THE DECLINE IN CHINA'S TRADE SHARE OF GDP: A STRUCTURAL ACCOUNTING *

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ABSTRACT

China's trade share of GDP has declined since 2007. To understand this, I develop a multi-sector, multi-region Ricardian trade model to quantify the forces driving China's trade share over 2002–2015. The model incorporates shocks to productivity, international and internal trade costs, labor mobility frictions, and factor supplies, as well as a non-homothetic preference structure. These shocks affect the trade share primarily by reshaping comparative advantage and thereby reallocating sourcing across origins and sectors. Building on the model, I first show that this ratio is pinned down by the domestic expenditure share and is therefore important not only as a measure of openness but also as a reduced-form proxy for gains from trade. I then calibrate the model and conduct a structural decomposition. The results indicate that falling international trade costs, especially in industry, account for most of the rise in China's trade share from 2002 to 2007. After 2007, fundamental productivity growth, concentrated in industry and services, together with capital deepening, accounts for most of the decline in the trade share, while preference changes induced by non-homothetic preferences play a minor role.

Keywords: China's trade share of GDP; Trade cost; Productivity; Structural change; Internal trade.

JEL Codes: F11, F43, O53.

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1. Introduction

The economic growth of China is one of the most important changes in the world economy over the last several decades. One key feature of this growth is China's increased participation in the global economy, as reflected in its rising shares of world GDP and world trade. Yet a notable trend has emerged: China's trade share of GDP has been steadily declining since the mid-2000s; prior to that, it had broadly trended upward since the onset of China's opening-up in the late 1970s.

This pattern is interesting in its own right, and it also matters from two perspectives. First, the trade share of GDP is a widely used and intuitive measure of trade openness, yet we know relatively little about the mechanisms through which fundamentals and frictions shape this ratio. China provides a particularly useful setting to study these mechanisms: as a large and representative developing economy, it saw a pronounced rise and then a rapid decline in measured openness over its development path. Identifying the mechanisms behind this reversal clarifies how trade openness responds to key drivers that also shape economic development and provides a benchmark for interpreting similar openness dynamics in other developing economies. It also sharpens the interpretation of empirical findings that use this ratio as a proxy for openness in related work.

Second, the trade share of GDP matters because it is tightly linked to the gains from trade. In the class of models summarized by Arkolakis, Costinot, and Rodríguez-Clare (2012), ex-post welfare gains from trade are a simple function of the domestic expenditure share and the trade elasticity. Building on this framework, a simple mapping can be derived between a country's trade share of GDP and its domestic expenditure share, so that movements in the trade share of GDP can be interpreted as movements in a reduced-form, data-based index of gains from trade over time. China is a natural case: its trade share of GDP rose sharply and then fell, implying large swings in the gains-from-trade index. Explaining what drives these movements helps us track how the benefits from China's integration into world markets have evolved and sheds light on the changing link between China's growth and the global economy.

In this paper, I develop a multi-sector, multi-region Ricardian trade model, drawing on Eaton and Kortum (2002), Caliendo and Parro (2015), and Sposi, Yi, and Zhang (2025), to quantify the forces driving changes in China's trade share of GDP over 2002–2015. The main shocks ("wedges") in the model include fundamental productivity, international and internal trade costs, internal labor mobility costs, labor and capital endowments, trade-imbalance wedges (saving wedges), production structure wedges, and preference wedges, together with non-homothetic preferences on the demand side. These wedges and the preference structure are chosen to capture the key forces behind China's rising importance in the global economy, its structural transformation, and its deepening domestic economic integration during the period under study. I then calibrate the model and conduct structural accounting decompositions to evaluate the contributions of each wedge to the changes in China's trade share of GDP. The results show that falling international trade costs, especially in industry, account for most of the rise in China's trade share from 2002 to 2007. From 2007 to 2015, fundamental productivity growth, concentrated in industry and services and of comparable magnitude, together with capital deepening, accounts for most of the decline in the trade share, while preference changes induced by non-homothetic preferences play a minor role.

I begin by clarifying the welfare interpretation of the trade share of GDP. In particular, I derive a multi-sector gains-from-trade expression and show that the same domestic-expenditure shares that enter the openness decomposition also govern welfare in the ACR sense (Arkolakis, Costinot and Rodríguez-Clare, 2012). To make this link as transparent as possible, I also present the one-sector special case, which delivers a simple closed-form mapping between the trade share of GDP and gains from trade. These results motivate studying changes in this ratio not only as movements in measured openness but also as movements in a reduced-form proxy for gains from trade.

I then turn to mechanisms. To clearly articulate how wedges affect China's trade share of GDP, I begin with a model-free decomposition. Specifically, I express China's trade share of GDP in terms of two objects: the export share of value added, which measures the fraction of domestic production absorbed abroad, and the import share of value added, which measures the fraction of domestic expenditure sourced from abroad. Changes in fundamentals—such as productivity, trade costs, factor endowments, and other wedges—shift production, expenditure, and sourcing patterns, and therefore move both objects.

Next, I express each object as a weighted aggregation of contributions from Chinese region–sector blocks. For the export share of GDP, the weight on each region–sector block is its share in aggregate Chinese output, which captures that block's importance on the production side. Its contribution is the product of three terms: the ratio of foreign sectoral consumption to foreign sectoral income, which captures each foreign region's tendency to run a deficit to consume; the ratio of foreign sectoral income to the income of the corresponding Chinese region–sector block, which scales the size of foreign demand; and the sectoral expenditure share of foreign regions on varieties produced by that block, which captures foreign sourcing patterns.

For the import share of GDP, the weight on each Chinese region–sector block is its expenditure share in aggregate Chinese spending, which captures that block's importance on the demand side. Its contribution is again the product of three terms: the ratio of aggregate domestic expenditure to aggregate domestic income, which captures China's tendency to run a deficit to consume; a relative-income term that equals one and thus simply normalizes the size of domestic demand; and the sectoral expenditure share of that region–sector block that is spent on foreign suppliers, which captures domestic sourcing patterns.

In the structural model, wedges move China's trade share of GDP by shifting (i) sourcing patterns—who buys from whom—and (ii) the sector–region weights and scaling terms that aggregate those sourcing shares into imports and exports. First, higher productivity or larger factor endowments in Chinese region–sector blocks reduce marginal costs and make Chinese varieties cheaper relative to foreign ones. This shifts spending toward Chinese suppliers and therefore lowers the import share of GDP. The same shock also lowers the export share because faster growth in Chinese output and income compresses foreign demand relative to China: the scaling term that maps foreign absorption into exports falls, and this contraction dominates the increase in foreign sourcing from China. Lower internal migration frictions work through similar production-cost and sourcing channels, but their aggregate effect is a priori ambiguous because inflow regions become cheaper and source more domestically, while outflow regions become costlier and more import-reliant.

Second, trade-cost wedges primarily operate by changing delivered prices and thereby reshuffling who buys from whom. Specifically, when external import costs fall, foreign varieties become cheaper for Chinese buyers, Chinese regions source more from abroad, and China's import share of GDP rises. At the same time, cheaper imported intermediates reduce production costs in China, so foreign buyers source more from Chinese regions and China's export share of GDP rises as well. The same logic applies in reverse for external export costs: when it becomes cheaper to sell Chinese goods abroad, exports rise directly, and the associated general-equilibrium cost and price-index adjustments can also affect imports in same direction. Meanwhile, when internal trade costs within China fall, domestic integration deepens: Chinese regions become closer substitutes for one another and displace foreign suppliers in domestic absorption, which lowers the import share sourced from abroad and thus reduces China's import share of GDP.

Third, several other wedges shift openness mainly by reweighting the economy toward more- versus less-tradable activities. On the demand side, taste wedges tilt final expenditure across sectors; when they push spending toward services, aggregate trade intensity falls mechanically because services are less tradable. On the production side, production-structure wedges shift input demand: moving away from primary factors toward traded intermediates tends to raise gross trade, but the effect is limited when the expanding intermediates are themselves less tradable, such as service inputs. More broadly, saving wedges reallocate trade imbalances across regions. When foreign regions borrow and China saves, foreigners consume more than they produce while China consumes less than it produces. As a result, China runs a surplus: its export share of GDP rises and its import share of GDP falls.

The quantitative model is implemented for 9 regions (8 regions within mainland China and one aggregate rest-of-world (ROW) region) and 3 sectors (agriculture, industry, and services). Due to data availability, the implementation covers the years 2002, 2007, and 2015. To calibrate the time-varying wedges, I borrow the methodology developed by Eaton and Kortum (2002), which is also employed in Waugh (2010), Levchenko and Zhang (2016), Sposi, Yi and Zhang (2025), and Santacreu, Sposi, and Zhang (2023). Specifically, I first construct time-comparable sectoral intermediate-goods prices. One measure is imputed from the production structure and sectoral value-added prices, following Sposi, Yi and Zhang (2025), using the algebraic mapping between value-added prices and gross-output prices implied by the production function coefficients. The other measure is obtained by estimating the model-implied gravity equation by sector and year and then imputing relative sectoral price levels from the importer fixed effects. To reduce measurement noise, I then average the implied changes in log prices from these two measures and apply them to a common base-year price level to obtain calibrated series of sectoral intermediate-goods prices. Given these prices, observed bilateral expenditure shares, factor incomes, and migration flows, I use the model-implied analytical equations to recover sector–region productivities, bilateral trade costs, and labor-mobility costs. Saving wedges are set equal to regional net exports as a share of value added, and taste parameters are inferred by matching sectoral value-added expenditure shares and aggregate consumption.

The calibration results replicate the observed data well. They also reveal a clear pattern in the time-varying wedges across the two calibration periods. Specifically, fundamental productivity in China rises strongly in both subperiods, especially in industry and services. External and internal trade costs fall sharply before 2007—most notably in services—but then stabilize or edge up slightly, with post-2007 increases in import costs larger than those in export costs. Labor-mobility costs decline throughout, though the average reduction slows over time and masks large cross-regional asymmetries. The remaining wedges indicate pronounced capital deepening in China in both subperiods, a saving wedge that first raises and then lowers China's external surplus, and taste and production-structure wedges that shift expenditure and input use first toward industry and then gradually toward services.

To quantify how different forces shape China's trade share of GDP, I run three sets of counterfactuals. First, I start with a transparent wedge-by-wedge counterfactual exercise. For each wedge group, I compare the terminal-year baseline to a counterfactual that holds that wedge at its base-year level while allowing all other wedges to follow their terminal-year values. I then attribute the resulting changes in external and internal trade shares of GDP and in real value added per worker to that wedge group. I refer to this procedure as a structural accounting decomposition. I implement it over eight wedge groups—China's productivity, internal and external trade costs, labor mobility and labor supply, capital supply, taste wedges, saving wedges, production structure, and a ROW group. Second, I repeat the decomposition for selected wedges—China's productivity, China's trade costs, and ROW forces—at a finer level of detail (e.g., by sector or by wedge components). Third, in order to see the mechanisms through which structural change affects China's trade share of GDP, and to assess how trade-balance assumptions affect the decomposition results, I repeat the structural accounting decomposition under non-homothetic versus Cobb–Douglas preferences and under unbalanced versus balanced trade.

The decompositions show a sharp contrast between the two subperiods. From 2002 to 2007, the rise in China's external trade share of GDP is driven mainly by falling external trade costs, which raise the export and import shares by 6.8 and 6.6 percentage points (p.p.), respectively. Stronger saving wedges, a shift in production structure away from endowment-intensive inputs toward tradable intermediates, and ROW wedges each add about 4 p.p. to the export share. China's own productivity growth works in the opposite direction, lowering the export and import shares by 11.3 and 7.6 p.p. Sectoral decompositions show that these movements are concentrated in industry, with agriculture and services playing smaller roles. From 2007 to 2015, the pattern reverses. Domestic productivity growth becomes the main force behind the decline in the trade share, reducing the export and import shares by 6.7 and 6.3 p.p. Capital deepening is the second key driver, lowering them by 3.4 and 2.6 p.p. through the same mechanism: cheaper home production and a larger relative economic size. Changes in trade costs and other wedges are modest. Within the productivity wedge, the decline is driven primarily by productivity gains in industry and services, with agriculture playing only a small role.

Furthermore, the counterfactuals show that neither the structural-change mechanism embedded in non-homothetic preferences nor the balanced-trade assumption changes the main message. Relative to a Cobb–Douglas benchmark, non-homothetic preferences imply only small additional declines in the trade share of GDP: -0.8 and -0.7 p.p. for exports and imports from 2002 to 2007, and about -0.6 p.p. for both from 2007 to 2015. Likewise, imposing balanced trade—which shuts down the saving wedge—leaves the ranking of forces unchanged: the calibrated wedges explain 5.6 of the 10.1 p.p. rise in the trade share from 2002 to 2007 and -9.2 of the -12.4 p.p. fall from 2007 to 2015, with falling external trade costs dominant in the first interval and domestic productivity growth and capital deepening dominant in the second.

The same counterfactuals also shed light on China's internal trade share of GDP and real value added per worker. From 2002 to 2007, the internal trade share rises by 21.1 p.p., driven mainly by falling internal trade costs, which account for a 16.7 p.p. increase; productivity growth is a secondary force, adding 4.6 p.p. From 2007 to 2015, the internal trade share is roughly flat: a 3.4 p.p. drag from higher internal trade costs is largely offset by productivity, capital deepening, and other wedges. Real value added per worker rises mainly because of productivity growth, which leads to a 32.3% increase from 2002 to 2007 and a 47.5% increase from 2007 to 2015. Capital deepening is the second driver, which leads to a 15.0% increase from 2002 to 2007 and a 22.6% increase from 2007 to 2015, while trade costs, saving wedges, and ROW forces make only limited contributions.

The paper is related to the literature linking trade with the geographical distribution of economic activity. This literature includes studies such as Waugh (2010), Caliendo and Parro (2015), Waugh and Ravikumar (2016), Allen and Arkolakis (2014), Redding (2016), Caliendo, Parro, Rossi-Hansberg, and Sarte (2018), Caliendo, Dvorkin, and Parro (2019), Rodríguez-Clare, Ulate, and Vasquez (2026) and Ma and Tang (2020). Besides interregional trade and international trade, I further incorporate labor flow under frictions across China's regions in a manner similar to Allen and Arkolakis (2014) Ahlfeldt, Redding, Sturm, and Wolf (2015), Redding (2016), Tombe and Zhu (2019), and Fan (2019). This strand of literature primarily focuses on the welfare implications of several exogenous forces, including but not limited to changes in tariffs, labor mobility costs, and productivity. This paper focuses on explaining the mechanism responsible for changing an economy's trade share of GDP as implied by the Ricardian trade model I have developed.

The paper is also related to the literature on trade and the Chinese economy. In terms of this strand, the most closely related paper is Brandt and Lim (2024). They study the forces shaping China's manufacturing trade and ask which forces account for the slowdown in the growth rate of China's manufacturing exports between 2000 and 2013. Huang, Ju, and Yue (2024) study the evolution of China's manufacturing production and trade patterns and account for the main forces behind these changes. Most recently, Alessandria, Khan, Khederlarian, Ruhl, and Steinberg (2025) study the rise of Chinese commodity exports to the United States from near autarky to about 15% of U.S. imports, highlighting the role of trade policy expectations in shaping the dynamics of export flows. This paper contributes to this strand by quantifying changes in China's trade share of GDP—a standard measure of openness and a reduced-form data proxy for the gains from trade—for both exports and imports, rather than manufacturing export levels per se, and I find that growth in service-sector fundamental productivity plays a key role—one as important as the effect of industry productivity growth—in the post-2007 decline in China's trade share of GDP.

The paper is further related to work on structural change in open economies and its implications for measured openness. In this class of models, sectoral expenditure shares move with income and relative prices, so the trade share of GDP can change as demand shifts across sectors, especially because some sectors are less tradable than others. Uy, Yi, and Zhang (2013) develop a three-sector open-economy model with non-homothetic preferences and show, in a quantitative application to Korea, how trade interacts with structural transformation to shape sectoral reallocation. McMillan, Rodrik, and Verduzco-Gallo (2014) document large productivity gaps between traditional and modern sectors and show that structural change has often reduced growth in Africa and Latin America, with a more positive pattern for Africa after 2000. Focusing directly on openness, Lewis, Monarch, Sposi, and Zhang (2022) quantify how the global shift toward services restrains the world trade share of GDP and dampens the gains from trade. Building on these insights, I quantify how structural change contributes to movements in China's trade share of GDP, while explicitly accounting for features central to China's development experience over the period studied, including internal migration, sector-specific internal and external trade costs, and heterogeneity in fundamental productivity across Chinese regions.

The rest of the paper is organized as follows. Section 2 presents motivating facts. Section 3 lays out the model and describes the mechanisms. Section 4 describes the data, calibrates the key parameters and shocks, and summarizes the calibrated wedges. Section 5 conducts counterfactual structural decompositions and discusses the results. Section 6 concludes.

2. Motivating Facts

In this section, I document three facts about China's openness, output, and spending patterns. First, I describe changes in China's trade share of GDP and compare them with those of other economies. Second, I take a disaggregated view—by sector and by Chinese region—decomposing changes in the trade share of GDP into within- and between- components and briefly summarizing shifts in sectoral expenditure shares. Third, I demonstrate that, during the same period as China's trade and GDP changes, the country experienced significant internal economic integration, as evidenced by changes in its internal trade share of GDP and cross-province migration.

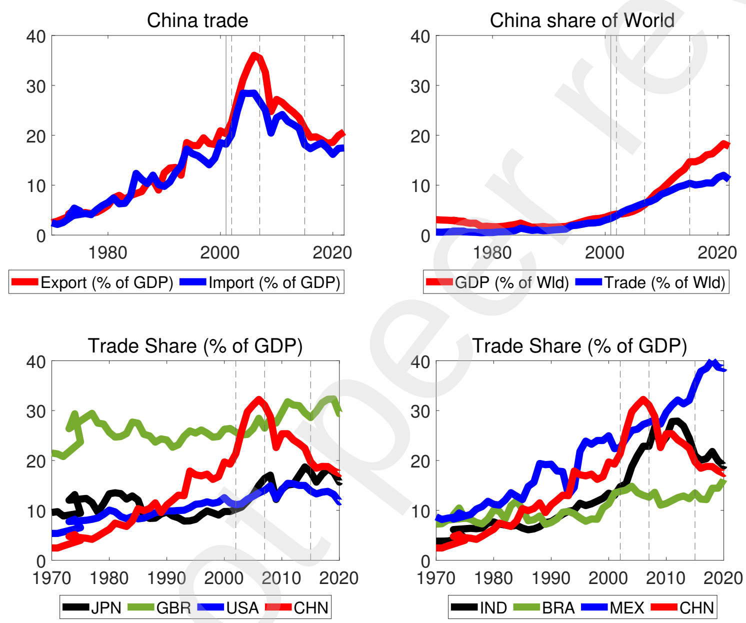
Overall changes As one of the most common measures of "trade openness," the ratio of trade to GDP provides insight into the extent to which a country's economy is connected to the global economy through trade.[1] As depicted in Figure 1, from 1970 to 2020, China's trade share of world trade consistently increased, with a notable acceleration after 2000. During the same period, China's GDP share of world GDP followed a similar upward trend. However, despite the continued growth in both China's GDP share of world GDP and its trade share of world trade, its trade share of GDP has reversed its several-decade upward trend and begun declining from the mid-2000s. Specifically, China's average export and import trade share of GDP peaked at 32.2% in 2006. Since then, it has declined, reaching

1. See Spilimbergo, Londoño, and Székely (1999); Rodrik (2002); Dollar and Kraay (2003); Yanikkaya (2003); Dollar and Kraay (2004); Giovanni and Levchenko (2009).

19.1% in 2022. This level is even lower than the 19.7% in 2000 before China joined the WTO.

Compared to other countries, China's trade share of GDP experienced more rapid growth, especially during 2001–2006, with both levels and slopes surpassing those of most developed and developing nations. After 2006, it also declined more rapidly, whereas many other countries either maintained their previous trends or levels. India shows a similar pattern to China, but its trade share peaked in 2011 at a lower level, with overall variations being less pronounced compared to China.

Figure 1
China's Trade and GDP Patterns and Trade-Share-of-GDP Comparisons



Notes: The solid line denotes the year 2001, when China acceded to the WTO. The three dotted vertical lines indicate the years 2002, 2007, and 2015, which correspond to the periods for which counterfactual analysis was performed. The data utilized are sourced from the World Development Indicators (WDI) database.

Sectoral and Regional Decomposition and Expenditure-Share Patterns To further examine changes in China's trade share of GDP at a more disaggregated level, I proceed in three steps. First, I decompose the aggregate change in China's trade share of GDP into within-sector and between-sector components. Second, I apply an analogous decomposition across eight Chinese regions, yielding within-region and between-region effects.[2] Finally, I briefly discuss the evolution of China's sectoral expenditure and value-added shares over the same period.

2. The eight regions within mainland China are: A. Northeast, B. Beijing and Tianjin, C. Northern Coastal, D. Eastern Coastal, E. Southern Coastal, F. Central, G. Northwest, and H. Southwest.

The aggregate change in China's trade share of GDP can be decomposed at the sector level into two components:

$$\Delta \frac{\sum_k T_k}{\sum_k Y_k} \equiv \sum_k \left(\bar{\omega}_k \cdot \Delta S_k \; + \; \Delta \omega_k \cdot \bar{S}_k \right), \tag{1}$$

where Y_k and T_k denote, respectively, value added and international trade (exports plus imports) in sector k. The aggregate GDP and trade are given by $\sum_k Y_k$ and $\sum_k T_k$. The variable ω_k is sector k's share in aggregate GDP, $\omega_k \equiv Y_k / \sum_k Y_k$, and S_k is sector k's trade share of GDP, $S_k \equiv T_k / Y_k$. For any variable $X \in \{\omega_k, S_k\}$, I define the time average and change as

$$\bar{X} \equiv \frac{X_{t=1} + X_{t=0}}{2}, \qquad \Delta X \equiv X_{t=1} - X_{t=0}.$$

The first term, the within-sector effect, is the change in the sector-level trade-GDP ratio weighted by the average sectoral GDP share over time. The second term, the between-sector effect, is the change in sectoral GDP share weighted by the average of the sector-level trade-GDP ratio over time. This decomposition reveals that if China's trade-GDP ratio declines, there are two sources of change. One is that the individual sector's trade-GDP ratio declines (within-sector effect). The other is that sectoral GDP changes as resources are reallocated to sectors that have a low trade-GDP ratio (between-sector effect).

