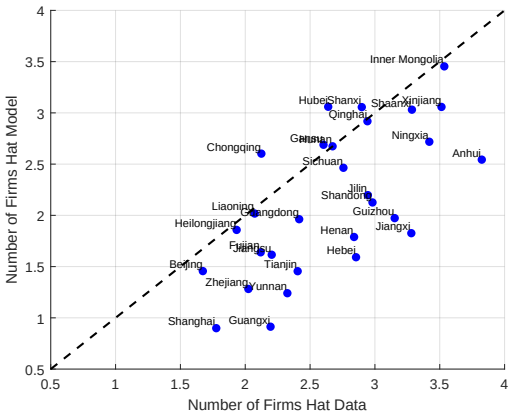
(c) Foxconn 2013 (d) Angang 2013

Note: This figure illustrates the spatial distribution of establishments for Foxconn (electronics) and Angang Group (steel) in both 1998 and 2013. The top left panel shows Foxconn's establishments in 1998, the top right panel shows Angang Group's establishments in 1998, the bottom left panel shows Foxconn in 2013, and the bottom right panel shows Angang Group in 2013. Light colors indicate new establishments in 2013, while dark colors represent establishments from 1998.

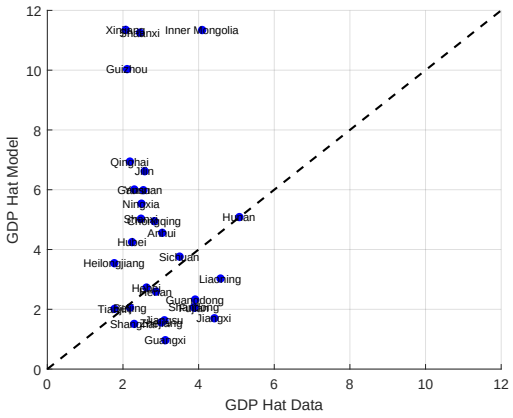
closely the simulated outcomes align with the actual data from 2007. While we cannot capture every shock, we believe the three shocks (to trade costs, sunk entry costs, and labor) played a significant role in driving China's economic development. The results are shown in Figure A3. The x-axis represents the observed data, while the y-axis shows the simulated results of the model after incorporating the shocks.

From the figures, the number of active firms ($\hat{T}_{nn}$) show that almost all regions align closely with the 45-degree line. However, the model fails to capture the simulated results for GDP ($\hat{Y}_n$).

Figure A3: "Fit" of the Model



$\hat{T}_{nn}$



$\hat{Y}_n$