TABLE 1
Sectoral Decomposition of Changes in China's Trade Share of GDP

Trade (% of GDP)	**2002 to 2007**			**2007 to 2015**		
Change	Total	Within	Between	Total	Within	Between
Total	**13.62**	**11.74**	**1.88**	**-19.41**	**-15.06**	**-4.36**
Agriculture	0.05	0.27	-0.22	-0.13	-0.01	-0.13
Industry	12.45	10.62	1.82	-16.60	-10.63	-5.97
Services	1.12	0.85	0.27	-2.69	-4.42	1.74

Notes: The table reports a sectoral decomposition of changes in China's trade share of GDP (exports plus imports) for 2002–2007 and 2007–2015. It is constructed from the OECD Inter-Country Input-Output (ICIO) Tables, which provide sector-level bilateral trade flows between China and foreign economies.

Table 1 reports the sectoral decomposition of changes in China's trade share of GDP (exports plus imports).[3] This decomposition highlights the central role of the industrial sector in both the rise and subsequent decline of China's trade share of GDP. From 2002 to 2007, industry accounts for almost the entire 13.62 percentage-point increase in aggregate

3. The export share of GDP and the import share of GDP display very similar time-series patterns and decomposition structures; the main differences lie in the magnitudes of the increases and declines. For this reason, I focus on the decomposition for total trade. The corresponding export and import decompositions are reported in Appendix E.

trade openness, and the within-industry component is much larger at 10.62 p.p. than the between-sector component at 1.82 p.p. From 2007 to 2015, industry again drives most of the 19.41 percentage-point decline in the trade share of GDP. The within-industry effect remains larger in absolute value at -10.63 p.p., while the between-sector effect is also quantitatively important at -5.97 p.p.

Put differently, from 2002 to 2007, the rise in China's aggregate trade share of GDP is driven primarily by higher trade intensity within industry, as the industrial sector trades more relative to its own value added. From 2007 to 2015, the decline in aggregate trade openness reflects both a fall in industrial trade intensity and a shift in value added away from industry toward services. This shift is also evident in Table 2: the industry's share of total value added falls from 42.97% to 36.10%, while the services share rises from 47.01% to 55.48%. Because services are substantially less tradable than industry, this reallocation toward services mechanically lowers China's overall trade share of GDP.

TABLE 2
CHINA'S SECTORAL CONSUMPTION AND VALUE-ADDED SHARES

Sectoral Share (% of Total)	2002	2007	2015		2002	2007	2015
Consumption				**Value-Added**			
Agriculture	9.71	6.28	3.71	Agriculture	13.22	10.01	8.42
Industry	30.64	31.10	28.17	Industry	40.89	42.97	36.10
Services	59.65	62.61	68.12	Services	45.88	47.01	55.48

Notes: Sectoral consumption and Value-Added shares are constructed from the OECD ICIO tables.

In Table 2, I report China's sectoral consumption and value-added shares in 2002, 2007, and 2015. On both the expenditure and production sides, the data display a clear pattern of structural transformation. Agriculture's share declines steadily, services' share rises throughout, and industry's share is hump-shaped, rising from 2002 to 2007 and then falling by 2015.

On the consumption side, expenditure shifts gradually toward services, with corresponding declines in agriculture and a modest reversal in industry after 2007. On the production side, value added shows the same qualitative pattern, but the post-2007 reallocation is sharper: services' share rises markedly and industry's share falls.

These shifts in both expenditure and production toward services may help explain the post-2007 decline in China's trade share of GDP. Because services are generally less tradable than industrial and agricultural goods; thus, all else equal, a shift toward a more service-oriented economic structure is consistent with lower aggregate trade openness.

TABLE 3
Regional Decomposition of Changes in China's Trade Share of GDP

Trade (% of GDP)	**2002 to 2007**			**2007 to 2015**		
Change	Total	Within	Between	Total	Within	Between
Total	**13.62**	**12.01**	**1.61**	**-19.41**	**-15.87**	**-3.54**
NorthEast (NE)	1.25	1.63	-0.38	-2.13	-1.80	-0.32
BeijingTianjin (BT)	1.81	-0.38	2.20	-2.18	-1.41	-0.77
NorthernCoastal (NC)	2.02	1.07	0.95	-1.51	-1.26	-0.26
EasternCoastal (EC)	5.44	4.37	1.07	-7.46	-5.50	-1.95
SouthernCoastal (SC)	-2.67	-0.97	-1.70	-1.48	0.22	-1.70
Central (CE)	2.38	2.91	-0.53	-1.97	-2.76	0.80
NorthWest (NW)	2.09	1.71	0.38	-1.87	-1.97	0.10
SouthWest (SW)	1.30	1.68	-0.38	-0.82	-1.38	0.56

Notes: Trade shares of GDP equal the average of exports and imports, as a share of GDP. The table decomposes changes in China's trade share into within- and between-region components, using sector-level bilateral trade flows from the OECD ICIO tables and China's interregional input–output tables. See Appendix E for details.

Table 3 reports the regional decomposition of changes in China's trade share of GDP, defined as exports plus imports relative to value added. The decomposition splits the aggregate change into a within-region component, which captures changes in trade intensity within regions, and a between-region component, which captures shifts in regional GDP shares.

The table shows that the Eastern Coastal region accounts for a large share of the aggregate change in China's trade share of GDP in both subperiods. The cross-region distribution of contributions also shifts over time: from 2002 to 2007, contributions are relatively more even, whereas from 2007 to 2015 they are more dispersed, even though the Eastern Coastal region remains the largest contributor in both subperiods. For the Eastern Coastal region, the within-region component exceeds the between-region component in each subperiod. From 2002 to 2007, it contributes 5.44 p.p. to the 13.62 p.p. aggregate increase, with 4.37 p.p. coming from higher within-region trade intensity and 1.07 p.p. coming from its rising GDP share. From 2007 to 2015, it contributes -7.46 p.p. to the 19.41 p.p. aggregate decline, again mainly through the within-region channel, with a -5.50 p.p. within-region effect and a -1.95 p.p. between-region effect.

Overall, the decomposition points to a dominant role for within-region adjustments, with the Eastern Coastal region remaining the single most important driver in both subperiods.

Internal economic integration Concurrent with China's rising importance in the global economy, its domestic economy has become substantially more integrated, as widely discussed in the literature.[4] Specifically, China's internal trade share of GDP increased from approximately 27% in 2002 to about 51% in 2015.[5] Over the same period, the proportion of cross-province migrants in total employment rose from around 14% to approximately 28%.[6]

Policy reforms targeting the household registration system, which aim to ease regulations on internal migration, combined with extensive infrastructure development and other related institutional reforms, are likely to have played instrumental roles in driving these internal dynamics. These forces underlying China's internal economic integration may also impact its trade and GDP dynamics.

Summary In sum, this section establishes three motivating facts about the joint evolution of China's external openness, sectoral and regional trade-intensity patterns, sectoral expenditure and value-added shares, and internal integration. These facts motivate the model and guide the calibration and counterfactual analysis that follow.

3. Model

I develop a static, multi-sector, multi-region Ricardian trade framework that nests a number of canonical models in the literature. At its core, the model follows Eaton and Kortum (2002), Alvarez and Lucas Jr. (2007), and Caliendo and Parro (2015), but it introduces several additional elements that are critical for understanding China's integration into the world economy. In particular, drawing on Redding (2016), Comin, Lashkari, and Mestieri (2021), Lewis, Monarch, Sposi and Zhang (2022), and Sposi, Yi and Zhang (2025), I incorporate internal trade within China, internal labor mobility frictions, and non-homothetic consumer preferences. I also allow for region-specific saving propensities which, through transfers across regions, generate trade imbalances.

3.1. Production

Consider N_0 regions within mainland China and $N_1 = N - N_0$ foreign regions. There are three sectors, indexed by $j \in \{a, m, s\}$, representing agriculture, manufacturing, and services. Within each region and sector there is a unit measure of varieties $\omega^j \in [0, 1]$. Each variety is tradable and produced by a continuum of competitive firms using Cobb–Douglas technology:

$$y^j_{n,t}(\omega) = q^j_{n,t}(\omega)\Big[\big(L^j_{n,t}(\omega)\big)^{\beta_n}\big(K^j_{n,t}(\omega)\big)^{1-\beta_n}\Big]^{\gamma^j_n}\prod_{k=1}^{J}\big(m^{k,j}_{n,t}(\omega)\big)^{\gamma^{k,j}_n}. \tag{2}$$

4. See Xu and Fan (2012); Fan (2019); Tombe and Zhu (2019); Facchini, Liu, Mayda, and Zhou (2019); Ma and Tang (2020); An, Qin, Wu, and You (2024); Zi (2025).

5. China's internal trade share of GDP is calculated based on data from the China IO table.

6. From Hao, Sun, Tombe, and Zhu (2020).

Firms combine efficient labor, $L^j_{n,t}(\omega)$, and capital, $K^j_{n,t}(\omega)$, with composite intermediate inputs from sectors $k = 1, \ldots, J$. The exponents satisfy $\sum_{k=1}^{J} \gamma^{k,j}_n + \gamma^j_n = 1$. Local firms are price takers and rent labor at wage W_t and capital at rental rate R_t.

Following Eaton and Kortum (2002), productivity $z^j_n(\omega^j)$ is drawn from a Fréchet distribution with location parameter λ^j_n and shape parameter θ. A larger λ^j_n implies a higher mean productivity, whereas a larger θ implies lower dispersion. Intermediate varieties $r^j_n(\omega^j)$ are aggregated with constant elasticity of substitution σ into a sectoral composite Q^j_n via

$$Q^j_n = \left[\int_0^1 \left(r^j_n(\omega^j)\right)^{\frac{\sigma-1}{\sigma}} \mathrm{d}\omega^j\right]^{\frac{\sigma}{\sigma-1}}. \tag{3}$$

The composite Q^j_n is non-traded and used as an intermediate input or for consumption.

3.2. Consumption

Each worker owns one unit of labor, which she supplies inelastically, and the mass of workers in region n is denoted by L_n. Capital supply is exogenous with mass K_n, immobile across regions, and owned by local workers. Workers lease their capital to local firms and receive rental income. Net income—labor income, capital income, and the transfer induced by saving wedges—is fully consumed in each period. A worker who chooses to work in region n consumes c^j_n units of sector-j composite intermediate goods and has aggregate consumption c_n. Aggregate consumption in region n is $C_n = c_n L_n$ and sectoral consumption is $C^j_n = c^j_n L_n$.

Given the rental rate R_n and the wage rate W_n, labor income per person is W_n and capital income per person is $\frac{K_n}{L_n} R_n$. Workers choose sectoral composite consumption subject to

$$\sum_{j \in \{a,m,s\}} P^j_n c^j_n \;=\; P^c_n c_n \;=\; W_n + \frac{K_n}{L_n} R_n + \chi_n.$$

Following Caliendo and Parro (2019), I model trade imbalances as arising from income transfers across regions. Each worker remits a constant fraction of her income to a global portfolio, with the remittance ratio denoted by ϕ_n. In return, to ensure aggregate trade balance, all workers receive an equal per capita transfer T from the pooled portfolio. The net transfer—defined as the difference between what workers remit and what they receive—generates the observed cross-regional trade imbalances. Workers with $\phi_n > 0$ are net savers, while those with $\phi_n < 0$ are net borrowers.

Formally, the per capita transfer received by workers in region n is

$$\chi_n = -\phi_n \left(W_n + \frac{K_n}{L_n} R_n\right) + T, \qquad T = \frac{\sum_{n=1}^{N} \phi_n \left(W_n L_n + K_n R_n\right)}{\sum_{n=1}^{N} L_n},$$

which implies a regional trade deficit $D_n = \chi_n L_n$.

Following Comin, Lashkari and Mestieri (2021) and Sposi, Yi and Zhang (2025), I model aggregate consumption using a generalized, CES aggregator over sectoral composite goods:

$$1 \;=\; \sum_{j \in \{a,m,s\}} \alpha_n^j \,(c_n)^{\frac{(1-\sigma_c)}{\sigma_c}\varepsilon^j} \left(c_n^j\right)^{\frac{\sigma_c - 1}{\sigma_c}},$$

which implies that the expenditure share ψ_n^j on sector-j composite consumption is

$$\psi_n^j \equiv \frac{P_n^j c_n^j}{P_n^c c_n} \;=\; \left(\alpha_n^j\right)^{\sigma_c} \left(\frac{P_n^j}{P_n^c}\right)^{1-\sigma_c} (c_n)^{(\varepsilon^j - 1)(1-\sigma_c)}.$$

The parameter $\sigma_c \in (0, 1)$ governs the elasticity of substitution across sectors and thus how sensitive expenditure is to relative sectoral prices. The parameter $\varepsilon^j > 0$ is the income elasticity of demand for sector j: it determines how ψ_n^j moves with the overall consumption scale c_n. The preference weight α_n^j captures the baseline importance of sector j in the consumption bundle.

3.3. Internal Migration

I model internal migration within China as workers choosing across regions subject to migration costs that generate frictions in interregional labor flows. The utility of a worker who migrates from region m to region n is

$$U^{n,m} \equiv \frac{z(\epsilon)}{\nu^{n,m}} U(c_n), \qquad U(c_n) = \log(c_n).$$

Each worker is registered in a home region m and chooses a destination region n to maximize utility; in the model, the work location coincides with the residence location. The migration utility has three components. First, by migrating the worker obtains real income Λ_n in the destination region, which determines consumption c_n and thus utility from goods. Second, the proportional term $\nu^{n,m} > 0$, referred to as the labor-mobility cost, captures the utility loss from leaving the registration region; physical distance, institutional barriers, and amenity differences between origin and destination all affect this cost. Third, following the random-utility approach in Redding (2016), the idiosyncratic term $z(\epsilon)$ is a preference shifter for moving and generates heterogeneity among workers making the same origin–destination choice (for example, from region m to region n).

The indirect utility for an individual from region m who chooses to work in region n is therefore

$$V^{n,m}(\epsilon) = \frac{z(\epsilon)\,\Lambda_n}{\nu^{n,m}}, \qquad \Lambda_n \equiv \frac{W_n + \dfrac{K_n}{L_n} R_n + \chi_n}{P_n}. \tag{4}$$

For each worker ϵ, the idiosyncratic preference shifter $z(\epsilon)$ is independent and identically distributed (i.i.d.) across all origin–destination pairs. It follows a Fréchet distribution with cumulative distribution function

$$G(z) = \exp\left(-z^{-\kappa}\right),$$

where $\kappa > 0$ is the migration elasticity parameter. A larger κ implies less dispersion in idiosyncratic tastes and hence a higher elasticity of migration with respect to the deterministic component $\Lambda_n/\nu^{n,m}$.

Let $m^{n,m}$ denote the fraction of workers registered in region m who choose to work in region n, so that $\sum_n m^{n,m} = 1$. By the law of large numbers, the migration shares are

$$m^{n,m} = \frac{\left(\frac{\Lambda_n}{\nu^{n,m}}\right)^{\kappa}}{\sum_{n'=1}^{N_0}\left(\frac{\Lambda_{n'}}{\nu^{n',m}}\right)^{\kappa}}. \tag{5}$$

Given the initial distribution of registered workers, destination-region real incomes, and mobility costs $\{\bar{L}_m, \Lambda_n, \nu^{n,m}\}$, these expressions imply a unique partial equilibrium allocation of labor flows $\{m^{n,m}\}$. The total labor supply in region n is

$$L_n = \sum_{m=1}^{N_0} m^{n,m}\,\bar{L}_m. \tag{6}$$

3.4. Trade, Goods Prices, and Aggregation

Trade is subject to iceberg costs. Delivering one unit of a tradable good ω^j in sector j from region i to region n requires $\kappa^j_{ni} \geq 1$ units at origin, with $\kappa^j_{nn} = 1$. Following Eaton and Kortum (2002) and Caliendo and Parro (2015), the unit cost of the input bundle used by firms in region n to produce sector-j varieties is

$$c^j_n \equiv \Upsilon^j_n \left[(W_n)^{\beta^j_n}(R_n)^{1-\beta^j_n}\right]^{\gamma^j_n} \prod_{k=1}^{J} P^{k\,\gamma^{k,j}_n}_n, \tag{7}$$

where

$$\Upsilon^j_n \equiv \gamma^j_n \beta^{j\,-\gamma^j_n\beta^j_n}_n \left[\gamma^j_n\left(1-\beta^j_n\right)\right]^{-\gamma^j_n\left(1-\beta^j_n\right)} \prod_{k=1}^{J} \gamma^{k,j\,-\gamma^{k,j}_n}_n.$$

The price index of the sector-j composite intermediate good in region n is

$$P_n^j \equiv \left[\int_0^1 p_n^j\left(\omega^j\right)^{1-\sigma^j} d\omega^j\right]^{\frac{1}{1-\sigma^j}} = A^j\left(\Phi_n^j\right)^{-\frac{1}{\theta}}, \qquad \Phi_n^j \equiv \sum_{i=1}^N \lambda_i^j\left(\kappa_{ni}^j c_i^j\right)^{-\theta}, \tag{8}$$

where

$$A^j = \left[\Gamma\left(\frac{1+\theta-\sigma^j}{\theta}\right)\right]^{\frac{1}{1-\sigma^j}},$$

and $\Gamma(\cdot)$ denotes the Gamma function.

Let X_n^j denote total expenditure on the sector-j composite good in region n, so that $X_n^j = P_n^j Q_n^j$. Let X_{ni}^j be expenditure in region n on sector-j goods produced in region i, implying

$$X_n^j = \sum_{m=1}^N X_{nm}^j.$$

Define the bilateral expenditure share

$$\pi_{ni}^j \equiv \frac{X_{ni}^j}{X_n^j},$$

from which we obtain

$$\pi_{ni}^j = \frac{\lambda_i^j\left(c_i^j\kappa_{ni}^j\right)^{-\theta}}{\sum_{m=1}^N \lambda_m^j\left(c_m^j\kappa_{nm}^j\right)^{-\theta}}. \tag{9}$$

Total expenditure on sector-j goods in region n is the sum of final and intermediate demand. Hence

$$X_n^j = P_n^j C_n^j + \sum_{k=1}^J \gamma_n^{j,k}\left(\sum_{i=1}^N X_{in}^k\right), \tag{10}$$

where $P_n^j C_n^j$ is final demand for sector-j goods by workers and rentiers in region n, and the second term captures intermediate demand by firms producing goods in sectors $k = 1, \ldots, J$.

Let D_n^j denote the sector-j trade deficit of region n, and define total regional trade imbalance as

$$D_n \equiv \sum_{j=1}^J D_n^j.$$

The trade-balance condition requires that total exports net of the trade deficit equal total imports:

$$\sum_{j=1}^J \sum_{i=1}^N X_{ni}^j - D_n = \sum_{j=1}^J \sum_{i=1}^N X_{in}^j.$$

Finally, factor markets for capital and labor clear:

$$
\begin{aligned}
R_n K_n &= \sum_{j=1}^{J} \left(1-\beta_n^j\right) \gamma_n^j \sum_{i=1}^{N} \pi_{in}^j X_i^j, \\
W_n L_n &= \sum_{j=1}^{J} \beta_n^j \gamma_n^j \sum_{i=1}^{N} \pi_{in}^j X_i^j.
\end{aligned}
\tag{11}
$$

3.5. Equilibrium

Given the model parameters $\left\{\beta_n^j,\, \gamma_n^j,\, \gamma_n^{k,j},\, \sigma_c,\, \varepsilon^j,\, \sigma^j,\, \theta,\, \kappa\right\}$, sectoral productivities λ_n^j, bilateral trade costs κ_{ni}^j, labor-mobility costs $\nu^{n,m}$, saving-motive parameters ϕ_n, taste coefficients α_n^j, regional capital endowments K_n, and initial population data—L_n for foreign regions $n \in \mathbb{N}_1$ and registered population $\bar{L}_m$ for Chinese regions $m \in \mathbb{N}_0$—there exists a unique equilibrium. In this equilibrium, sectoral trade shares π_{ni}^j, labor-flow shares $m^{n,m}$, wages W_n, and the other endogenous variables jointly satisfy: (i). households' optimization, (ii). all firms' optimization, and (iii). clear markets.

3.6. Discussion

This subsection clarifies how the model connects the trade share of GDP to gains from trade and to the wedges I later quantify. I start with two equations. First, Equation (12) shows that a region's trade share of GDP is a spending-weighted average of sectoral import intensities, so changes in openness can come from changes in sectoral spending shares. Second, Equation (13) expresses gains from trade as a function of domestic expenditure shares and the trade elasticity. I then use these results to interpret the trade share of GDP as an observable statistic that is informative about gains from trade. Finally, I relax the balanced-trade, single-region benchmark and derive decompositions for China's export- and import share of GDPs under multiple regions and potentially unbalanced trade. These decompositions yield weights and contribution terms that clarify how each wedge works through composition weights, consumption tendencies, relative demand scales, and sourcing shares, guiding the wedge-by-wedge mechanism discussion that follows.

Trade share of GDP A region's trade share of GDP can be written as a spending-weighted average of sectoral import intensities. With $j = 1, \ldots, J$ indexing sectors and n indexing the region,

$$
\frac{Trd_n}{VA_n} \;=\; \frac{1}{\gamma} \sum_{j=1}^{J} \left(\frac{X_n^j}{X_n}\right) (1-\pi_{nn}^j), \tag{12}
$$

where Trd_n denotes total trade and equals both exports and imports under balanced trade, and VA_n denotes value added and thus GDP. The term X_n^j is total expenditure by region n on sector-j goods, and $X_n \equiv \sum_{g=1}^{J} X_n^g$ is total expenditure across sectors, so that X_n^j/X_n is sector j's spending share. The parameter π_{nn}^j is the domestic expenditure share in sector j, implying that $1-\pi_{nn}^j$ is the sectoral import share. Finally, γ is the value-added share in the production function and is assumed common across regions for simplicity.

Equation (12) implies that the trade share of GDP rises when domestic expenditure shares are lower, and when high-spending sectors also have high import shares.

Gains from trade I define the gains from trade as the ex-post proportional welfare gain from moving from autarky to the current level of trade openness. Let W_n denote welfare under the current trade equilibrium and W_n^{aut} denote welfare in autarky. Then

$$GT_n \equiv \frac{W_n - W_n^{\text{aut}}}{W_n} = 1 - \prod_{k=1}^{J}\prod_{j=1}^{J} \left(\pi_{nn}^k\right)^{\frac{1}{\theta}\tilde{\gamma}_n^{k,j}\frac{\psi_n^j(\tilde{\kappa})}{\sum_{g=1}^{J}\psi_n^g(\tilde{\kappa})\,\varepsilon^g}}.\text{[7]} \tag{13}$$

The term $\tilde{\gamma}_n^{k,j}$ summarizes how intermediate-input linkages transmit sectoral demand across production. In particular, it accounts for the fact that producing sector-j output requires not only direct inputs from sector k but also inputs embodied in other intermediates that ultimately trace back to sector k.[8] This production-network term interacts with the demand side because preferences make sectoral expenditure shares endogenous. The function $\psi_n^j(\kappa)$ is the sector-j consumption-expenditure share implied by the model at trade-cost level κ, and ε^g denotes the income elasticity of demand for sector g. As trade costs fall from autarky to the current level, equilibrium outcomes change continuously and so do the implied expenditure shares; by the mean-value theorem for integrals, there exists an intermediate trade-cost level $\tilde{\kappa} \in [\kappa_{\text{current}}, \kappa_{\text{aut}}]$ such that the relevant path-averaged expenditure-share term can be evaluated at $\tilde{\kappa}$, which yields the closed-form representation in (13).[9]

The multiplicative structure in (13) highlights that larger domestic expenditure shares π_{nn}^k reduce the product term and therefore lower GT_n. Intuitively, greater self-sourcing reduces exposure to foreign varieties and diminishes welfare gains from trade.

7. To simplify the derivation, assume labor is the sole input (capital share $\beta = 0$). Hence real income W_n/P_c^n is used as the welfare metric. This simplification eases the algebra but does not alter the main insights from analytical expression for gains from trade.

8. Let $(A_n^\top)_{kj} \equiv \gamma_n^{k,j}$ denote the intermediate-input share of sector k used in producing sector j (row k, column j). Define the Leontief inverse $\tilde{A}_n^\top \equiv (I - A_n^\top)^{-1}$ and $\tilde{\gamma}_n^{k,j} \equiv (\tilde{A}_n^\top)_{kj}$.

9. The detailed derivation of (13) is provided in Appendix B.4.

Interpretation Equations (12) and (13) show that domestic expenditure shares π_{nn}^j enter both the trade share of GDP and the gains-from-trade equation. Ceteris paribus, an increase in the home expenditure share π_{nn}^j for sector j in region n reduces the trade share of GDP, as the region sources more from itself and fewer varieties from abroad. At the same time, it also lowers the gains from trade. Put differently, the trade share of GDP and the gains from trade move together: economies that are more open tend to enjoy larger welfare improvements from trade liberalization.

This connection becomes more transparent in the one-sector case, where the gains from trade reduce to

$$GT_n = 1 - \left(1 - \gamma \frac{Trd_n}{VA_n}\right)^{1/\theta}.[10] \tag{14}$$

Thus, lower openness, measured by a smaller Trd_n/VA_n and therefore a higher π_{nn}, implies smaller gains from trade GT_n, ceteris paribus. Intuitively, a lower trade share of GDP indicates that region n sources a smaller fraction of its spending from abroad and relies more on domestic suppliers, so trade changes the cost of living by less; therefore welfare gains from trade are lower.

Taken together, this one-sector mapping clarifies how an observable openness statistic translates into welfare movements. This mapping mirrors the insight of the canonical ACR framework (Arkolakis, Costinot and Rodríguez-Clare, 2012), in which welfare changes from trade depend solely on two sufficient statistics—the domestic expenditure share and the trade elasticity. Building on that logic, my formulation makes the link explicit by connecting the trade share of GDP to the domestic expenditure share. In this sense, the trade share of GDP not only serves as a widely used empirical measure of openness but also functions, to some extent, as a simple reduced-form indicator of the welfare implications of trade integration.

Mechanisms To better examine the mechanisms through which each exogenous wedge affects China's trade share of GDP, I relax the baseline assumption of a single, balanced-trade economy and instead allow for multiple regions with potentially unbalanced trade. Let j index sectors and n index regions. Mainland China is partitioned into regions indexed by $n \in \mathbb{N}_0$, while the remaining regions, indexed by $n \in \mathbb{N}_1$, represent foreign economies.

For each region n, total production and total expenditure are denoted by Y_n and X_n, respectively, and the trade deficit is defined as $D_n \equiv X_n - Y_n$. At the sectoral level, Y_n^j and X_n^j denote production and expenditure in sector j, and the corresponding sectoral trade imbalance is $D_n^j \equiv X_n^j - Y_n^j$.

The export share of GDP can then be expressed as

10. Under the one-sector case, the relationship follows from $\dfrac{Trd_n}{VA_n} = \dfrac{1}{\gamma}(1 - \pi_{nn})$ and $GT_n = 1 - \pi_{nn}^{1/\theta}$, where γ denotes the value-added share in the production function.

$$\frac{EX_{\text{chn}}}{VA_{\text{chn}}} = \frac{1}{\gamma}\sum_{n\in\mathbb{N}_0}\sum_{i\in\mathbb{N}_1}\sum_{j=1}^{J} \underbrace{\left(\frac{Y_n^j}{\sum_{n\in\mathbb{N}_0} Y_n}\right)}_{\text{region–sector production share}} \times \underbrace{\left(\frac{Y_i^j + D_i^j}{Y_i^j}\right)}_{\text{foreign consumption tendency}} \times \underbrace{\left(\frac{Y_i^j}{Y_n^j}\right)}_{\text{relative income ratio}} \times \underbrace{\pi_{in}^j}_{\text{foreign sourcing share}} . \tag{15}$$

Similarly, the import share of GDP can be written as

$$\frac{IM_{\text{chn}}}{VA_{\text{chn}}} = \frac{1}{\gamma}\sum_{n\in\mathbb{N}_0}\sum_{i\in\mathbb{N}_1}\sum_{j=1}^{J} \underbrace{\left(\frac{X_n^j}{\sum_{n\in\mathbb{N}_0} X_n}\right)}_{\text{region–sector expenditure share}} \times \underbrace{\left(\frac{\sum_{n\in\mathbb{N}_0}(Y_n + D_n)}{\sum_{n\in\mathbb{N}_0} Y_n}\right)}_{\text{domestic consumption tendency}} \times \underbrace{\left(\frac{Y_n^j}{Y_n^j}\right)}_{\text{relative income ratio}} \times \underbrace{\pi_{ni}^j}_{\text{domestic sourcing share}} . \tag{16}$$

As shown in Equation 15 and Equation 16, China's export share of GDP is determined by an aggregation of foreign regions' expenditure shares π_{in}^j across sectors and regions, whereas the import share of GDP is determined by an aggregation of domestic regions' expenditure shares π_{ni}^j across sectors and regions. In both cases, the expenditure shares are weighted by a set of ratios prior to aggregation.

Specifically, in the export equation, each foreign region's sourcing from domestic suppliers π_{in}^j is scaled by three sets of ratios. The region–sector production share captures the supply size of each China region–sector block relative to aggregate Chinese production. The foreign consumption tendency measures the extent to which foreign expenditure exceeds foreign income. The relative income ratio captures the demand size of each foreign market relative to the corresponding domestic region.

Similarly, in the import equation, each domestic region's sourcing from foreign suppliers π_{ni}^j is scaled by analogous ratios. The region–sector expenditure share captures the demand size of each China region–sector block relative to aggregate Chinese expenditure. The domestic consumption tendency measures the extent to which domestic expenditure exceeds domestic income. The relative income ratio captures the demand size of the domestic region relative to itself, which equals one.

Taken together, these decompositions indicate that openness, as measured by import-to-GDP and export share of GDPs, is shaped by sourcing patterns—represented by expenditure shares—scaled by sector–region composition, consumption tendencies, and relative economic size. Each component responds differently to shocks. The next section details these mechanisms—by wedge—showing how each exogenous force shifts expenditure shares, reweights composition, and moves China's trade share of GDP.

(i). Productivity Shocks and Factor Supplies *Chinese regional productivity or factor supplies rise.* Higher productivity or larger factor endowments in Chinese regions lower unit costs and therefore reduce the prices of varieties produced in China relative to foreign varieties. Consumers in both China and abroad substitute toward these cheaper Chinese varieties. In (16), this substitution shows up as a lower share of Chinese expenditure on foreign suppliers, so π_{ni}^{j} falls for $n \in \mathbb{N}_0$ and $i \in \mathbb{N}_1$. Holding the remaining terms in the decomposition fixed, this primary sourcing-share channel lowers $IM_{\text{chn}}/VA_{\text{chn}}$ because a larger fraction of domestic expenditure is absorbed by home varieties.

The same shock also reduce the export share of GDP. In (15), cheaper Chinese varieties tend to raise foreign sourcing shares π_{in}^{j}, but productivity and factor-supply changes also move the weights and scaling terms that map foreign absorption into the export margin. In particular, higher Chinese sectoral output and income raise Y_n^j relative to Y_i^j, lowering the relative-income ratio Y_i^j/Y_n^j that scales foreign demand. This contraction in the scaling term dominates the increase in π_{in}^{j}, so $EX_{\text{chn}}/VA_{\text{chn}}$ declines on net.

(ii). Labor Mobility Cost Shocks *Internal migration frictions across Chinese regions fall.* Lower labor-mobility costs reallocate workers across Chinese regions, shifting regional labor supplies and therefore regional unit costs, outputs, and prices. Workers move from lower–income-per-person regions toward higher–income regions, which reshapes which Chinese region–sector blocks are the low-cost suppliers and, in turn, the sourcing shares that govern the trade share of GDP.

On the *import* side, the sign is ambiguous. In (16), the import margin loads on π_{ni}^{j}, the share of spending by Chinese region n on foreign suppliers. Net labor inflows can lower marginal costs and expand the set of within-China varieties in destination regions, which tends to shift expenditure toward domestic sources and reduce π_{ni}^{j}, lowering $IM_{\text{chn}}/VA_{\text{chn}}$ holding other terms fixed. Offsetting this, net outflows raise costs in origin regions and can increase their reliance on foreign suppliers, raising π_{ni}^{j}. The aggregate effect depends on which force dominates in general equilibrium.

On the *export* side, the sign is also ambiguous. In (15), exports depend on foreign sourcing shares π_{in}^{j} multiplied by weights and scaling terms. If migration reallocates labor toward the more trade-exposed Chinese regions and lowers their delivered costs, foreign sourcing shares π_{in}^{j} rise and $EX_{\text{chn}}/VA_{\text{chn}}$ tends to increase, all else equal. If instead the dominant effect is that destination-region wages and other factor prices rise enough to increase delivered export prices, then π_{in}^{j} falls and the export share of GDP declines. Migration also changes the weights and relative-demand scaling terms by shifting regional outputs and incomes, which can reinforce either direction.

In short, lower labor-mobility costs move China's trade share of GDP by changing regional labor supply and hence sourcing shares, but the net effects on both the import and export margins are unclear a priori and depend on which general-equilibrium channel dominates.

(iii). Trade Cost Shocks In the model, bilateral iceberg trade costs κ_{ni}^j affect the delivered prices that buyers in region n face when sourcing sector-j goods from region i. Those delivered prices feed into the sectoral price index P_n^j, which is an average over *all* potential sources—including the domestic source. As a result, when any κ_{ni}^j changes, P_n^j moves and buyers re-optimize their sourcing, shifting the expenditure shares.

This is why, in (16) and (15), the most immediate impact of trade-cost wedges comes through the sourcing shares π_{ni}^j and π_{in}^j, which enter the import and export margins directly. The same shocks can also influence the weights and scaling terms via general-equilibrium adjustments in output, expenditure, and incomes; in practice, however, these effects tend to be less central than the direct sourcing-share response.

External import costs for Chinese regions fall. Consider a decline in κ_{ni}^j for $n \in \mathbb{N}_0$ and $i \in \mathbb{N}_1$. In (16), the import margin loads directly on π_{ni}^j, the expenditure share of Chinese region n spent on foreign suppliers. Lower κ_{ni}^j reduces delivered prices from foreign sources in region n, lowers P_n^j, and raises π_{ni}^j; holding the other weights and scaling terms fixed, $IM_{\text{chn}}/VA_{\text{chn}}$ increases. The same shock can also raise the export margin because cheaper imported inputs reduce unit costs in Chinese region–sector blocks and lower delivered prices abroad, which tends to raise foreign sourcing shares π_{in}^j in (15).

External export costs for Chinese regions fall. Now consider a decline in κ_{in}^j for $i \in \mathbb{N}_1$ and $n \in \mathbb{N}_0$. In (15), this directly lowers delivered prices of varieties produced in Chinese regions in foreign markets, raises π_{in}^j, and thus increases $EX_{\text{chn}}/VA_{\text{chn}}$ holding other terms fixed. The same shock can also increase the import margin through general-equilibrium price-index effects abroad: by lowering foreign sectoral price indices and, via input–output linkages, foreign unit costs, it can reduce delivered prices of foreign varieties into Chinese regions, which raises π_{ni}^j in (16).

Internal trade costs within China fall. Finally, consider a decline in internal trade costs κ_{nm}^j for $n, m \in \mathbb{N}_0$. In (16), lower within-China trade costs make other Chinese regions cheaper sources for region n, shifting expenditure toward domestic suppliers and reducing the share spent on foreign suppliers π_{ni}^j; holding the other terms fixed, $IM_{\text{chn}}/VA_{\text{chn}}$ falls.

For exports, internal integration affects (15) through several general-equilibrium channels. On the cost side, cheaper within-China intermediate inputs lower sectoral price indices P_n^j and delivered marginal costs, which tends to reduce export prices and raise foreign sourcing shares π_{in}^j. Offsetting this force, internal integration can raise region-level wages and other factor prices in China, increasing delivered export prices and lowering π_{in}^j. Internal integration also shifts the weights and scaling terms that multiply π_{in}^j, including the relative-income term that scales foreign demand. Imposing balanced trade pins down the net effect: the export share of GDP declines as well. This implies that, in net terms, the forces that reduce the export share dominate, so $EX_{\text{chn}}/VA_{\text{chn}}$ declines.

(iv). Saving Wedges In the model, saving wedges ϕ_n govern each region's intertemporal spending relative to income and thus its trade imbalance. A higher ϕ_n corresponds to stronger saving pressure and a tendency to run a trade surplus, while a lower ϕ_n corresponds to stronger borrowing pressure and a tendency to run a trade deficit.

Suppose foreign regions borrow to finance current absorption, so they run trade deficits, and Chinese regions run the corresponding trade surpluses. In (15), this shows up through the foreign consumption-tendency term $(Y_i^j + D_i^j)/Y_i^j$: a larger foreign deficit raises foreign absorption relative to income and increases the demand weight placed on Chinese varieties, pushing up $EX_{\text{chn}}/VA_{\text{chn}}$ all else equal. On the import side, the same configuration implies that China spends less than it produces. In (16), this is reflected in the domestic consumption-tendency term $\sum_{n\in\mathbb{N}_0}(Y_n + D_n)/\sum_{n\in\mathbb{N}_0} Y_n$: a lower domestic deficit (or a surplus) reduces aggregate absorption relative to income and, holding sourcing shares fixed, tends to lower $IM_{\text{chn}}/VA_{\text{chn}}$.

(v). Taste Wedges and Production-Structure Wedges The model allows sectoral expenditure shares to move systematically with relative prices and income through preferences. After netting out these systematic movements, the remaining variation in sectoral spending shares is absorbed by taste wedges α_n^j, which shift demand toward or away from sector j at given prices and income.

While taste wedges govern the composition of *final demand*, a separate set of wedges governs the composition of *production* by determining how each sector combines primary factors and intermediate inputs. Production-structure wedges summarize the input composition of sectoral production, captured by value-added shares and intermediate-input shares across agriculture, industry, and services. Aggregated from input–output tables, these wedges pin down how changes in final demand propagate through intermediate-input linkages and how intensively each sector uses tradable versus non-tradable inputs.

Together, the two wedges affect the trade share of GDP mainly by reweighting more-tradable versus less-tradable activities in the economy, either through the composition of expenditure or through the composition of intermediate demand. On the expenditure side, a rise in α_n^j for services shifts spending toward a less-tradable sector and thus mechanically lowers the trade share of GDP, for given sectoral trade intensities.

On the intermediate-demand side, production-structure wedges operate through input use. A shift away from primary factors and toward intermediates tends to raise gross trade because intermediates are more tradable than factor inputs. The magnitude, however, depends on *which* intermediates expand. If production becomes more intensive in intermediates that are themselves less tradable—for example, service inputs—the trade share of GDP increases only modestly.

In sum, this section lays out the model and clarifies the mechanisms through which each wedge and shock affects the trade share of GDP. I then turn to calibration, where I discipline the model with input–output data and infer the wedges so that the model matches China's sectoral and regional trade patterns.

4. Calibration

In this section, I calibrate the model to quantify the forces that drive the evolution of China's trade share of GDP over time.

Table 4 summarizes the calibration environment. The model covers eight mainland Chinese regions, an aggregate rest of the world (ROW), and three sectors for the periods 2002–2007 and 2007–2015. The eight regions—A. Northeast, B. Beijing–Tianjin, C. Northern Coastal, D. Eastern Coastal, E. Southern Coastal, F. Central, G. Northwest, and H. Southwest—follow the classification in Figure 2. The three sectors are agriculture, industry, and services.

The calibration proceeds in three steps. I first pin down the exogenous, time-invariant parameters that can be computed directly from the data or taken from the literature. I then use these parameters, together with model-implied relationships and the sectoral price data, to recover the time-varying shocks. Incorporating these shocks into the model allows me to assess the calibration's fit. Finally, I present the recovered shocks and briefly discuss them.

The data come from the 5th, 6th, and 7th National Censuses of China (2000, 2005, and 2015); the China Statistical Yearbooks for 2002, 2007, and 2015 (Press, 2002, 2007, 2015); the Penn World Table 10.0 (Feenstra, Inklaar, and Timmer, 2015); the OECD Inter-Country Input–Output (ICIO) Tables (OECD, 2021); the China Cross-Regional Input–Output Tables (Zhang and Qi, 2012; Zheng, Zhang, Wei, Song, Dietzenbacher, Wang, Meng, Shan, Ou, and Guan, 2020); and the CEPII gravity database (Head and Mayer, 2014). Details on data sources, regional definitions, and sector concordance are provided in Appendix E.

4.1. Time-Invariant Parameters

In this subsection, I set the exogenous, time-invariant parameters. I set the trade elasticity θ to 4, in line with Simonovska and Waugh (2014). Following Tombe and Zhu (2019), I set the labor-flow elasticity κ to 1.5. The parameters in the aggregate consumption function are taken from Sposi, Yi and Zhang (2025), who estimate them in a model with a similar

TABLE 4
CALIBRATION

	Notation	Methodology
Time-Invariant Parameters		
Trade Elasticity	$\theta = 4$	Simonovska and Waugh (2014)
Labor Flow Elasticity	$\kappa = 1.5$	Tombe and Zhu (2019)
Price Elasticity	$\sigma_c = 0.23$	Sposi, Yi and Zhang (2025)
Income Elasticity	$(\varepsilon^a, \varepsilon^i, \varepsilon^s) = (0.10, 1, 1.33)$	Sposi, Yi and Zhang (2025)
Varieties Elasticity	$\sigma^j = 2$	Broda and Weinstein (2006)
Capital Share	$\beta_n = 0.33$	Gollin (2002)
Time-Varying Wedges		
Production Structure	$\gamma_n^j, \gamma_n^{j,k}$	Calculate from IO table
Labor and Capital Supply	$\bar{L}^m$, K_n	Discussion follows
Fundamental Productivity	${\lambda_n^j}^{1/\theta}$	Discussion follows
Trade Cost	κ_{ni}^j	Discussion follows
Labor Mobility Cost	ν_{nm}	Discussion follows
Taste-Share Parameters	α_n^j	Discussion follows
Trade-Imbalance (or Saving) Parameters	ϕ_n	Discussion follows

FIGURE 2
MAINLAND CHINA'S REGIONS

preference structure: $\sigma_c = 0.23$, $\varepsilon^a = 0.10$, $\varepsilon^i = 1$ (normalized), and $\varepsilon^s = 1.33$. The elasticity of substitution among intermediate goods within a sector is assumed to be constant across all sectors, with $\sigma^j = 2$ for all sectors j (Broda and Weinstein, 2006). Finally, following Gollin (2002), I set the capital share in value added to $\beta_n = 0.33$.

4.2. Time-Varying Wedges

In this section, I calibrate a set of time-varying parameters and exogenous shocks—referred to as wedges—including input shares from the production function, labor endowments, capital stocks, fundamental productivity parameters, bilateral trade costs, labor mobility costs, fundamental taste-share parameters, and the trade-imbalance parameter.

I calibrate the production shares directly from the input–output data. For each region n and sector j, I set the value-added share as $\gamma^j_{n,t} = V^j_{n,t}/Y^j_{n,t}$, where $Y^j_{n,t} = \sum_{i=1}^{N} X^j_{in,t}$ is gross output of sector j in region n and $V^j_{n,t}$ is value added in that sector and region. I then allocate the remaining share $1 - \gamma^j_{n,t}$ across intermediate inputs according to their expenditure shares in total intermediate spending of each sector k, setting

$$\gamma^{j,k}_{n,t} = (1 - \gamma^j_{n,t}) \frac{V^{j,k}_{n,t}}{\sum_{j'=1}^{J} V^{j',k}_{n,t}},$$

where $V^{j,k}_{n,t}$ denotes the value of sector j inputs used in the production of sector k in region n. I construct $Y^j_{n,t}$, $V^j_{n,t}$, and $V^{j,k}_{n,t}$ from the China Cross-Regional IO Tables for Chinese regions and from the OECD ICIO Tables for the ROW.

Country-level total labor force data are taken from PWT 10.0, which reports the number of persons engaged (in millions) by year and country. Data on China's cross-regional labor-flow shares and the distribution of labor across source locations are derived from the China Population Census (2000) and the China 1% Population Sampling Surveys (2005 and 2015). I construct initial regional labor supplies by multiplying the national labor force by the initial distribution of labor across source locations. Because no comparable micro or regional data are available for 2002 and 2007, I use the 2000 and 2005 distributions as approximations for 2002 and 2007, respectively.[11]

I obtain China's total capital stock from PWT 10.0, measured at constant 2017 national prices (in million 2017 US$). To allocate this aggregate capital stock across regions, I first construct a regional capital-stock series using data from the China Statistical Yearbook. The

11. The official reports of these surveys are released in two forms: a confidential micro-level dataset with individual records and an aggregate dataset at the provincial level. The provincial reports provide, for each province pair (A, B), the number of people currently living in province A but registered in province B. Due to data availability, I rely on these provincial aggregates to construct China's labor-flow shares and the distribution of labor across source locations at the regional level.

yearbook reports province-level gross fixed capital formation and investment price indices, which I use to compute real investment at constant prices. I then estimate the initial province-level capital stocks in 2000 using the perpetual inventory method, based on real investment and an average depreciation rate and investment growth rate over 2000–2005. Given the initial capital stock and yearly investment, I build a time series of capital stocks by province and then aggregate these to the regional level. Finally, I scale the regional capital stocks so that their sum matches the national total from PWT, thereby obtaining regional capital stocks consistent with both national and subnational data.

I calibrate the sector- and region-specific productivity parameter $\lambda_{n,t}^j$ using

$$\lambda_{n,t}^j = \pi_{nn,t}^j \left(\frac{A^j c_{n,t}^j}{P_{n,t}^j} \right)^{\theta}, \tag{17}$$

where

$$A^j \equiv \left[\Gamma\left(\frac{1+\theta-\sigma^j}{\theta} \right) \right]^{\frac{1}{1-\sigma^j}}, \qquad c_{n,t}^j \equiv \Upsilon_{n,t}^j \left[(W_{n,t})^{\beta} (R_{n,t})^{1-\beta} \right]^{\gamma_{n,t}^j} \prod_{k=1}^{J} (P_{n,t}^k)^{\gamma_{n,t}^{k,j}}.$$

To implement this calibration, I first recover factor prices. Using the calibrated labor supplies $L_{n,t}$ and capital stocks $K_{n,t}$, together with the value-added components of labor and capital, I infer the wage rate $W_{n,t}$ and the rental rate $R_{n,t}$. I then construct sectoral intermediate-goods prices $P_{n,t}^j$ from two complementary sources. First, following Sposi, Yi and Zhang (2025), I back out these prices using the production structure and sectoral value-added prices reported in the China Statistical Yearbook. Second, I use importer fixed effects from gravity regressions as an alternative measure of sectoral price levels. I take the average of these two measures to reduce measurement noise and obtain calibrated time-varying sectoral intermediate-goods prices $P_{n,t}^j$.

I calibrate the bilateral trade costs using

$$\kappa_{ni,t}^j = \left[\left(\frac{\pi_{ni,t}^j}{\pi_{nn,t}^j} \right) \frac{\lambda_{n,t}^j (c_{n,t}^j)^{-\theta}}{\lambda_{n,t}^j (c_{i,t}^j)^{-\theta}} \right]^{-\frac{1}{\theta}}, \tag{18}$$

where $\pi_{ni,t}^j$ denotes the share of region n's expenditure on sector j goods that is sourced from region i in year t, as computed from the input–output tables. For each sector j, destination n, origin i, and year t, I observe $\pi_{ni,t}^j$ and $\pi_{nn,t}^j$ in the data and use the calibrated productivities $\lambda_{n,t}^j$ and unit costs $c_{n,t}^j$ and $c_{i,t}^j$ to back out $\kappa_{ni,t}^j$.

I recover the labor-mobility cost parameter as

$$\nu_{nm,t} = \left(\frac{m_{nm,t}}{m_{mm,t}} \right)^{-1/\kappa} \frac{\Lambda_{n,t}}{\Lambda_{m,t}}, \tag{19}$$

where $m_{nm,t}$ is the share of workers registered in region m who migrate to region n in year t, $m_{mm,t}$ is the share who remain in their origin region m, and $\Lambda_{n,t}$ denotes real income per worker in region n.

The trade-imbalance (saving) parameter $\phi_{n,t}$, interpreted as a remittance ratio, is set equal to net exports as a share of GDP in each region and year. Under this calibration, the return on the global portfolio is zero in the baseline, and all intertemporal transfers are summarized by the term $\chi_{n,t} = -\phi_{n,t} VA_{n,t}$. A negative $\chi_{n,t}$ captures net saving by residents of region n, whereas a positive $\chi_{n,t}$ captures net borrowing for consumption.

The fundamental taste-share parameters $\alpha^j_{n,t}$ are calibrated to match the time-varying value-added expenditure share $\psi^j_{n,t}$ and the aggregate expenditure $P^c_n c_n$ such that

$$\psi^j_{n,t} = \frac{\left(\alpha^j_{n,t}\right)^{\sigma_c} \left(P^j_{n,t}\right)^{1-\sigma_c} \left(c_{n,t}\right)^{(1-\sigma_c)(\varepsilon^j-1)}}{\sum_{k=1}^{J} \left(\alpha^k_{n,t}\right)^{\sigma_c} \left(P^k_{n,t}\right)^{1-\sigma_c} \left(c_{n,t}\right)^{(1-\sigma_c)(\varepsilon^k-1)}}, \tag{20}$$

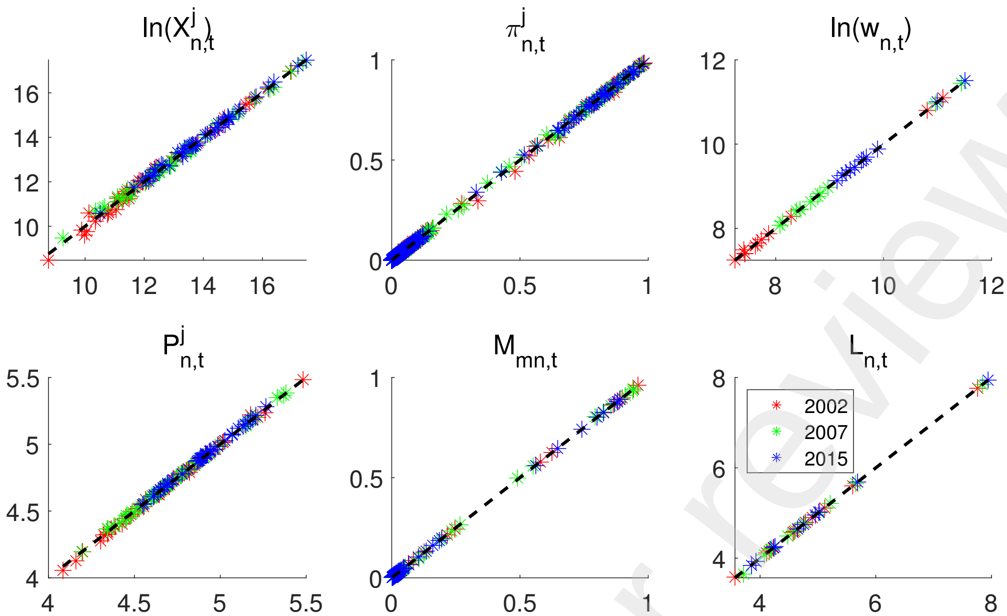
$$P^c_{n,t} c_{n,t} = \left[\sum_{j=1}^{J} \left(\alpha^j_{n,t}\right)^{\sigma_c} \left(P^j_{n,t}\right)^{1-\sigma_c} \left(c_{n,t}\right)^{(1-\sigma_c)\varepsilon^j}\right]^{\frac{1}{1-\sigma_c}}. \tag{21}$$

Here, $\psi^j_{n,t}$ and $P^c_{n,t} c_{n,t}$ are computed from the input–output tables. In practice, $\alpha^j_{n,t}$ also absorbs additional factors—such as institutional influences or measurement errors—that affect sectoral demand but are not explicitly captured by the preference structure, even though they are reflected in the observed data. For further details on the calibration procedure, see Appendix D in the appendix.

4.3. Model Fit and Discussion

In this subsection, I feed the calibrated time-invariant parameters and time-varying wedges back into the model to assess the quality of the calibration. I then present and discuss each of these calibrated time-varying shocks.

Figure 3
Model Fit



Notes: The scatter plots display data on the x-axis and model-generated values on the y-axis, with a 45-degree reference line on the diagonal.

Model Fit Figure 3 compares model-generated values (on the y-axis) with their data counterparts (on the x-axis). The points include log expenditures $X^j_{ni,t}$, expenditure shares $\pi^j_{ni,t}$, log wages $w_{n,t}$, prices $P^j_{n,t}$, migration shares $M_{mn,t}$, and labor supplies $L_{n,t}$ for each of the nine regions. The scatter lies close to the 45-degree line, indicating that the calibrated wedges allow the model to reproduce key features of the data.

TABLE 5
Average Fundamental Productivity ($\lambda_n^{j\,1/\theta}$) changes

Average Fundamental Productivity Change (%)	**2002 to 2007**		**2007 to 2015**	
	China	**ROW**	**China**	**ROW**
All	20.0	12.3	31.9	-6.2
Agriculture	23.0	18.8	20.7	-24.6
Industry	25.2	-2.4	30.7	-7.5
Services	14.2	16.7	35.9	-5.0

Notes: The table reports average percentage changes in fundamental productivity, $\lambda_n^{j\,1/\theta}$, for 2002–2007 and 2007–2015. Regional and sectoral productivity are aggregated using average value-added shares (averaged over 2002, 2007, and 2015) as weights, so that changes in average productivity are not driven by shifts in value-added composition. For details on the time-series behavior of calibrated productivity, see Appendix D.

Productivity Shocks Table 5 reports changes in calibrated fundamental productivity by region and sector.[12] Between 2002 and 2007, China's average fundamental productivity rose by 20.0%, and it increased by a further 31.9% between 2007 and 2015. All three sectors in China experienced productivity gains in both periods, with services showing the largest increase in the later period (35.9%) and industry also growing strongly (25.2% in 2002–2007 and 30.7% in 2007–2015). Agriculture posted more modest but still sizable gains of 23.0% and 20.7%, respectively. By contrast, productivity in the ROW rose by 12.3% in 2002–2007 but fell by 6.2% over 2007–2015, with particularly sharp declines in agriculture and industry.

TABLE 6
AVERAGE TRADE COST CHANGES

Average Trade Cost Change (%)	**2002 to 2007**			
	External	*Export*	*Import*	**Internal**
Overall	-6.8	-6.0	-9.7	-13.6
Agriculture	-1.5	0.8	-9.9	-18.2
Industry	-4.9	-2.4	-17.8	-9.1
Services	-20.2	-18.7	1.6	-21.4
	2007 to 2015			
	External	*Export*	*Import*	**Internal**
Overall	1.1	0.5	3.4	1.8
Agriculture	-5.3	-5.5	-5.6	-6.0
Industry	3.9	5.8	-7.2	8.4
Services	0.9	-18.7	16.3	-10.1

Notes: The table reports percentage changes in average trade costs relative to the base year for 2002–2007 and 2007–2015. Regional and sectoral trade costs are aggregated using average expenditure shares (averaged over 2002, 2007, and 2015) as weights, so that changes in average trade costs are not driven by shifts in expenditure composition. For details on the time-series behavior of calibrated sectoral trade costs, see Appendix D.

12. Here, the calibrated fundamental productivity $(\lambda_{n,t}^j)^{1/\theta}$ is in fact a function of the measured productivity level $Z_{n,t}^j$ and of the Solow residual. In particular, for sector j we can write

$$Z_n^j = (\left[\Gamma\left(\frac{1+\theta-\sigma^j}{\theta}\right)\right]^{\frac{1}{1-\sigma^j}})^{-1}\left(\frac{\lambda_n^j}{\pi_{nn}^j}\right)^{1/\theta}, \tag{22}$$

which adjusts for Ricardian selection effects, following Finicelli, Pagano, and Sbracia (2013). Thus, changes in calibrated fundamental productivity are jointly driven by changes in the trade share π_{nn}^j and in the Solow residual, the latter being widely used in the growth–accounting literature. Put differently, a decline in the home-expenditure share π_{nn}^j in the early period and an increase in π_{nn}^j in the later period implicitly imply that the change in the Solow residual in the first period is larger than the calibrated change in fundamental productivity, whereas in the later period the change in the Solow residual is smaller than the calibrated change in fundamental productivity.

Trade Cost Shocks Table 6 reports average changes in China's trade costs. Between 2002 and 2007, both external and internal frictions declined, with overall external costs falling by 6.8% and internal costs by 13.6%. Import costs fell by 9.7%, a larger decline than the 6.0% drop in export costs, and trade costs in services fell especially sharply, even though services accounted for only a small share of total trade. These patterns are consistent with China's WTO accession in 2001 and the concurrent integration of its domestic market.

Between 2007 and 2015, changes in trade costs were modest. On average, external costs rose by 1.1% and internal costs by 1.8%, suggesting stabilization rather than continued liberalization. Import costs increased by 3.4%, compared with a 0.5% rise in export costs. Taken together, the post-2007 period looks like a pause—or mild reversal—in the earlier downward trend in both external and internal trade costs.

TABLE 7
Labor mobility cost changes

Average Mobility Cost Change (%)	2002 to 2007								
	All	*NE.*	*BT.*	*NC.*	*EC.*	*SC.*	*CE.*	*NW.*	*SW.*
By Source	-13.6	-14.7	-6.1	-31.8	35.6	16.0	-34.8	3.6	-27.0
By Destination	-	-6.7	-36.5	19.5	-44.9	-28.9	41.7	-13.1	23.6
	2007 to 2015								
	All	*NE.*	*BT.*	*NC.*	*EC.*	*SC.*	*CE.*	*NW.*	*SW.*
By Source	-10.0	-41.9	-42.5	-0.9	-0.9	-48.6	14.9	-12.9	20.2
By Destination	-	39.9	-11.8	-15.1	-21.4	56.8	-41.1	1.4	-37.2

Notes: The table reports percentage changes in labor mobility costs relative to the base year for 2002–2007 and 2007–2015. Migration frictions are aggregated using average labor-flow shares (based on 2000, 2005, and 2015) as weights, so that changes in average frictions are not driven by shifts in labor-flow composition. Regional abbreviations are: NE = Northeast, BT = Beijing and Tianjin, NC = Northern Coastal, EC = Eastern Coastal, SC = Southern Coastal, CE = Central, NW = Northwest, and SW = Southwest. For details on the time-series behavior of calibrated migration costs, see Appendix D.

Labor Mobility Cost Shocks Table 7 shows that labor mobility costs declined in both periods, though at a slower pace over time. Between 2002 and 2007, the average decrease was 13.6%, whereas during 2007–2015 the decline moderated to 10.0%.

Regional patterns are asymmetric on both the origin and destination margins, and these asymmetries shift over time. On the source side, out-migration from the Central region experienced the largest cost decline in 2002–2007, whereas the steepest subsequent declines occurred for outflows from the Northeast and Southern Coastal regions. On the destination side, entry into the Eastern Coastal region became much easier in 2002–2007, while 2007–

2015 featured sharp cost reductions for moving into the Central region but sizable cost increases for entry into the Southern Coastal region.

TABLE 8
OTHER WEDGES CHANGES

Other Wedges Changes	**2002 to 2007**		**2007 to 2015**	
	China	**ROW**	**China**	**ROW**
Labor Supply (%)	3.0	8.1	3.4	9.4
Capital (%)	79.8	15.2	155.7	23.4
Saving Wedges (p.p.)	6.6	-0.5	-5.3	-0.1
Taste Wedges (p.p.)				
Agriculture	2.8	0.5	-2.2	-0.1
Industry	12.7	-0.5	8.4	-1.9
Services	-15.5	0.0	-6.1	2.0
Production Structure (p.p.)				
Agriculture	0.0	0.0	0.6	0.3
Industry	6.5	1.9	-3.5	-1.7
Services	-0.4	0.3	3.2	0.6
Valued-Added	-6.1	-2.2	-0.2	0.7

Beyond fundamental productivity, trade costs, and labor-mobility costs, which account for the observed changes in trade shares, Table 8 summarizes the remaining wedges. These include exogenous factor supplies (labor and capital); income-transfer (saving) wedges that match observed trade imbalances; sectoral taste wedges that match sectoral expenditure shares beyond those implied by non-homothetic preferences (via income and relative-price effects); and production-structure wedges, measured by endowment shares and intermediate-input shares implied by input–output tables.

Factor Supplies Capital deepening in China is large and accelerates: capital rises by 79.8% in 2002–2007 and by 155.7% in 2007–2015, while labor grows modestly (3.0% and 3.4% over the two periods). ROW exhibits smaller capital growth (15.2% and 23.4%) but stronger labor growth (8.1% and 9.4%). This pattern points to a China-specific investment boom relative to ROW.

Saving Wedges The saving wedge matches observed trade imbalances by tilting households toward saving or borrowing. A positive wedge implies a stronger saving motive, while a negative wedge implies borrow-to-consume behavior. Table 8 shows that China's saving wedge rises by 6.6 p.p. in 2002–2007 and then reverses by -5.3 p.p. in 2007–2015, consistent with the sharp rise and subsequent decline in China's external surplus over these periods.

By contrast, ROW wedge changes are minimal (−0.5 p.p. in 2002–2007 and −0.1 p.p. in 2007–2015).[13]

Taste Wedges Taste wedges capture shifts in sectoral expenditure shares beyond those implied by the nonhomothetic preference structure.[14] They absorb influences such as taste shocks, policy distortions, and measurement error. The calibrated taste wedges reweight demand toward industry and away from services in China, with only modest movements in ROW. In 2002–2007, China tilts sharply toward industry +12.7 p.p. and away from services −15.5 p.p. In 2007–2015, the reweighting persists but softens: industry +8.4 p.p. and services −6.1 p.p.

Production Structure The production-structure wedges describe the composition of gross output into value added (payments to capital and labor) and intermediate inputs from agriculture, industry, and services, aggregated from the input–output tables. Table 8 shows two patterns for China: value-added intensity falls in 2002–2007 and then stabilizes, and input use shifts from industry toward services after 2007. Quantitatively, value added changes by −6.1 p.p. in 2002–2007 and by −0.2 p.p. in 2007–2015; industry intermediates move +6.5 p.p. then −3.5 p.p.; and services inputs move −0.4 p.p. then +3.2 p.p. ROW changes are modest along all dimensions.

Summary Overall, The behavior of these calibrated time-varying wedges aligns with intuition. A full accounting of their quantitative contributions requires the counterfactual exercises that follow.

5. Quantitative Analysis

In this section, I conduct three sets of counterfactual exercises to unpack the forces driving changes in China's trade share. I begin with a structural accounting decomposition that attributes changes in China's trade share of GDP to eight wedge groups, seven of which are China-specific: fundamental productivity; trade costs (internal and external); labor-mobility costs and labor supply; capital supply; taste wedges; saving wedges; and production structure. The remaining group captures ROW forces, including foreign economies' fundamental productivity, labor supply, capital supply, taste wedges, saving wedges, and production structure.

13. Here "p.p." denotes percentage points: +1 p.p. corresponds to an increase of 0.01 in the sectoral expenditure share, i.e., $x^j_{n,t=1} - x^j_{n,t=0} = 0.01$.

14. Nonhomothetic preferences generate income and relative-price effects, so sectoral expenditure shares move as households grow richer or as relative prices change.

I then conduct similar structural accounting decompositions at a more disaggregated level for selected wedges—China's productivity, China's trade costs, and ROW forces. For each wedge or wedge group, I solve the model with that wedge held at its base-year level while allowing all other wedges to vary as observed, and compare the outcome with the baseline scenario. The baseline scenario represents the case in which all wedges follow their observed paths. The effect of a given wedge is measured as the difference between the outcome under the baseline and the outcome when that wedge is fixed at its base-year value.

Finally, I investigate two channels—structural change and trade imbalances—in explaining changes in China's trade share. I assess structural change by comparing these decompositions with counterparts computed under Cobb–Douglas preferences. I quantify trade-imbalance effects by comparing these decompositions with counterparts under balanced trade. Together, these exercises clarify how structural change and trade imbalances shape China's trade-share dynamics.

Although the primary focus of the paper is to quantify the forces driving changes in China's external trade share of GDP, I also examine the implications for other macroeconomic variables, such as China's internal trade share of GDP and real value added per worker. The internal trade share of GDP is defined as the value of interregional trade among China's eight regions divided by China's aggregate GDP. I measure changes in real GDP per capita as percentage differences in the counterfactual relative to the baselinee, and I report these outcomes alongside the trade-share results in the subsections that follow.

5.1. Decomposition of Change in Trade Share of GDP

Table 9 and Table 10 report the structural accounting decomposition for the periods 2002–2007 and 2007–2015. For each period, I measure the contribution of a given wedge (or wedge group) to the change in China's trade share of GDP by comparing two model outcomes. The baseline outcome is the equilibrium in the terminal year of the period (2007 or 2015) with all wedges set to their calibrated values for that year. The counterfactual holds the wedge (or wedge group) fixed at its base-year value (2002 or 2007), while all other wedges are set to their calibrated values in the terminal year. The contribution of that wedge is defined as the difference between the baseline trade share and the trade share in this counterfactual.

The first row labeled *Overall* reports the effect of all wedges taken together. It is computed as the difference between the trade share in the terminal-year baseline and the trade share when all wedges are held at their base-year values. The same decomposition is applied to two additional macro variables: China's internal trade share of GDP and China's real GDP per worker. For real GDP per capita, I report "ex-post" percentage change defined as

$$\text{Ex-post percentage change in } x = \frac{x_{\text{baseline}} - x_{\text{wedge fixed at base-year}}}{x_{\text{baseline}}} \times 100,$$

so that the denominator is common across wedges and the magnitudes are directly comparable.

TABLE 9
STRUCTURAL ACCOUNTING DECOMPOSITION, 2002 TO 2007

2002 to 2007	Change in Trade Share of GDP (p.p.)			Ex-post Change in Real GDP per capita
	Export	Import	Internal	(%)
Overall	10.1	3.5	21.1	44.9
China's Productivity	-11.3	-7.6	4.6	32.3
China's Trade Cost	5.6	5.3	13.7	5.6
External Trade Cost	6.8	6.6	-2.9	1.5
Internal Trade Cost	-1.5	-1.4	16.7	4.2
China's Labor	1.2	-0.1	-0.4	0.03
Mobility Cost	1.5	0.1	-0.4	1.0
Initial Supply	-0.2	-0.2	0.1	-1.0
China's Capital	-2.6	-2.1	0.4	15.0
China's Taste Wedges	0.2	0.1	0.6	1.7
China's Saving Wedges	4.4	-4.1	-0.1	0.5
China's Production Structure	4.0	1.4	8.3	-3.5
RoW's Forces	4.1	2.4	1.2	0.8

Notes: This table decomposes changes in China's trade share of GDP and other variables over the period 2002–2007 into eight wedge groups: (i) China's fundamental productivity; (ii) China's trade costs (internal and external); (iii) China's labor-mobility costs and labor supply; (iv) China's capital supply; (v) China's taste wedges; (vi) China's saving wedges; (vii) China's production structure; and (viii) rest-of-world (ROW) forces. ROW forces include ROW's fundamental productivity, labor supply, capital supply, taste wedges, saving wedges, and production structure. For each group, effects are computed as differences between the terminal-year baseline (all wedges set to their calibrated values in 2007) and counterfactuals that hold the selected wedges at their 2002 values.

As shown in Table 9, from 2002 to 2007 the main force behind the rise in China's external trade share (for both exports and imports as a share of GDP) is the decline in external trade costs. Lower external frictions raise China's export trade share of GDP by 6.8 percentage points (p.p.) and its import trade share by 6.6 p.p.

The saving wedge is the second important positive force for exports. A stronger saving motive raises the export trade share of GDP by 4.4 p.p., and, mechanically, lowers the import share of GDP by 4.1 p.p., because higher desired saving widens the gap between exports and imports.

The third major contribution comes from the ROW. Joint shifts in ROW fundamentals—productivity, labor and capital supply, taste and saving wedges, and production structure—raise China's export share of GDP by 4.1 p.p. and its import share of GDP by 2.4 p.p. Put differently, stronger foreign demand or a larger external market lift China's exports; at the same time, higher foreign productivity lower the relative price of foreign goods and encourage Chinese imports; quantitatively, the export effect larger (4.1 vs. 2.4 p.p.). Further details on these ROW forces are discussed in the next section.

Changes in China's production structure are equally important. As China's production becomes more intensive in tradable industrial intermediate inputs and less intensive in non-tradable or labor inputs, the trade share of GDP rises: the export trade share increases by 4.0 p.p. and the import trade share by 1.4 p.p., holding other wedges fixed.

By contrast, China's own productivity growth exerts a sizable offsetting effect on external trade. Higher productivity reduces the export trade share of GDP by 11.3 p.p. and the import trade share by 7.6 p.p. The remaining wedges are aligned with the model's intuition in sign but are small in magnitude relative to these main forces.

For China's internal trade share of GDP, the primary driver is the decline in internal trade costs, which raises the internal trade share by 16.7 p.p. Other wedges have negligible effects, with the exception of China's productivity growth, which contributes an additional 4.6 p.p. increase in the internal trade share.

Regarding China's real GDP per capita, productivity growth is the key factor, generating a 32.3% ex-post increase relative to the baseline. Capital deepening is the second main force, adding a further 15.0% to real GDP per capita.

TABLE 10
Structural accounting decomposition, 2007 to 2015

2007 to 2015	Change in Trade Share of GDP (p.p.)			Change in Real GDP per capita
	Export	Import	Internal	(%)
Overall	-12.4	-7.1	0.1	56.3
China's Productivity	-6.7	-6.3	1.2	47.5
China's Trade Cost	-1.2	-1.5	-4.6	-1.4
External Trade Cost	-1.4	-1.3	-1.2	-0.3
Internal Trade Cost	-0.3	-0.7	-3.4	-1.3
China's Labor	-0.8	-0.6	0.4	0.66
Mobility Cost	-0.5	-0.4	0.5	1.3
Initial Supply	-0.3	-0.2	0.0	-0.7
China's Capital	-3.4	-2.6	0.1	22.6
China's Taste Wedges	-0.1	0.0	0.6	2.5
China's Saving Wedges	0.3	0.7	0.1	-1.6
China's Production Structure	0.8	1.2	-1.1	-6.1
RoW's Forces	-0.6	-0.7	0.6	-0.1

Notes: This table decomposes changes in China's trade share of GDP and other variables over the period 2007–2015 into eight wedge groups: (i) China's fundamental productivity; (ii) China's trade costs (internal and external); (iii) China's labor-mobility costs and labor supply; (iv) China's capital supply; (v) China's taste wedges; (vi) China's saving wedges; (vii) China's production structure; and (viii) rest-of-world (ROW) forces. ROW forces include ROW's fundamental productivity, labor supply, capital supply, taste wedges, saving wedges, and production structure. For each group, effects are computed as differences between the terminal-year baseline (all wedges set to their calibrated values in 2015) and counterfactuals that hold the selected wedges at their 2007 values.

As shown in Table 10, between 2007 and 2015 China's own productivity growth is the most important force behind the decline in both trade shares of GDP. It lowers the export trade share of GDP by 6.7 p.p. and the import trade share of GDP by 6.3 p.p. On the import side, higher domestic productivity redirects sourcing toward home goods, so China buys more from itself and less from abroad, reducing the import trade share of GDP. On the export side, higher Chinese productivity raises foreign regions' expenditure shares on Chinese goods, which would lift China's export trade share of GDP. However, because it enlarges China's relative economic size, foreign demand shrinks in relative terms and scales down the implied export increase, so the export trade share of GDP still declines.

The second most important force is China's rising capital stock. Capital deepening lowers the export trade share of GDP by 3.4 p.p. and the import trade share of GDP by 2.6 p.p. It operates through the same mechanisms as productivity growth. On the import side, lower domestic production costs shift sourcing toward home varieties, reducing the import trade share of GDP. On the export side, lower costs raise foreigners' expenditure shares on Chinese goods, but the expansion of China's relative economic size scales down foreign demand in relative terms and offsets the gain, so the export trade share of GDP declines. The remaining wedges have relatively modest effects on external trade shares compared with productivity and capital.

China's internal trade share of GDP is essentially flat over this period. Higher internal trade costs reduce the internal trade share by 3.4 p.p., and this decline is almost fully offset by the combined effects of the other wedges. As in the earlier period, China's real GDP per capita continues to rise—by 47.5% ex post—driven primarily by domestic productivity growth. Capital deepening is the second major source of income gains, adding 22.6% to real GDP per capita; both forces have larger effects than in 2002–2007.

To summarize, over 2002–2007, the fall in external trade costs is the main force behind the rise in China's trade share of GDP. Three additional forces provide comparable support—especially on exports: a stronger saving motive, a shift in production structure that raises intermediate-input intensity, and ROW wedges (TFP, labor and capital supplies, and tastes) that expand foreign demand. By contrast, China's own productivity growth works in the opposite direction, lowering the export and import trade shares of GDP.

Over 2007–2015, the pattern reverses: China's domestic productivity growth and capital deepening are the dominant drivers of the decline in its trade share of GDP, while changes in trade costs and other wedges play limited roles. A fuller account of how key wedges—such as China's productivity shocks and external trade-cost shocks—operate at a more disaggregated sectoral level requires additional counterfactual analysis, which I take up next.

5.2. *Decomposition of Change in Trade Share of GDP at more disaggregated level*

In this section, I further decompose the contributions of key wedges—China's productivity shocks, external trade costs, and ROW wedges—at a more disaggregated level. The results are presented in Table 11 and Table 12. The decomposition methodology follows the same counterfactual logic as in the previous subsection.

TABLE 11
STRUCTURAL ACCOUNTING DECOMPOSITION AT MORE DISAGGREGATED LEVEL, 2002 TO 2007

2002 to 2007	Change in Trade Share of GDP (p.p.)			Change in Real GDP per capita
	Export	Import	Internal	(%)
Overall	10.1	3.5	21.1	44.9
China's Productivity	-11.3	-7.6	4.6	32.3
Agriculture	-1.0	-0.6	0.5	2.9
Industry	-10.4	-7.5	4.7	23.5
Services	-2.8	-2.3	-1.6	9.6
China's External Trade Cost	6.8	6.6	-2.9	1.5
Agriculture	0.1	0.1	0.1	0.0
Industry	6.2	6.0	-2.1	1.4
Services	0.5	0.5	-1.0	0.1
China's Internal trade cost	-1.5	-1.4	16.7	4.2
Agriculture	0.0	0.0	1.2	0.3
Industry	-1.0	-0.8	8.5	2.1
Services	-0.3	-0.4	6.2	1.6
RoW's forces	4.1	2.4	1.2	0.8
Productivity	1.7	1.6	1.6	0.3
Labor Supply	0.6	0.5	-0.1	0.1
Capital	0.5	0.4	-0.1	0.1
Taste Wedges	-0.1	-0.1	0.0	0.0
Saving Wedges	1.0	-0.6	0.0	0.2
Production Structure	0.4	0.5	-0.2	0.1

Notes: This table decomposes changes in China's trade share of GDP and other variables over the period 2002–2007 into sector-level wedge groups: (i) China's sectoral fundamental productivity; (ii) China's sectoral external trade costs; and (iii) rest-of-world (ROW) forces. ROW forces include ROW's fundamental productivity, labor supply, capital supply, taste wedges, saving wedges, and production structure. For each group, effects are computed as differences between the terminal-year baseline (all wedges set to their calibrated values in 2007) and counterfactuals that hold the selected wedges at their 2002 values.

As discussed in the previous section, Table 11 shows that the decline in external trade costs is the primary driver of the 2002–2007 rise in China's external trade share of GDP. The sectoral decomposition then attributes most of this effect to industry, with agriculture and services playing smaller roles. Specifically, lower industry trade costs raise the export trade share by 6.2 p.p. and the import trade share by 6.0 p.p. Mechanically, cuts in iceberg costs reduce delivered prices, expand China's foreign market access, and raise foreigners' expenditure shares on Chinese industry goods; symmetrically, they lower the domestic price of foreign industry goods and increase China's import expenditure share.

Turning to China's productivity, the effect is large and offsetting. Industry drives the result: industry productivity growth lowers the export trade share of GDP by 10.4 p.p. and the import trade share of GDP by 7.5 p.p., while agriculture (–1.0, –0.6 p.p.) and services (–2.8, –2.3 p.p.) play smaller roles. Mechanically, higher domestic productivity shifts sourcing toward home goods, cutting the import trade share of GDP; at the same time, although it raises foreigners' expenditure shares on Chinese goods, it enlarges China's relative economic size and scales down foreign demand in relative terms, so the export trade share of GDP also falls.

Among ROW wedges, foreign productivity growth is the largest component but modest in magnitude, lifting China's export trade share of GDP by 1.7 p.p. and the import trade share of GDP by 1.6 p.p.

Regarding changes in China's internal trade share at the sector level, reductions in internal trade costs in industry and services are the main drivers, raising the internal trade share by 8.5 p.p. and 6.2 p.p., respectively. Regarding the increase in real GDP per capita, productivity growth in both industry and services plays a crucial role, with the impact of industry productivity growth clearly exceeding that of services.

Turning to real GDP per capita, the sectoral decomposition in Table 11 shows that the 32.3% ex-post gain attributed to China's productivity is overwhelmingly driven by industry, which accounts for 23.5%, compared with 9.6% from services and 2.9% from agriculture. Changes in China's trade costs make only a modest contribution to income: lower external trade costs raise real GDP per capita by 1.5%, and lower internal trade costs raise it by 4.2%, again mainly through industry and services. ROW wedges together add just 0.8%, confirming that, over 2002–2007, most of China's income gains are generated by domestic, and especially industrial, productivity improvements.

As shown in Table 12, from 2007 to 2015 China's productivity growth is the key force behind the decline in its trade share of GDP. At the sector level, the 30.7% increase in industry productivity alone reduces the export trade share by 7.2 p.p. and the import trade share by 6.9 p.p. The 35.9% productivity growth in services is almost as important, lowering both the export and import trade shares by 6.3 p.p.

As mentioned earlier, China's internal trade share of GDP changes little over this period. At a more disaggregated level, industry productivity is the main force pushing internal trade up, raising the internal trade share by 2.9 p.p., while services productivity slightly lowers it by 0.4 p.p. These effects are largely offset by higher internal trade costs, which reduce the internal trade share by 3.4 p.p., leaving the overall change close to zero.

Turning to real GDP per capita, the 56.3% ex-post increase is driven predominantly by

TABLE 12

Structural accounting decomposition at more disaggregated level, 2007 to 2015

2007 to 2015	Change in Trade Share of GDP (p.p.)			Change in Real GDP per capita
	Export	Import	Internal	(%)
Overall	-12.4	-7.1	0.1	56.3
China's Productivity	-6.7	-6.3	1.2	47.5
Agriculture	-0.6	-0.6	0.1	2.7
Industry	-7.2	-6.9	2.9	27.6
Services	-6.3	-6.3	-0.4	24.6
China's External Trade Cost	-1.4	-1.3	-1.2	-0.3
Agriculture	0.1	0.1	0.0	0.0
Industry	0.2	0.2	-0.4	0.0
Services	-1.4	-1.4	-0.7	-0.3
China's Internal trade cost	-0.3	-0.7	-3.4	-1.3
Agriculture	0.0	0.0	0.0	0.0
Industry	-0.1	-0.1	-7.4	-2.1
Services	0.1	-0.3	2.9	0.6
RoW's forces	-0.6	-0.7	0.6	-0.1
Productivity	-1.2	-1.0	0.6	-0.2
Labor Supply	0.5	0.5	-0.1	0.1
Capital	0.5	0.5	-0.1	0.1
Taste Wedges	-0.4	-0.4	0.0	-0.1
Saving Wedges	0.1	0.0	0.0	0.0
Production Structure	-0.2	-0.2	0.2	0.0

Notes: This table decomposes changes in China's trade share of GDP and other variables over the period 2002–2007 into sector-level wedge groups: (i) China's sectoral fundamental productivity; (ii) China's sectoral external trade costs; and (iii) rest-of-world (ROW) forces. ROW forces include ROW's fundamental productivity, labor supply, capital supply, taste wedges, saving wedges, and production structure. For each group, effects are computed as differences between the terminal-year baseline (all wedges set to their calibrated values in 2015) and counterfactuals that hold the selected wedges at their 2007 values.

China's own productivity growth. Sectorally, productivity in industry and services together accounts for almost all of the 47.5% gain attributed to China's productivity—27.6% from industry and 24.6% from services, compared with 2.7% from agriculture. Changes in China's trade costs and ROW wedges have only small effects on income, with external and internal trade-cost wedges together slightly lowering real GDP per capita and ROW wedges reducing it by just 0.1%.

To summarize, at a more disaggregated level, over 2002–2007 the decline in external trade costs in the industry sector is central to explaining the rise in China's external trade share, while productivity growth in industry is important but works in the opposite direction by lowering the trade share. Over 2007–2015, the main forces behind the decline in China's trade share of GDP are productivity growth in the industry and services sectors.

5.3. *Effects of Non-homothetic Preferences, and Trade Imbalance*

In this subsection, I examine how structural change (via non-homothetic preferences) and trade imbalances affect China's trade share of GDP.

I begin by isolating the effect of structural change by comparing the baseline model with non-homothetic preferences to a counterfactual with Cobb–Douglas preferences, in which sectoral expenditure shares are constant over time.

In the Cobb–Douglas case, utility is specified as

$$c_n = \prod_{j \in \{a,m,s\}} (c_n^j)^{\psi_n^j},$$

In this specification, all income elasticities and substitution elasticities are unity, so sectoral expenditure shares are constant over time. This change in preferences mainly affects the aggregate price level and the calibrated labor-flow costs, but it does not alter the calibrated trade costs, productivity, or other wedges.

Under this framework, I compare counterfactual outcomes of specific wedges under the two preference assumptions. Table 13 reports the decomposed effects of each force under non-homothetic preferences and the incremental effect of structural change, computed as the difference from the Cobb–Douglas benchmark.

TABLE 13
STRUCTURAL ACCOUNTING DECOMPOSITION, PREFERENCE STRUCTURE

	Change in Trade Share of GDP (p.p.)					
	Non-homothetic			**Non-homo. minus Cobb-D.**		
2002 to 2007	Export	Import	Internal	Export	Import	Internal
China's Productivity	-11.32	-7.62	4.59	-0.81	-0.74	-0.95
China's Trade Cost	5.56	5.35	13.68	-0.03	-0.02	-0.21
China's Labor & Capital	-1.35	-2.21	-0.04	0.10	0.01	-0.02
China's Saving Wedges	4.35	-4.05	-0.07	-0.03	0.15	0.19
China's Production Structure	4.04	1.37	8.35	-0.04	0.01	0.13
2007-2015	Export	Import	Internal	Export	Import	Internal
China's Productivity	-6.74	-6.25	1.22	-0.62	-0.60	-1.18
China's Trade Cost	-1.17	-1.53	-4.62	0.01	0.01	0.13
China's Labor & Capital	-4.21	-3.37	0.63	0.16	0.15	-0.12
China's Saving Wedges	0.34	0.73	0.08	-0.12	-0.01	-0.11
China's Production Structure	0.78	1.21	-1.07	0.05	0.03	0.12

Notes: This table reports the structural accounting decomposition of changes in China's export, import, and internal trade shares of GDP for 2002–2007 and 2007–2015. The left block ("Non-homothetic") shows the contribution (in percentage points) of each wedge group under the baseline model with non-homothetic preferences. The right block ("Non-homo. minus Cobb-D.") reports the differences in the decomposition results under non-homothetic preferences versus Cobb–Douglas preferences, thereby isolating the incremental effect of structural change implied by non-homothetic preferences. Positive (negative) entries indicate that the corresponding wedge raises (lowers) the relevant trade share relative to its base-year level.

The results indicate that, in both periods, structural change has only a modest negative effect (typically less than 1 percentage point) on China's trade share of GDP. As incomes rise, households shift consumption towards services, which are less tradable, and away from agriculture and manufacturing. This shift lowers the overall trade share. For example, during 2002–2007 the structural-change effect on the export trade share is about -0.81 p.p. and about -0.74 p.p. on the import trade share, reflecting this reallocation of spending. The impact is somewhat smaller in 2007–2015 (about -0.61 p.p. on exports and -0.60 p.p. on imports), because income growth slowed in that period, so the shift towards services was less pronounced.

I next assess how the trade imbalance (unbalanced versus balanced trade) affects the decomposition results. To do this, I solve the model under a balanced-trade assumption in both the baseline and counterfactual cases and then perform the same shock decompositions.

TABLE 14
STRUCTURAL ACCOUNTING DECOMPOSITION, TRADE BALANCE CONDITION

2002 to 2007	Change in Trade Share of GDP (p.p.)					
	Unbalanced Trade			Balanced Trade		
	Export	Import	Internal	Export	Import	Internal
Overall	10.1	3.5	21.1	5.6	-	21.6
China's Productivity	-11.3	-7.6	4.6	-8.4	-	4.3
China's Trade Cost	5.6	5.3	13.7	5.0	-	13.9
External Trade Cost	6.8	6.6	-2.9	6.2	-	-2.7
Internal Trade Cost	-1.5	-1.4	16.7	-1.2	-	16.4
China's Labor	1.2	-0.1	-0.4	0.4	-	-0.8
Mobility Cost	1.5	0.1	-0.4	0.6	-	-0.8
Initial Supply	-0.2	-0.2	0.1	-0.2	-	0.1
China's Capital	-2.6	-2.1	0.4	-2.4	-	0.3
China's Taste Wedges	0.2	0.1	0.6	0.1	-	0.4
China's Saving Wedges	4.4	-4.1	-0.1	0.0	-	0.0
China's Production Structure	4.0	1.4	8.3	1.9	-	7.4
RoW's Forces	4.1	2.4	1.2	3.3	-	1.1
2007-2015						
Overall	-12.4	-7.1	0.1	-9.2	-	0.5
China's Productivity	-6.7	-6.3	1.2	-6.5	-	1.1
China's Trade Cost	-1.2	-1.5	-4.6	-1.1	-	-5.1
External Trade Cost	-1.4	-1.3	-1.2	-1.3	-	-1.5
Internal Trade Cost	-0.3	-0.7	-3.4	-0.3	-	-3.7
China's Labor	-0.8	-0.6	0.4	-0.7	-	0.4
Mobility Cost	-0.5	-0.4	0.5	-0.4	-	0.5
Initial Supply	-0.3	-0.2	0.0	-0.3	-	0.0
China's Capital	-3.4	-2.6	0.1	-2.9	-	0.2
China's Taste Wedges	-0.1	0.0	0.6	0.0	-	0.6
China's Saving Wedges	0.3	0.7	0.1	0.0	-	0.0
China's Production Structure	0.8	1.2	-1.1	1.1	-	-0.9
RoW's Forces	-0.6	-0.7	0.6	-0.5	-	0.7

Notes: This table decomposes changes in China's trade share of GDP (p.p.) for 2002–2007 (top) and 2007–2015 (bottom) under two trade-balance assumptions: unbalanced trade, where regional imbalances $D_n \equiv X_n - Y_n \neq 0$, and balanced trade, where $D_n = 0$ in both the baseline and all counterfactuals (thus shutting down the saving wedge). Under balanced trade, aggregate exports equal imports, making the import column redundant ("—"). For each wedge, effects are computed as differences between the terminal-year baseline (all wedges at their calibrated 2015 values) and counterfactuals that hold the selected wedges fixed at their 2007 levels.

Table 14 compares the decomposed wedges under unbalanced and balanced trade scenarios. Under balanced trade, the calibrated wedges together explain about 55% of China's increase in the trade share during 2002–2007 (since 5.6 of the 10.1 p.p. rise comes from calibrated wedges) and about 74% of its decline during 2007–2015 (since −9.2 of −12.4 p.p. is explained). Put differently, aside from the saving wedge, the calibrated wedges reproduce the hump-shaped pattern of China's trade share quite well, especially capturing the sharp decline in the second period.

The qualitative conclusions under balanced trade are very similar to those under unbalanced trade. In 2002–2007, falling external trade costs are the main force pushing the trade share up, while China's productivity growth is also important but works in the opposite direction by lowering the trade share. In 2007–2015, productivity growth is the dominant force driving the trade share down, and capital accumulation also contributes, with an effect of roughly one-third the size of the productivity effect.

In summary, structural change induced by non-homothetic preferences play only a limited role in driving China's trade-share dynamics in both periods. Imposing balanced trade reduces the magnitude of the first-period increase in the trade share by about one-half and the second-period decline by about one-quarter, but it does not change the overall narrative: China's trade share still rises in the earlier period and falls in the later period for the same fundamental reasons.

5.4. Summary

In sum, this section delivers three main findings. First, over 2002–2007 the decline in external trade costs is the principal driver of the rise in China's trade share of GDP; three forces of similar magnitude—stronger saving, a shift toward intermediate-input intensity, and ROW wedges—provide comparable support, while China's own productivity growth is important but lowers both the export and import trade share of GDP. Over 2007–2015 the pattern reverses: domestic productivity growth and capital deepening dominate the decline in the trade share of GDP, while movements in trade costs and other wedges are quantitatively small. Second, at the sector level, external trade-cost declines in industry account for most of the first-period increase in the trade share of GDP, whereas productivity gains in industry and services—of comparable magnitude—drive the second-period fall. Third, the results are robust: non-homothetic preferences play only a limited role, and imposing balanced trade attenuates magnitudes but leaves the narrative unchanged.

6. Conclusion

In this paper, I present some key facts concerning China's increase in trade share of GDP in the early 2000s and its subsequent decline since 2007. To explain the change in China's trade share, I conduct a structural accounting decomposition through a static multi-sector, multi-country Ricardian trade model. The model features non-homothetic preferences, international trade, inter-regional trade within China, and labor flow across regions within China. Specifically, the model is implemented with eight regions in mainland China, one foreign economy group, and three sectors over the periods 2002-2007 and 2007-2015. The calibrated model replicates the change in China's trade share of GDP well.

Through structural accounting decompositions, I find that China's trade share of GDP rose over 2002–2007 chiefly because external trade costs fell, with comparable support from a stronger saving motive, a production shift toward intermediate-input intensity, and ROW wedges that expanded foreign demand; by contrast, China's own productivity growth worked in the opposite direction by lowering the trade share. Over 2007–2015, the pattern reverses: domestic productivity growth and capital deepening dominate the decline in the trade share of GDP, while changes in trade costs and other wedges play limited roles. Sectorally, industry is pivotal—external cost declines in industry drive the first-period rise, whereas productivity gains in industry and services drive the second-period fall. These conclusions are robust under balanced trade: magnitudes attenuate, but the narrative is unchanged, and non-homothetic preferences play only a minor role.

In my framework, productivity, capital deepening, and external trade costs move China's trade share of GDP primarily by changing production costs, sourcing patterns, and the effective size of outside demand. Higher productivity or capital stocks lower Chinese prices, shift sourcing toward home goods, and reduce the import trade share of GDP; they also raise foreign region's expenditure shares on Chinese goods but enlarge China's relative economic size, scaling down the weight of foreign demand so the export trade share of GDP can fall even when exports rise in levels. Declines in external trade costs work through delivered prices: they expand foreign market access for Chinese goods and lift the export trade share of GDP, while making foreign varieties cheaper for China and raising the import trade share of GDP.

Looking ahead, the framework developed here can be extended along several dimensions. A first step is to incorporate more granular regional and sectoral disaggregation, which would allow for richer variation and more detailed information at both the regional and sectoral levels. A second step is to embed an endogenous trade deficit in a dynamic trade model, which would offer further insights into how borrowing and lending over time shape the evolution of the trade share of GDP. A third extension is to introduce multi-stage production and explicit global value chains, which would allow the model to track value added, imported intermediates, and trade-cost shocks along production networks and thus link changes in China's trade share more tightly to its position in global supply chains. I leave these and other extensions for future research.

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Appendix A: Tables

TABLE A.1

Sectoral Decomposition of Changes in China's Export and Import Trade Share of GDP

Export (% of GDP)	**2002 to 2007**			**2007 to 2015**		
Change	Total	Within	Between	Total	Within	Between
Total	**10.12**	**8.99**	**1.13**	**-12.36**	**-9.45**	**-2.91**
Agriculture	-0.10	-0.02	-0.08	-0.08	-0.05	-0.03
Industry	9.44	8.37	1.07	-10.07	-6.40	-3.67
Service	0.78	0.65	0.13	-2.21	-3.00	0.79
Import (% of GDP)	**2002 to 2007**			**2007 to 2015**		
Change	Total	Within	Between	Total	Within	Between
Total	**3.50**	**2.75**	**0.75**	**-7.05**	**-5.61**	**-1.45**
Agriculture	0.15	0.29	-0.14	-0.05	0.05	-0.09
Industry	3.01	2.26	0.75	-6.53	-4.23	-2.30
Service	0.34	0.21	0.14	-0.48	-1.42	0.94

Notes: The table reports a sectoral decomposition of changes in China's trade share of GDP (exports plus imports) for 2002–2007 and 2007–2015. It is constructed from the OECD Inter-Country Input-Output (ICIO) Tables, which provide sector-level bilateral trade flows between China and foreign economies.

TABLE A.2

Regional Decomposition of Changes in China's Export and Import Trade Share of GDP

Export (% of GDP)	2002 to 2007			2007 to 2015		
Change	Total	Within	Between	Total	Within	Between
Total	**10.12**	**9.04**	**1.08**	**-12.36**	**-9.99**	**-2.37**
NorthEast (NE)	0.34	0.50	-0.16	-0.88	-0.76	-0.13
BeijingTianjin (BT)	1.30	0.08	1.22	-1.84	-1.44	-0.40
NorthernCoastal (NC)	1.30	0.77	0.53	-1.11	-0.97	-0.14
EasternCoastal (EC)	6.09	5.44	0.65	-6.52	-5.27	-1.24
SouthernCoastal (SC)	-0.62	0.40	-1.02	-1.39	-0.34	-1.05
Central (CE)	0.51	0.69	-0.19	0.02	-0.31	0.33
NorthWest (NW)	1.02	0.84	0.18	-0.72	-0.78	0.05
SouthWest (SW)	0.18	0.31	-0.13	0.08	-0.12	0.20
Import (% of GDP)	**2002 to 2007**			**2007 to 2015**		
Change	Total	Within	Between	Total	Within	Between
Total	**3.50**	**2.97**	**0.54**	**-7.05**	**-5.88**	**-1.17**
NorthEast (NE)	0.91	1.13	-0.22	-1.24	-1.05	-0.19
BeijingTianjin (BT)	0.52	-0.47	0.98	-0.35	0.03	-0.38
NorthernCoastal (NC)	0.72	0.30	0.42	-0.40	-0.29	-0.12
EasternCoastal (EC)	-0.66	-1.07	0.42	-0.94	-0.23	-0.71
SouthernCoastal (SC)	-2.05	-1.37	-0.68	-0.09	0.56	-0.65
Central (CE)	1.88	2.22	-0.34	-1.98	-2.45	0.47
NorthWest (NW)	1.07	0.87	0.20	-1.14	-1.19	0.05
SouthWest (SW)	1.11	1.36	-0.25	-0.91	-1.26	0.35

Notes: The average trade share of GDP represents the mean value of import and export shares relative to GDP. For each region in China, the trade share of GDP is calculated by averaging the import and export trade values between that region and foreign countries, then dividing by China's total GDP. Similarly, for each foreign region, the trade share of GDP is computed by averaging the import and export trade values between that region and China, and dividing by China's total GDP.

TABLE A.3
SECTORAL SHARES OF CHINESE CONSUMPTION, GDP, AND TRADE DATA

Sectoral share (% of Total)		2002	2007	2015
Consumption	**Agriculture**	9.71%	6.28%	3.71%
	Manufacture	30.64%	31.10%	28.17%
	Services	59.65%	62.61%	68.12%
GDP	**Agriculture**	13.22%	10.01%	8.42%
	Manufacture	40.89%	42.97%	36.10%
	Services	45.88%	47.01%	55.48%
Import	**Agriculture**	2.11%	2.43%	3.20%
	Manufacture	69.63%	72.10%	63.10%
	Services	28.27%	25.47%	33.70%
Export	**Agriculture**	1.45%	0.70%	0.72%
	Manufacture	76.13%	81.48%	81.50%
	Services	22.42%	17.82%	17.78%

Notes: The data are obtained from the OECD Inter-Country Input-Output (ICIO) Tables.

APPENDIX B: ALGEBRA

B.1. Decomposition into Within- and Between-Sector Effects

Let total trade share of GDP be

$$TS_t \equiv \frac{\sum_k T_{k,t}}{\sum_k Y_{k,t}}.$$

Define sector k's GDP share $\omega_{k,t} \equiv \frac{Y_{k,t}}{\sum_m Y_{m,t}}$ and sector k's trade share of its own GDP $S_{k,t} \equiv \frac{T_{k,t}}{Y_{k,t}}$. Then

$$TS_t = \frac{\sum_k T_{k,t}}{\sum_k Y_{k,t}} = \sum_k \frac{Y_{k,t}}{\sum_m Y_{m,t}} \cdot \frac{T_{k,t}}{Y_{k,t}} = \sum_k \omega_{k,t} S_{k,t}. \tag{B.1}$$

Consider two dates $t = 0, 1$. The aggregate change is

$$\Delta TS \equiv TS_1 - TS_0 = \sum_k \omega_{k,1} S_{k,1} - \sum_k \omega_{k,0} S_{k,0} = \sum_k \left(\omega_{k,1} S_{k,1} - \omega_{k,0} S_{k,0}\right). \tag{B.2}$$

For any pair of scalars (a_0, a_1) and (b_0, b_1), the following bilinear identity holds:

$$a_1 b_1 - a_0 b_0 = \frac{a_1 + a_0}{2}(b_1 - b_0) + \frac{b_1 + b_0}{2}(a_1 - a_0). \tag{B.3}$$

Proof of (B.3):

$$\begin{aligned}
\text{RHS} &= \tfrac{1}{2}\big[(a_1+a_0)b_1-(a_1+a_0)b_0\big]+\tfrac{1}{2}\big[(b_1+b_0)a_1-(b_1+b_0)a_0\big] \\
&= \tfrac{1}{2}(a_1b_1+a_0b_1-a_1b_0-a_0b_0)+\tfrac{1}{2}(a_1b_1+a_1b_0-a_0b_1-a_0b_0) \\
&= a_1b_1-a_0b_0=\text{LHS}.
\end{aligned}$$

Applying (B.3) to $a_t=\omega_{k,t}$ and $b_t=S_{k,t}$ gives

$$\omega_{k,1}S_{k,1}-\omega_{k,0}S_{k,0}=\frac{\omega_{k,1}+\omega_{k,0}}{2}\,(S_{k,1}-S_{k,0})+\frac{S_{k,1}+S_{k,0}}{2}\,(\omega_{k,1}-\omega_{k,0}). \tag{B.4}$$

Define midpoint averages and first differences

$$\bar{X}_k\equiv\frac{X_{k,1}+X_{k,0}}{2},\qquad \Delta X_k\equiv X_{k,1}-X_{k,0}.$$

Summing over k yields the exact two-term decomposition

$$\Delta TS=\sum_k\big(\bar{\omega}_k\,\Delta S_k+\Delta\omega_k\,\bar{S}_k\big). \tag{B.5}$$

The first term, $\sum_k \bar{\omega}_k\,\Delta S_k$, is the *within-sector (intensity) effect*—changes in sectoral trade intensity weighted by average GDP shares. The second term, $\sum_k \Delta\omega_k\,\bar{S}_k$, is the *between-sector (composition) effect*—reallocation of GDP shares across sectors weighted by average trade intensities. Because the midpoint (symmetric) formula is used, there is no residual term; the two components add up exactly to the total change.

B.2. Deriving Labor Flow Function

The cumulative distribution function for the utility of people who migrates from location m to location n is

$$\begin{aligned}
F^{n,m}(u) &= \Pr\left(V(\omega)^{n,m}\le u\right) \\
&= \Pr\left(\frac{z_n(\omega)\,W_n}{\nu^{n,m}}\le u\right) \\
&= \Pr\left(z_n(\omega)\le u\frac{\nu^{n,m}}{W_n}\right) \\
&= exp\left\{-(u)^{-\kappa}(\frac{W_n}{\nu^{n,m}})^{\kappa}\right\},
\end{aligned} \tag{B.6}$$

where $dF^{n,m}(u)=exp\left\{-(u)^{-\kappa}(\frac{W_n}{\nu^{n,m}})^{\kappa}\right\}(\frac{W_n}{\nu^{n,m}})^{\kappa}d(-(u)^{-\kappa})$.

The cumulative distribution function for the utility of people from location m is

$$\begin{aligned} F^m(u) &= \Pr\left(max_{n'} V(\omega)^{n',m} \leq u\right) \\ &= \prod_{n'=1}^{N_0} \Pr\left(z_{n'}(\omega) \leq u \frac{\nu^{n',m}}{W_{n'}}\right) \\ &= \prod_{n'=1}^{N_0} exp\left\{-(u)^{-\kappa}\left(\frac{W_{n'}}{\nu^{n',m}}\right)^{\kappa}\right\} \\ &= exp\left\{-(u)^{-\kappa}\sum_{n'=1}^{N_0}\left(\frac{W_n}{\nu^{n,m}}\right)^{\kappa}\right\} \\ &= exp\left\{-(u)^{-\kappa}\Psi_m\right\}, \end{aligned} \tag{B.7}$$

where $\Psi_m \equiv \sum_{n'=1}^{N_0} (\frac{W_{n'}}{\nu^{n',m}})^{\kappa}$.

Let $m^{n,m}$ denote the fraction of worker originally in region m who migrated to region n, where $\sum_n m^{n,m} = 1$. I can derive

$$\begin{aligned} m^{n,m} &= \Pr\left(V(\omega)^{n,m} \geq max_{n'\neq n} V(\omega)^{n',m}\right) \\ &= \int_0^{+\infty} \Pr\left(max_{n'\neq n} V(\omega)^{n',m} \leq u\right) dF(u)^{n,m} \\ &= \int_0^{+\infty} exp\left\{-(u)^{-\kappa}\sum_{n'\neq n}\left(\frac{W_{n'}}{\nu^{n',m}}\right)^{\kappa}\right\} dF(u)^{n,m} \\ &= \int_0^{+\infty} \frac{exp\left\{-(u)^{-\kappa}\sum_{n'=1}^{N_0}(\frac{W_{n'}}{\nu^{n',m}})^{\kappa}\right\}}{exp\left\{-(u)^{-\kappa}(\frac{W_n}{\nu^{n,m}})^{\kappa}\right\}} dF(u)^{n,m} \\ &= \int_0^{+\infty} \frac{exp\left\{-(u)^{-\kappa}\sum_{n'=1}^{N_0}\left(\frac{W_{n'}}{\nu^{n',m}}\right)^{\kappa}\right\}}{exp\left\{-(u)^{-\kappa}\left(\frac{W_n}{\nu^{n,m}}\right)^{\kappa}\right\}} exp\left\{-(u)^{-\kappa}\left(\frac{W_n}{\nu^{n,m}}\right)^{\kappa}\right\}\left(\frac{W_n}{\nu^{n,m}}\right)^{\kappa} d\left(-(u)^{-\kappa}\right) \\ &= \int_0^{+\infty} exp\left\{-(u)^{-\kappa}\sum_{n'=1}^{N_0}\left(\frac{W_{n'}}{\nu^{n',m}}\right)^{\kappa}\right\}\left(\frac{W_n}{\nu^{n,m}}\right)^{\kappa} d\left(-(u)^{-\kappa}\right) \\ &= \left(\frac{W_n}{\nu^{n,m}}\right)^{\kappa}\int_0^{+\infty} exp\left\{-(u)^{-\kappa}\Psi_m\right\} d\left(-(u)^{-\kappa}\right) \\ &= (\frac{W_n}{\nu^{n,m}})^{\kappa}\int_{-\infty}^{0} exp\left\{t\ \Psi_m\right\} dt \\ &= \frac{(\frac{W_n}{\nu^{n,m}})^{\kappa}}{\Psi_m} = \frac{(\frac{W_n}{\nu^{n,m}})^{\kappa}}{\sum_{n'=1}^{N_0}(\frac{W_{n'}}{\nu^{n',m}})^{\kappa}}. \end{aligned} \tag{B.8}$$

B.3. Trade Share of GDP

This section derives expressions for the trade share of GDP by linking sectoral expenditure, sectoral production, cross-country sourcing behavior, and cross-country demand. Let j index sectors and n index regions. Here, $\gamma_n = \gamma$ for all n, representing the value-added share in the production function. Total production and total expenditure are denoted by Y_n and X_n, respectively. The trade deficit of region n is defined as

$$D_n \equiv X_n - Y_n.$$

Import Share of GDP

The import-to-GDP ratio can be decomposed as follows:

$$\begin{aligned}
\frac{IM_n}{VA_n} &= \frac{X_n}{VA_n} = \frac{IM_n}{X_n} \cdot \frac{X_n}{VA_n} \\
&= \frac{\sum_{j=1}^{J} IM_n^j}{\sum_{j=1}^{J} X_n^j} = \frac{Y_n + D_n}{\gamma Y_n} \sum_{j=1}^{J} \left(\frac{X_n^j}{\sum_{j=1}^{J} X_n^j} (1 - \pi_{nn}^j) \right) \\
&= \frac{1}{\gamma} \underbrace{\left(\frac{Y_n + D_n}{Y_n} \right)}_{\text{consumption tendency}} \sum_{j=1}^{J} \underbrace{\left(\frac{X_n^j}{\sum_{j=1}^{J} X_n^j} \right)}_{\text{sector expenditure weights}} \underbrace{(1 - \pi_{nn}^j)}_{\text{self-sourcing behavior}} .
\end{aligned}$$

Interpretation: The import share of GDP increases with (i) the consumption tendency $\frac{Y_n + D_n}{Y_n}$, (ii) the sectoral expenditure weights $e_{nj}^{\bar{X}} = \frac{X_n^j}{\sum_{j=1}^{J} X_n^j}$, and (iii) lower domestic sourcing shares $(1 - \pi_{nn}^j)$, which reflect comparative advantage and global sourcing behavior.

Export Share of GDP

Similarly, the export-to-GDP ratio can be expressed as

$$\begin{aligned}
\frac{EX_n}{VA_n} &= \frac{1}{\gamma} \sum_{i \neq n} \sum_{j=1}^{J} \frac{Y_n^j}{Y_n} \frac{Y_i^j}{Y_n^j} \frac{Y_i^j + D_i^j}{Y_i^j} \pi_{in}^j \\
&= \frac{1}{\gamma} \sum_{i \neq n} \sum_{j=1}^{J} \underbrace{\left(\frac{Y_i^j + D_i^j}{Y_i^j} \right)}_{\text{foreign consumption tendency}} \underbrace{\left(\frac{Y_n^j}{Y_n} \right)}_{\text{sector income weights}} \underbrace{\left(\frac{Y_i^j}{Y_n^j} \right)}_{\text{relative income size}} \underbrace{\pi_{in}^j}_{\text{foreign sourcing behavior}} .
\end{aligned}$$

Interpretation: The export share depends on foreign demand conditions and trade structure. It rises with (i) foreign consumption intensity, (ii) the relative income size of trading partners, and (iii) the pattern of trade linkages π_{in}^j, which capture comparative advantage and global sourcing behavior.

One sector case

$$\begin{aligned}\frac{IM_n}{VA_n} = \frac{X_n}{VA_n} &= \frac{IM_n}{X_n} \cdot \frac{X_n}{VA_n} \\ &= \frac{IM_n}{X_n} = \frac{Y_n + D_n}{\gamma Y_n}(1-\pi_{nn}) \\ &= \frac{1}{\gamma} \underbrace{\left(\frac{Y_n + D_n}{Y_n}\right)}_{\text{home consumption tendency}} \underbrace{(1-\pi_{nn})}_{\text{home sourcing behavior}},\end{aligned}$$

$$\begin{aligned}\frac{EX_n}{VA_n} &= \frac{\sum_{i \neq n} X_i \pi_{in}}{\gamma Y_n} = \frac{1}{\gamma}\sum_{i \neq n} \frac{Y_i + D_i}{Y_n}\pi_{in} \\ &= \frac{1}{\gamma}\sum_{i \neq n} \frac{Y_i}{Y_n}\frac{Y_i + D_i}{Y_i}\pi_{in} \\ &= \frac{1}{\gamma}\sum_{i \neq n} \underbrace{\frac{Y_i}{Y_n}}_{\text{relative income size}} \underbrace{\frac{Y_i + D_i}{Y_i}}_{\text{foreign consumption tendency}} \underbrace{\pi_{in}}_{\text{foreign sourcing behavior}}.\end{aligned}$$

B.4. Gains from Trade (GTF)

Step 1: Consumption price index and its log change I begin with the price index for aggregate consumption, P_c^n, defined as

$$P_c^n = \left[\sum_{j=1}^{J} \left(\alpha_n^j\right)^{\sigma^c} (P_n^j)^{1-\sigma^c} (c_n)^{(1-\sigma^c)(\varepsilon^j - 1)}\right]^{\frac{1}{1-\sigma^c}}.$$

Taking the logarithmic differential of P_c^n yields

$$d\ln P_n^c = \frac{1}{1-\sigma^c}\sum_{j=1}^{J} \psi_n^j d\ln\left[\left(\hat{\alpha}_n^j\right)^{\sigma^c}\left(P_n^j\right)^{1-\sigma^c}\right], \tag{AA1}$$

where

$$\left(\hat{\alpha}_n^j\right)^{\sigma^c} = \left(\alpha_n^j\right)^{\sigma^c} (c_n)^{(1-\sigma^c)(\varepsilon^j-1)}, \tag{AA2}$$

and

$$\psi_n^j = \frac{\left(\alpha_n^j\right)^{\sigma^c} \left(P_n^j\right)^{1-\sigma^c} (c_n)^{(1-\sigma^c)(\varepsilon^j-1)}}{\sum_{j=1}^{J}\left(\alpha_n^j\right)^{\sigma^c}\left(P_n^j\right)^{1-\sigma^c}(c_n)^{(1-\sigma^c)(\varepsilon^j-1)}} = \frac{\left(\hat{\alpha}_n^j\right)^{\sigma^c}\left(P_n^j\right)^{1-\sigma^c}}{\sum_{j=1}^{J}\left(\hat{\alpha}_n^j\right)^{\sigma^c}\left(P_n^j\right)^{1-\sigma^c}}. \tag{AA3}$$

Now consider the change in welfare, i.e., the change in real income W_n/P_c^n. To simplify notation, I assume that only labor inputs are used in production, so the capital share $\beta = 0$.

This simplifying assumption does not affect the analytical expression for the gains from trade; it only reduces notation without changing the core trade–welfare mechanism.

The change in real income is then

$$d\ln\frac{W_n}{P_n^c} = d\ln W_n - d\ln P_n^c = d\ln W_n - \frac{1}{1-\sigma^c}\sum_{j=1}^{J}\psi_n^j d\ln\left[\left(\hat{\alpha}_n^j\right)^{\sigma^c}\left(P_n^j\right)^{1-\sigma^c}\right].$$

Step 2: Deriving $d\ln P_n^j$ Sectoral prices P_n^j are given by

$$P_n^j = A^j\left(\sum_{i=1}^{N}\lambda_i^j(\kappa_{ni}^j c_i^j)^{-\theta}\right)^{-\frac{1}{\theta}}, \qquad A^j = \Gamma\left(\frac{1+\theta-\sigma}{\theta}\right).$$

Define

$$\Phi_{ni}^j = \lambda_i^j(\kappa_{ni}^j c_i^j)^{-\theta} \quad\Rightarrow\quad P_n^j = A^j\left(\sum_{m=1}^{N}\Phi_{nm}^j\right)^{-\frac{1}{\theta}}.$$

Taking logarithmic differentials,

$$d\ln P_n^j = -\frac{1}{\theta}\sum_{m=1}^{N}\pi_{nm}^j\, d\ln\Phi_{nm}^j,$$

where $\pi_{nm}^j = \Phi_{nm}^j/\sum_v \Phi_{nv}^j$ is the trade share.

Using

$$\frac{\Phi_{nm}^j}{\Phi_{nn}^j} = \frac{\pi_{nm}^j}{\pi_{nn}^j} \quad\Rightarrow\quad d\ln\Phi_{nm}^j = d\ln\Phi_{nn}^j + d\ln\pi_{nm}^j - d\ln\pi_{nn}^j,$$

we obtain

$$d\ln P_n^j = -\frac{1}{\theta}\sum_{m=1}^{N}\pi_{nm}^j\big(d\ln\Phi_{nn}^j + d\ln\pi_{nm}^j - d\ln\pi_{nn}^j\big).$$

Step 3: Combining expressions for P_c^n and P_n^j Substituting $d\ln P_n^j$ into the expression for $d\ln P_c^n$ and rearranging, I can write the change in real income as

$$d\ln W_n - d\ln P_c^n = d\ln W_n - \frac{\sigma^c}{1-\sigma^c}\sum_{j=1}^{J}\psi_n^j d\ln\hat{\alpha}_n^j - \sum_{j=1}^{J}\psi_n^j d\ln P_n^j.$$

Using the expression for $d\ln P_n^j$ from Step 2:

$$d\ln W_n - d\ln P_c^n = d\ln W_n - \frac{\sigma^c}{1-\sigma^c}\sum_{j=1}^{J}\psi_n^j d\ln\hat{\alpha}_n^j$$
$$+\frac{1}{\theta}\sum_{j=1}^{J}\psi_n^j\sum_{m=1}^{N}\pi_{nm}^j\big(d\ln\Phi_{nn}^j + d\ln\pi_{nm}^j - d\ln\pi_{nn}^j\big).$$

Using $\sum_m \pi_{nm}^j d\ln\pi_{nm}^j = 0$, this simplifies to

$$d\ln W_n - d\ln P_c^n = d\ln W_n - \frac{\sigma^c}{1-\sigma^c}\sum_{j=1}^{J}\psi_n^j d\ln\hat{\alpha}_n^j + \frac{1}{\theta}\sum_{j=1}^{J}\psi_n^j\big(d\ln\Phi_{nn}^j - d\ln\pi_{nn}^j\big).$$

Step 4: The formula and differential of Φ_{nn}^j The domestic term Φ_{nn}^j can be written as

$$\Phi_{nn}^j = \lambda_n^j\left(\Upsilon_n^j W_n^{\gamma_n^j}\prod_{k=1}^{J}(P_n^k)^{\gamma_n^{k,j}}\right)^{-\theta}.$$

Taking logarithmic differentials gives

$$d\ln\Phi_{nn}^j = d\ln\lambda_n^j - \theta\gamma_n^j d\ln W_n - \theta\sum_{k=1}^{J}\gamma_n^{k,j} d\ln P_n^k.$$

Using again the structure of $d\ln P_n^k$ from Step 2, this can be rewritten as

$$d\ln\Phi_{nn}^j = d\ln\lambda_n^j - \theta\gamma_n^j d\ln W_n + \sum_{k=1}^{J}\sum_{m=1}^{N}\gamma_n^{k,j}\pi_{nm}^k\big(d\ln\Phi_{nn}^k + d\ln\pi_{nm}^k - d\ln\pi_{nn}^k\big).$$

Using $\sum_m \pi_{nm}^k d\ln\pi_{nm}^k = 0$, this simplifies to

$$d\ln\Phi_{nn}^j = d\ln\lambda_n^j - \theta\gamma_n^j d\ln W_n + \sum_{k=1}^{J}\sum_{m=1}^{N}\gamma_n^{k,j}\pi_{nm}^k\big(d\ln\Phi_{nn}^k - d\ln\pi_{nn}^k\big).$$

Step 5: Matrix formulation Collect the J sectors in vector form:

$$d\ln\Phi_{nn} = \begin{bmatrix} d\ln\Phi_{nn}^1 \\ \vdots \\ d\ln\Phi_{nn}^J \end{bmatrix}, \quad \Lambda_{nn} = -\begin{bmatrix} d\ln\pi_{nn}^1 \\ \vdots \\ d\ln\pi_{nn}^J \end{bmatrix}.$$

Let A_n^T denote the $J \times J$ matrix of cost shares,

$$A_n^T = \left[\gamma_n^{k,j}\right]_{k,j=1}^{J},$$

and define

$$B_n = \begin{bmatrix} d\ln \lambda_n^1 - \theta \gamma_n^1 d\ln W_n \\ \vdots \\ d\ln \lambda_n^J - \theta \gamma_n^J d\ln W_n \end{bmatrix}.$$

Then the previous expression can be written compactly as

$$d\ln \Phi_{nn} = B_n + A_n^T\big(d\ln \Phi_{nn} + \Lambda_{nn}\big).$$

Define the Leontief-type inverse

$$(\tilde{A}_n)^T \equiv (I - A_n^T)^{-1},$$

so that

$$d\ln \Phi_{nn} = (\tilde{A}_n)^T B_n + (\tilde{A}_n)^T A_n^T \Lambda_{nn}.$$

Step 6: Leontief inverse property Using the Neumann series,

$$(I - A_n^T)^{-1} = I + A_n^T + (A_n^T)^2 + \dots,$$

one obtains the identity

$$(I - A_n^T)^{-1} A_n^T = (I - A_n^T)^{-1} - I,$$

and hence

$$(\tilde{A}_n)^T A_n^T = (\tilde{A}_n)^T - I.$$

Substituting into the expression for $d\ln \Phi_{nn}$ gives

$$d\ln \Phi_{nn} = (\tilde{A}_n)^T B_n + \big((\tilde{A}_n)^T - I\big)\Lambda_{nn}.$$

Step 7: Component-wise expression for $d\ln \Phi_{nn}^j$ Writing the j-th component explicitly,

$$d\ln \Phi_{nn}^j = \sum_{k=1}^{J} \tilde{\gamma}_n^{k,j}\big(d\ln \lambda_n^k - \theta \gamma_n^k d\ln W_n\big) + \sum_{k=1}^{J} \tilde{\gamma}_n^{k,j}\big(-d\ln \pi_{nn}^k\big) - \big(-d\ln \pi_{nn}^j\big), \tag{B.9}$$

where $\tilde{\gamma}_n^{k,j}$ denotes the (k, j)-element of $(\tilde{A}_n)^T$.

Thus,

$$d\ln\Phi^j_{nn} = \sum_{k=1}^J \tilde{\gamma}^{k,j}_n\big(d\ln\lambda^k_n - \theta\gamma^k_n d\ln W_n - d\ln\pi^k_{nn}\big) + d\ln\pi^j_{nn}.$$

Step 8: Back to $d\ln W_n - d\ln P^c_n$ Substitute $d\ln\Phi^j_{nn}$ into the expression in Step 3:

$$d\ln W_n - d\ln P^c_n = d\ln W_n - \frac{\sigma^c}{1-\sigma^c}\sum_{j=1}^J \psi^j_n d\ln\hat{\alpha}^j_n + \frac{1}{\theta}\sum_{j=1}^J \psi^j_n\big(d\ln\Phi^j_{nn} - d\ln\pi^j_{nn}\big). \quad \text{(B.10)}$$

Using the expression for $d\ln\Phi^j_{nn}$,

$$d\ln W_n - d\ln P^c_n = d\ln W_n - \frac{\sigma^c}{1-\sigma^c}\sum_{j=1}^J \psi^j_n d\ln\hat{\alpha}^j_n + \frac{1}{\theta}\sum_{j=1}^J \psi^j_n\left(\sum_{k=1}^J \tilde{\gamma}^{k,j}_n\big(d\ln\lambda^k_n - \theta\gamma^k_n d\ln W_n - d\ln\pi^k_{nn}\big)\right).$$

Collecting $d\ln W_n$ terms yields

$$d\ln\frac{W_n}{P^c_n} = \left(1 - \sum_{j=1}^J \psi^j_n \sum_{k=1}^J \tilde{\gamma}^{k,j}_n\gamma^k_n\right) d\ln W_n - \frac{\sigma^c}{1-\sigma^c}\sum_{j=1}^J \psi^j_n d\ln\hat{\alpha}^j_n + \frac{1}{\theta}\sum_{j=1}^J \psi^j_n\left(\sum_{k=1}^J \tilde{\gamma}^{k,j}_n\big(d\ln\lambda^k_n - d\ln\pi^k_{nn}\big)\right).$$

Step 9: Final expression for gains from trade Recall that

$$\psi^j_n = \frac{\big(\hat{\alpha}^j_n\big)^{\sigma^c}(P^j_n)^{1-\sigma^c}}{\sum_{g=1}^J\big(\hat{\alpha}^g_n\big)^{\sigma^c}(P^g_n)^{1-\sigma^c}}, \qquad (\hat{\alpha}^j_n)^{\sigma^c} = (\alpha^j_n)^{\sigma^c} c_n^{(1-\sigma^c)(\varepsilon^j-1)}.$$

Thus ψ^j_n is endogenous and depends on exogenous variables (e.g. trade costs); write

$$\psi^j_n = \psi^j_n\big(c_n(\mathcal{EXO})\big).$$

Denote by $W_{n,A}$ the autarky real income level and define the gains from trade as

$$GT_n = \frac{W_n - W_{n,A}}{W_n} = 1 - \exp\left(-\int_\kappa^\infty d\ln\Psi_n\right),$$

where $d\ln\Psi_n$ collects the relevant real-income changes.

Using the structure derived above, one can express GT_n in terms of changes in domestic trade shares π^k_{nn}:

$$GT_n = 1 - \exp\left(-\int_{\pi^j_{nn}}^1 \frac{1}{\sum_{g=1}^J \psi^g_n\varepsilon^g}\frac{1}{\theta}\sum_{j=1}^J \psi^j_n \sum_{k=1}^J \tilde{\gamma}^{k,j}_n d\ln\pi^k_{nn}\right), \quad \text{(B.11)}$$

or equivalently,

$$GT_n = 1 - \exp\left(-\sum_{j=1}^{J}\sum_{k=1}^{J} \frac{1}{\theta}\tilde{\gamma}_n^{k,j} \int_{\pi_{nn}^j}^{1} \frac{\psi_n^j}{\sum_{g=1}^{J} \psi_n^g \varepsilon^g} d\ln \pi_{nn}^k \right). \tag{B.12}$$

Since ψ_n^j depends on exogenous variables, write explicitly

$$GT_n = 1 - \exp\left(-\sum_{j=1}^{J}\sum_{k=1}^{J} \frac{1}{\theta}\tilde{\gamma}_n^{k,j} \int_{\pi_{nn}^j}^{1} \frac{\psi_n^j(\mathcal{EXO})}{\sum_{g=1}^{J} \psi_n^g(\mathcal{EXO}) \varepsilon^g} d\ln \pi_{nn}^k \right). \tag{B.13}$$

By the Mean Value Theorem, for each n there exists $\tilde{\kappa} \in [\kappa_{\text{now}}, \infty)$ such that

$$GT_n = 1 - \exp\left(-\sum_{j=1}^{J}\sum_{k=1}^{J} \frac{1}{\theta}\tilde{\gamma}_n^{k,j} \frac{\psi_n^j(\tilde{\kappa})}{\sum_{g=1}^{J} \psi_n^g(\tilde{\kappa}) \varepsilon^g} \int_{\pi_{nn}^j}^{1} d\ln \pi_{nn}^k \right). \tag{B.14}$$

Using $\int_{\pi_{nn}^j}^{1} d\ln \pi_{nn}^k = -\ln \pi_{nn}^k$, the gains from trade can finally be written in product form:

$$GT_n = 1 - \prod_{k=1}^{J}\prod_{j=1}^{J} \left(\pi_{nn}^k\right)^{\frac{1}{\theta}\tilde{\gamma}_n^{k,j} \frac{\psi_n^j(\tilde{\kappa})}{\sum_{g=1}^{J} \psi_n^g(\tilde{\kappa})\varepsilon^g}}. \tag{B.15}$$

Appendix C: Algorithm

Table C.1 lists the entire set of equilibrium conditions in our model, and algorithm 1 describes the procedure to compute the equilibrium.

Algorithm 1 Algorithm to Solve the model

1: Guess initial values for GDP_n^0 or $(WL + RK)_n^0$.

2: Solve for W_{n0} and the corresponding $R_{n0} = \frac{1-\beta_n}{\beta_n}\frac{W_n L_n}{K_n}$ such that F1, F2, H1, H2, H3, and H4 hold. (Use the `fsolve` routine in Matlab to solve the system of equations to match the target GDP_n^0 or $(WL + RK)_n^0$.)

3: Guess $P_{n\,0}^{k\,0}$. Using F1 and F2, generate $P_{n\,0}^{k\,1}$, and iterate until $P_{n\,0}^{k\,1}$ converges.

4: Given W_{n0}, R_{n0}, and $P_{n\,0}^{k\,1}$, use F3 to calculate π_{ni0}^j.

5: Guess L_{n0}^0. Using $P_{n\,0}^{k\,1}$ together with H1, H2, and H3, generate L_{n0}^1, and iterate until L_{n0}^1 converges.

6: Using W_{n0}, R_{n0}, L_{n0}^1, $P_{n\,0}^{k\,1}$, H2, M1, and M2, generate X_{n0}^j, and then compute the market-clearing condition M2 (or M2′).

7: If M2 or M2′ does not hold, update the guess for GDP_n^1 (or $(WL + RK)_n^1$) following the procedure in Alvarez and Lucas Jr. (2007), and repeat Steps 2–6 until M2 or M2′ holds.

TABLE C.1
EQUILIBRIUM CONDITIONS

(F1)	$c_n^j \equiv \Upsilon_n^j \left[(W_n)^{\beta_n}(R_n)^{1-\beta_n}\right]^{\gamma_n^j} \prod_{k=1}^{J} P_n^{k^{\gamma_n^{k,j}}};\ \Upsilon_n^j \equiv \gamma_n^j \beta_n^{-\gamma_n^j\beta_n} \gamma_n^j (1-\beta_n)^{-\gamma_n^j(1-\beta_n)} \prod_{k=1}^{J} \gamma_n^{k,j^{-\gamma_n^{k,j}}}$	$\forall(n,j)$
(F2)	$P_n^j = A^j\left(\sum_{i=1}^{N} \lambda_i^j \left(\kappa_{ni}^j c_i^j\right)^{-\theta}\right)^{-\frac{1}{\theta}};\ A^j = \Gamma\left(\frac{1+\theta-\sigma^j}{\theta}\right)^{\frac{1}{(1-\sigma^j)}}$	$\forall(n,j)$
(F3)	$\pi_{ni}^j = \frac{\lambda_i^j \left(c_i^j \kappa_{ni}^j\right)^{-\theta}}{\sum_{m=1}^{N} \lambda_m^j \left(c_m^j \kappa_{nm}^j\right)^{-\theta}} = \lambda_i^j \left(A^j \frac{c_i^j \kappa_{ni}^j}{P_n^j}\right)^{-\theta}$	$\forall(n,j)$
(H1)	$P_n^c = \left[\sum_{j=1}^{J} \left(\alpha_n^j\right)^{\sigma_c} \left(P_n^j\right)^{1-\sigma_c} \left(\frac{C_n}{L_n}\right)^{(1-\sigma_c)(\varepsilon^j-1)}\right]^{\frac{1}{1-\sigma_c}}$	$\forall(n)$
(H2)	$\chi_n = -\phi_n(W_n + \frac{K_n}{L_n}R_n) + T, \quad \text{where} \quad T = \frac{\sum_{n=1}^{N} \phi_n(W_nL_n + K_nR_n)}{\sum_{n=1}^{N} L_n}$	$\forall(n)$
(H3)	$m^{n,m} = \frac{\left(\frac{\Lambda_n}{\nu^{n,m}}\right)^{\kappa}}{\sum_{n'}^{N0} \left(\frac{\Lambda_{n'}}{\nu^{n',m}}\right)^{\kappa}};\ \Lambda_n \equiv \frac{W_n + \frac{K_n}{L_n}R_n + \chi_n}{P_n};\ L_n = \sum_{m}^{N0} m^{n,m} \bar{L}_m$	$\forall(n,m)$
(M1)	$X_n^j = \psi_n^j I_n + \sum_{k=1}^{J} \gamma_n^{j,k} \left(\sum_{i=1}^{N} X_{in}^k\right);\ I_n \equiv R_nK_n + W_nL_n + D_n;\ D_n \equiv \chi_n L_n$	$\forall(n,j)$
(M2)	$\psi_n^j = \left(\alpha_n^j\right)^{\sigma_c} \left(\frac{P_n^j}{P_n^c}\right)^{1-\sigma_c} (c_n)^{(\varepsilon^j-1)(1-\sigma_c)}$	$\forall(n,j)$
(M3)	$\sum_{j=1}^{J}\sum_{i=1}^{N} X_{ni}^j - D_n = \sum_{j=1}^{J}\sum_{i=1}^{N} X_{in}^j$	$\forall(n,j)$
(M3′)	$R_nK_n = \sum_{j=1}^{J} (1-\beta_n)\gamma_n^j \sum_{i=1}^{N} \pi_{in}^j X_i^j;\ W_nL_n = \sum_{j=1}^{J} \beta_n \gamma_n^j \sum_{i=1}^{N} \pi_{in}^j X_i^j$	$\forall(n)$

APPENDIX D: CALIBRATION

D.1. Sectoral gross output price

As discussed in Sposi, Yi and Zhang (2025), the production structure implies a direct mapping between sectoral value-added prices and sectoral gross output prices, $P_{n,t}^j$. Let $p_{n,t}^{v,j}$ denote the value-added price for sector j in country n at time t, retrieved from the corresponding dataset as detailed in the main text. The corresponding gross output prices, $P_{n,t}^j$, are then derived by solving the following system of equations:

$$\begin{bmatrix} \ln P_{n,t}^1 \\ \ln P_{n,t}^2 \\ \ln P_{n,t}^3 \end{bmatrix} \equiv (\mathbf{E} - \mathbf{\Upsilon})^{-1}\mathbf{P} - \mathbf{C},$$

where

$$\mathbf{C} \equiv \begin{bmatrix} \gamma_{n,t}^1 \ln \gamma_{n,t}^1 \\ \gamma_{n,t}^2 \ln \gamma_{n,t}^2 \\ \gamma_{n,t}^3 \ln \gamma_{n,t}^3 \end{bmatrix} + \begin{bmatrix} \sum_k \gamma_{n,t}^{k,j=1} \ln \gamma_{n,t}^{k,j=1} \\ \sum_k \gamma_{n,t}^{k,j=2} \ln \gamma_{n,t}^{k,j=2} \\ \sum_k \gamma_{n,t}^{k,j=3} \ln \gamma_{n,t}^{k,j=3} \end{bmatrix},$$

$$\mathbf{E} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}, \quad \mathbf{P} = \begin{bmatrix} \gamma_{n,t}^{1} \ln p_{n,t}^{v,1} \\ \gamma_{n,t}^{2} \ln p_{n,t}^{v,2} \\ \gamma_{n,t}^{3} \ln p_{n,t}^{v,3} \end{bmatrix} \quad \text{, and} \quad \mathbf{\Upsilon} = \begin{bmatrix} \gamma_{n,t}^{1,j=1} & \gamma_{n,t}^{2,j=1} & \gamma_{n,t}^{3,j=1} \\ \gamma_{n,t}^{1,j=2} & \gamma_{n,t}^{2,j=2} & \gamma_{n,t}^{3,j=2} \\ \gamma_{n,t}^{1,j=3} & \gamma_{n,t}^{2,j=3} & \gamma_{n,t}^{3,j=3} \end{bmatrix}.$$

D.2. Gravity Equation Regression

In this section, I show the structure and results of the gravity-equation regressions used in the calibration.

From Equation 9, I derive the following structural gravity equation:

$$\ln\left(\frac{X_{ni,t}^{j}}{X_{nn,t}^{j}}\right) = \ln\left(\lambda_{i,t}^{j}\left(c_{i,t}^{j}\right)^{-\theta}\right) - \ln\left(\lambda_{n,t}^{j}\left(c_{n,t}^{j}\right)^{-\theta}\right) - \theta \ln\left(\kappa_{ni,t}^{j}\right). \tag{D.1}$$

Following Eaton and Kortum (2002), I assume that the unobserved trade cost terms $\kappa_{ni,t}^{j}$ can be described by both a symmetric component and an exporter-specific component.[15] The symmetric component is well proxied by geographic distance:

$$\log\left(\kappa_{ni,t}^{j}\right) = EX_{i,t}^{j} + \beta_{t}^{j} \log\left(Dist_{ni}\right) + \epsilon_{ni,t}^{j}, \tag{D.2}$$

where t is a time variable. $EX_{n,t}^{j}$ is exporter n's fixed effect in the regression fixed at sector j and time t. $X_{ni,t}^{j}$ denotes the value of sector j goods imported by region n from region i. This data is derived from the constructed multi-region, multi-sector input-output table. The term $\log\left(Dist_{ni}\right)$ is the logarithm of the population-weighted geographic distance between regions n and i, defined as follows:

$$Dist_{ni} = \sum_{r \in \{r_1^n, \ldots, r_p^n\}} \left(\frac{pop_r}{pop_n} \sum_{s \in \{r_1^i, \ldots, r_q^i\}} \left(\frac{pop_s}{pop_i}\right) Dist_{rs}\right), \tag{D.3}$$

where pop_n represents the population of economic group (or China's region) n. Each economic group (or China's region) n comprises a set of economies (or China's provinces), denoted as $\{r_1^n, \ldots, r_p^n\}$.

To calculate the population-weighted geographic distance, I first record the coordinate data of the capitals of each of mainland China's 34 provinces and the capitals of 226 foreign economies from Google Maps. Then, I calculate the geographic distance between each pair of coordinates. Lastly, I compute the population-weighted distance between each pair of the 9 regions, consisting of 8 regions in China (each corresponding to an aggregation of several

15. See also Waugh (2010), Levchenko and Zhang (2016), Tombe and Zhu (2019), and Santacreu, Sposi and Zhang (2023)

of China's provinces) and 1 groups of foreign economies. For the population-based weights, I use population data from the year 2000, sourced from the China Statistical Yearbook and the Penn World Table version 10.0 .

Combining Equation D.2 and Equation D.1, I get the following structural equation:

$$\log\left(\frac{X^j_{ni,t}}{X^j_{nn,t}}\right) = E^j_{i,t} + M^j_{n,t} + \Theta^j_t \log Dist_{ni} + \nu^j_{ni,t}, \tag{D.4}$$

where $E^j_{i,t} \equiv S^j_{i,t} - \theta EX^j_{i,t}$, $M^j_{n,t} \equiv -S^j_{n,t}$, $\Theta^j_t \equiv -\theta\beta^j_t$, $\nu^j_{ni,t} \equiv -\theta\epsilon^j_{ni,t}$, and $S^j_{n,t} \equiv \log\left(\lambda^j_{n,t}\left(c^j_{n,t}\right)^{-\theta}\right)$. I estimate Equation D.4 separately for each year and sector and obtain the importer fixed effects $\tilde{M}^j_{n,t}$. Table D.1 reports the corresponding calibration results.

TABLE D.1
Gravity Equation Calibration Results

Sector	Agriculture			Industry			Services		
Year	2002	2007	2015	2002	2007	2015	2002	2007	2015
Variables	$\log\left(\frac{X_{ni}}{X_{nn}}\right)$	$\log\left(\frac{X_{ni}}{X_{nn}}\right)$	$\log\left(\frac{X_{ni}}{X_{nn}}\right)$	$\log\left(\frac{X_{ni}}{X_{nn}}\right)$	$\log\left(\frac{X_{ni}}{X_{nn}}\right)$	$\log\left(\frac{X_{ni}}{X_{nn}}\right)$	$\log\left(\frac{X_{ni}}{X_{nn}}\right)$	$\log\left(\frac{X_{ni}}{X_{nn}}\right)$	$\log\left(\frac{X_{ni}}{X_{nn}}\right)$
logdist	-1.64***	-1.39***	-0.06	-1.18***	-1.21***	-0.19	-1.47***	-1.15***	0.31
	(-4.52)	(-4.02)	(-0.29)	(-4.92)	(-6.05)	(-0.93)	(-5.29)	(-4.31)	(1.24)
IMd1	11.17***	7.91**	-3.92**	8.17***	8.91***	-0.80	9.47***	7.21***	-6.00**
	(3.33)	(2.46)	(-2.15)	(3.68)	(4.83)	(-0.42)	(3.68)	(2.91)	(-2.56)
IMd2	11.55***	10.28***	-0.78	8.95***	8.98***	-0.10	10.42***	8.00***	-5.68**
	(3.65)	(3.40)	(-0.46)	(4.27)	(5.16)	(-0.06)	(4.30)	(3.43)	(-2.57)
IMd3	9.83***	9.77***	-3.00*	7.96***	8.07***	-2.27	9.89***	7.53***	-6.09***
	(3.14)	(3.26)	(-1.76)	(3.84)	(4.69)	(-1.28)	(4.12)	(3.26)	(-2.78)
IMd4	10.67***	10.20***	-2.43	7.37***	8.48***	-0.65	9.13***	6.54***	-6.10***
	(3.33)	(3.32)	(-1.40)	(3.47)	(4.81)	(-0.36)	(3.72)	(2.77)	(-2.72)
IMd5	10.17***	9.51***	-2.22	8.66***	9.58***	-1.03	10.28***	7.45***	-6.07**
	(3.05)	(2.98)	(-1.23)	(3.92)	(5.22)	(-0.55)	(4.02)	(3.03)	(-2.60)
IMd6	9.98***	8.92***	-3.30*	7.68***	8.64***	-1.18	9.04***	7.87***	-5.84**
	(3.14)	(2.93)	(-1.92)	(3.65)	(4.95)	(-0.65)	(3.72)	(3.36)	(-2.63)
IMd7	11.41***	9.54***	-3.49*	8.94***	9.43***	-0.48	10.50***	8.56***	-5.64**
	(3.49)	(3.05)	(-1.97)	(4.13)	(5.26)	(-0.26)	(4.20)	(3.55)	(-2.47)
IMd8	9.29***	8.41**	-4.11**	7.94***	8.99***	-0.82	10.83***	8.12***	-6.16**
	(2.78)	(2.63)	(-2.26)	(3.58)	(4.89)	(-0.43)	(4.23)	(3.29)	(-2.63)
IMd9	10.58***	8.34**	-6.76***	6.83**	8.02***	-2.89	8.89***	5.83**	-10.56***
	(2.72)	(2.24)	(-3.20)	(2.65)	(3.75)	(-1.31)	(2.98)	(2.03)	(-3.88)
EXo1	-3.65***	-2.97***	0.09	-3.41***	-3.37***	-1.57***	-4.58***	-4.19***	-0.59
	(-5.25)	(-4.46)	(0.24)	(-7.40)	(-8.82)	(-4.00)	(-8.60)	(-8.17)	(-1.21)
EXo2	-6.58***	-6.60***	-3.19***	-4.60***	-4.52***	-1.61***	-4.84***	-3.30***	0.03
	(-7.70)	(-8.07)	(-6.88)	(-8.13)	(-9.62)	(-3.34)	(-7.39)	(-5.24)	(0.05)
EXo3	-4.03***	-3.19***	-0.55	-3.66***	-3.58***	-1.19**	-5.72***	-3.84***	-0.23
	(-4.57)	(-3.78)	(-1.14)	(-6.25)	(-7.38)	(-2.38)	(-8.46)	(-5.90)	(-0.37)
EXo4	-6.49***	-7.23***	-1.47***	-2.87***	-3.40***	-0.21	-3.92***	-4.21***	1.16**
	(-7.93)	(-9.23)	(-3.31)	(-5.30)	(-7.56)	(-0.45)	(-6.26)	(-6.99)	(2.04)
EXo5	-3.60***	-5.62***	-0.90**	-2.19***	-2.45***	-0.87**	-4.47***	-4.18***	-0.52
	(-5.07)	(-8.26)	(-2.33)	(-4.65)	(-6.26)	(-2.15)	(-8.20)	(-7.97)	(-1.04)
EXo6	-3.06***	-3.68***	-0.08	-3.23***	-3.57***	-0.44	-5.08***	-3.78***	0.25
	(-3.62)	(-4.55)	(-0.17)	(-5.78)	(-7.69)	(-0.92)	(-7.85)	(-6.08)	(0.43)
EXo7	-3.39***	-2.76***	-0.10	-4.07***	-3.80***	-1.46***	-5.08***	-3.21***	-0.52
	(-4.41)	(-3.74)	(-0.23)	(-8.00)	(-8.99)	(-3.36)	(-8.62)	(-5.66)	(-0.97)
EXo8	-3.43***	-3.17***	-0.03	-3.54***	-4.02***	-1.36***	-5.00***	-3.58***	-0.60
	(-4.87)	(-4.70)	(-0.09)	(-7.59)	(-10.40)	(-3.42)	(-9.26)	(-6.89)	(-1.22)
Observations	72	72	72	72	72	72	72	72	72
R-squared	0.984	0.984	0.993	0.986	0.987	0.987	0.990	0.987	0.986
Importer FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Exporter FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: t-statistics in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The term $S^j_{n,t}$ is defined as the states of the technology for region n sector j at time t. Based on the estimated values of $\tilde{M}^j_{n,t}$, the states of the technology, $S^j_{n,t}$, can be estimated as $S^j_{n,t} = -M^j_{n,t}$. The available degrees of freedom imply that, in each sector, $M^j_{n,t}$ is identified only up to a normalization. I use the region Eastern Coastal (an aggregation of JiangSu, Shanghai, and Zhejiang) as the reference location. Therefore, $\tilde{M}^j_{EC,t} = 0$. Since the fixed effects ($\tilde{M}^j_{n,t}$) I estimated is relative to the reference location's fixed effects, for each year and each sector, I have $S^j_{n,t} - S^j_{EC,t} = -\tilde{M}^j_{n,t}$. Thus, I can back out sectoral price from

$$P^j_{n,t} = A^j \left(\frac{exp(S^j_{n,t})}{\pi^j_{nn,t}} \right)^{-\frac{1}{\theta}}.$$

D.3. Details of Preference Weight Calibration

TABLE D.2
THE ESTIMATION PROCEDURE FOR PREFERENCE WEIGHTS

Step 1	Guess $\theta^a = \log(\alpha^a_n/\alpha^m_n), \quad \theta^s = \log(\alpha^s_n/\alpha^m_n)$
Step 2	Recover weights via softmax: $\alpha^m_n = \frac{1}{1+e^{\theta^a}+e^{\theta^s}}, \quad \alpha^j_n = \alpha^m_n \cdot e^{\theta^j}, \quad j \in \{a,s\}$
Step 3	Solve for $C_{n,t}$ from the CES aggregator identity: $P^c_n = \left[\sum_{j=1}^{J} \left(\alpha^j_n\right)^{\sigma_c} \left(P^j_n\right)^{1-\sigma_c} \left(\frac{C_n}{L_n}\right)^{(1-\sigma_c)(\varepsilon^j-1)} \right]^{\frac{1}{1-\sigma_c}}$ (Use numerical root-finding such as `fzero` or `fsolve`.)
Step 4	For a given (θ^a, θ^s), construct the model-implied relative expenditures for $j \in \{a,s\}$ and iteratively update (θ^a, θ^s) until the model moments match their data counterparts: $\left(\frac{\alpha^j_n}{\alpha^m_n}\right)^{\sigma_c} \left(\frac{P^j_{n,t}}{P^m_{n,t}}\right)^{1-\sigma_c} \left(\frac{C_{n,t}}{L_{n,t}}\right)^{(1-\sigma_c)(\varepsilon^j-1)} = \frac{P^j_{n,t}C^j_{n,t}}{P^m_{n,t}C^m_{n,t}} = \frac{\psi^j_n}{\psi^m_n}, \quad j \in \{a,s\}$
Step 5	Recover final weights: $\alpha^j_n = \frac{e^{\theta^j}}{1+e^{\theta^a}+e^{\theta^s}}, \quad \alpha^m_n = \frac{1}{1+e^{\theta^a}+e^{\theta^s}}$
Step 6	Recover real time-varying weights from $\alpha^j_{n,t} = \left[\frac{P^j_{n,t}C^j_{n,t}}{P^c_{n,t}C_{n,t}} \left(\frac{P^j_{n,t}}{P^c_{n,t}}\right)^{\sigma_c-1} \left(\frac{C_{real,n,t}}{L_{n,t}}\right)^{(\sigma_c-1)(\varepsilon^j-1)} \right]^{\frac{1}{\sigma_c}}, \ \forall j \in \{a,s\}$

D.4. Calibrated Shocks

Figure D.1 displays the fundamental productivity change for both the period 2002–2007 and the period 2007–2015.

Figure D.1

Calibration Results: Fundamental Productivity, $\left(\dfrac{\lambda^{j}_{n,t=1}}{\lambda^{j}_{n,t=0}}\right)^{1/\theta}$

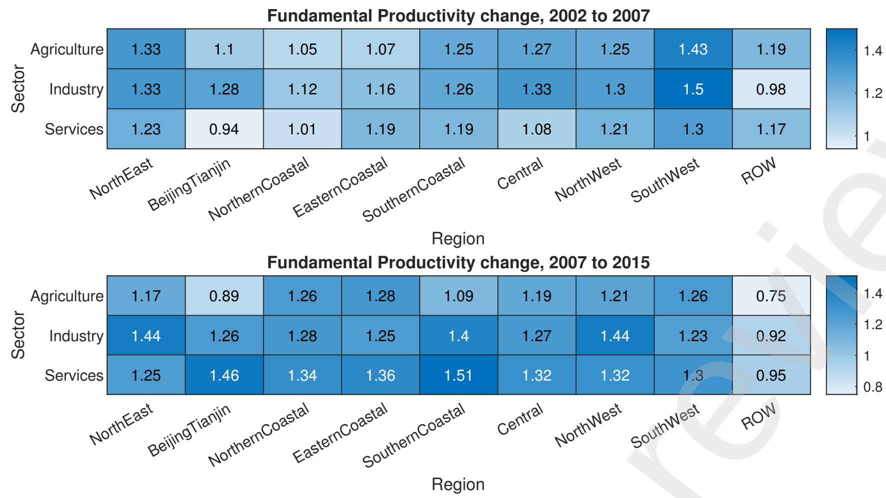

Figure D.2 displays the average trade cost changes for both the period 2002-2007 and period 2007-2015.

Figure D.2

Calibration Results: Trade cost change, $\frac{\kappa^{j}_{ni,t=1}}{\kappa^{j}_{ni,t=0}}$

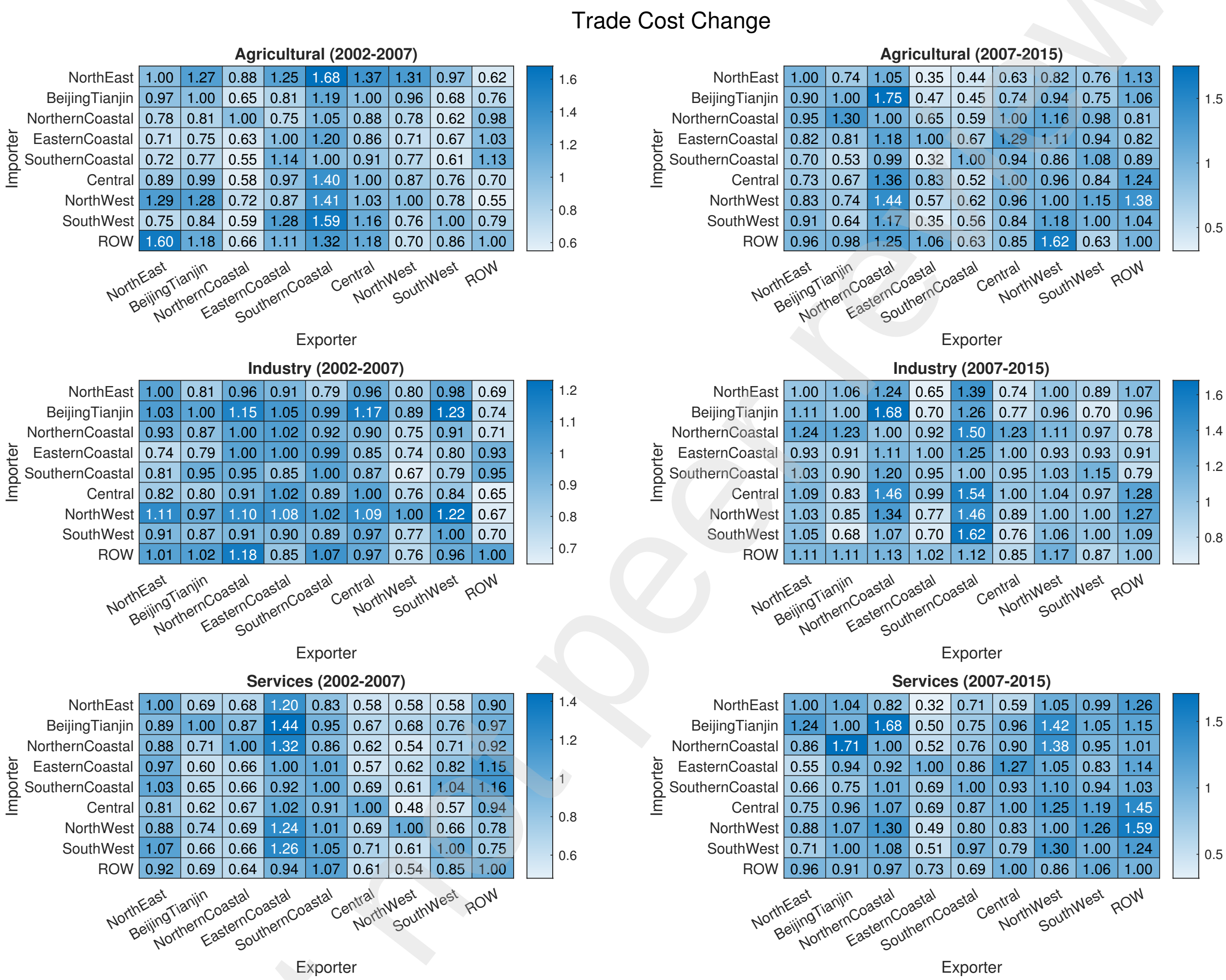

Figure D.3 and Figure D.4 display the changes in labor mobility costs for both the period 2002-2007 and period 2007-2015.

Figure D.3

Calibration Results: Labor mobility cost, $\frac{\nu^{nm}_{t=1}}{\nu^{nm}_{t=0}}$ (non-homothetic preferences)

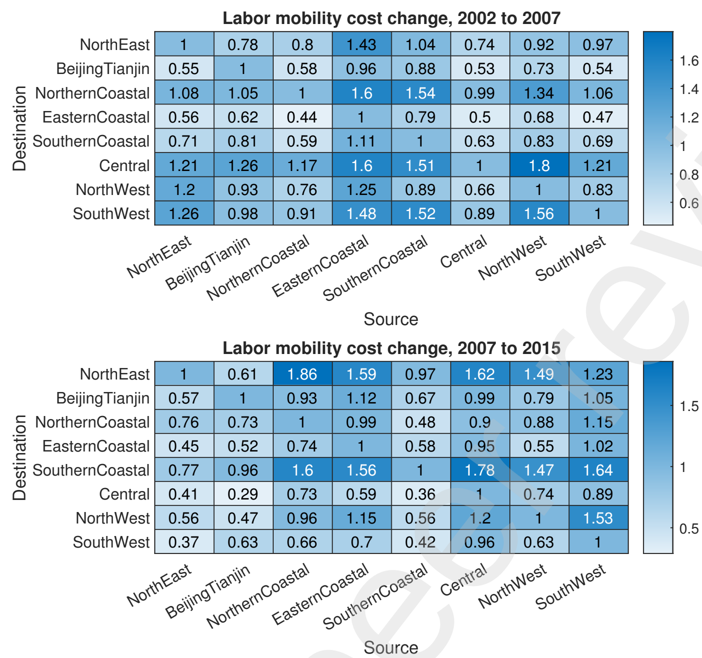

Figure D.4

Calibration Results: Labor mobility cost change, $\frac{\nu^{nm}_{t=1}}{\nu^{nm}_{t=0}}$ (CES preferences)

Figure D.5

Calibration Results: Saving wedges, $\psi_{n,t}$

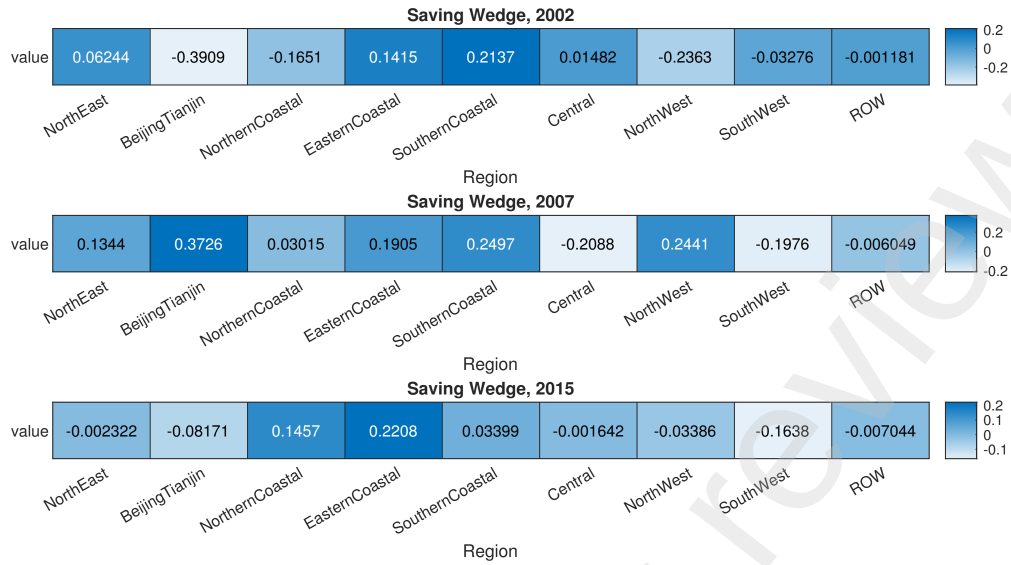

Figure D.6

Calibration Results: Taste wedges, $\phi_{n,t}$

Appendix E: Data

The data utilized in this paper include: the 5th National Census Data from 2000; the 6th National Census Data from 2005, which is the most recent available labor flow data near the years 2002 and 2007; and the 7th National Census Data from 2015. Additional sources are the Penn World Table (PWT) 10.0 for the years 2002, 2007, and 2015 (Feenstra, Inklaar and Timmer, 2015); the OECD Inter-Country Input-Output (ICIO) Tables for 2002, 2007, and 2015 (OECD, 2021); the China Cross Regional Input-Output Table for 2002, 2007, and

2015 (Zhang and Qi, 2012; Zheng et al., 2020); and the Centre d'Études Prospectives et d'Informations Internationales (CEPII) (Head and Mayer, 2014).

E.1. Data Concordance

This section demonstrates how I aggregate data from various sources into a version encompassing 3 sectors and 9 regions.

Sectors Classification

TABLE E.1
SECTOR CLASSIFICATION (UNIFIED IO, 2002 AND 2007 CHINA IO TABLES)

Unified sector	2002 China IO table		2007 China IO table	
	Code	Description	Code	Description
Agriculture	1	Farming, forestry, animal husbandry, fishery, industry	1	Farming, forestry, animal husbandry, fishery, industry
Industry	2	Mining and quarrying	2	Mining and quarrying
	3	Light manufacture	3	Food production and tobacco processing
			4	Textile and garment industry
			5	Wood processing and furniture manufacturing
			6	Paper printing and stationery and sporting goods manufacturing industry
	4	Heavy manufacture	7	The petrochemical industry
			8	Non-metallic mineral products
			9	Metal smelting and products
			10	Mechanical industry
			11	Transportation equipment manufacturing industry
			12	Electrical and electronic equipment manufacturing industry
			13	Other manufacturing
	5	Electricity and steam, gas, hot water, tap water production and supply industry	14	Electricity and steam, gas, hot water, tap water production and supply industry
Services	6	The construction industry	15	The construction industry
	7	Goods transportation and warehousing	16	Goods transportation and warehousing
	8	Other services	17	Other services

TABLE E.2
Sector Classification ISIC_rev4

ISIC_rev4	Sector description	ISIC_rev4 Code	Sector description
Agriculture		F	Construction
A01	Crop and animal production, hunting and related service activities	G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
A02	Forestry and logging	G46	Wholesale trade, except of motor vehicles and motorcycles
A03	Fishing and aquaculture	G47	Retail trade, except of motor vehicles and motorcycles
Industry		H49	Land transport and transport via pipelines
C10-C12	Manufacture of food products, beverages and tobacco products	H50	Water transport
C13-C15	Manufacture of textiles, wearing apparel and leather products	H51	Air transport
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	H52	Warehousing and support activities for transportation
C17	Manufacture of paper and paper products	H53	Postal and courier activities
C18	Printing and reproduction of recorded media	I J58	Accommodation and food service activities Publishing activities
B	Mining and quarrying	J59_J60	Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities
C19	Manufacture of coke and refined petroleum products	J61	Telecommunications
C20	Manufacture of chemicals and chemical products	J62_J63	Computer programming, consultancy and related activities; information service activities
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	K64	Financial service activities, except insurance and pension funding
C22	Manufacture of rubber and plastic products	K65	Insurance, reinsurance and pension funding, except compulsory social security
C23	Manufacture of other non-metallic mineral products	K66	Activities auxiliary to financial services and insurance activities
C24	Manufacture of basic metals	L68	Real estate activities
C25	Manufacture of fabricated metal products, except machinery and equipment	M69_M70	Legal and accounting activities; activities of head offices; management consultancy activities
C26	Manufacture of computer, electronic and optical products	M71	Architectural and engineering activities; technical testing and analysis
C27	Manufacture of electrical equipment	M72	Scientific research and development
C28	Manufacture of machinery and equipment n.e.c.	M73	Advertising and market research
C29	Manufacture of motor vehicles, trailers and semi-trailers	M74_M75	Other professional, scientific and technical activities; veterinary activities
C30	Manufacture of other transport equipment	N	Administrative and support service activities
C31_C32	Manufacture of furniture; other manufacturing	O84	Public administration and defence; compulsory social security
C33	Repair and installation of machinery and equipment	P85	Education
D35	Electricity, gas, steam and air conditioning supply	Q	Human health and social work activities
E36	Water collection, treatment and supply	R_S	Other service activities
E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services	T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
Services		U	Activities of extraterritorial organizations and bodies

Table E.1 and Table E.2 present sector classifications for data from various sources. The classifications for China's cross-region IO Tables in 2002 and 2007 follow China's Industry Classification (see Table E.1), whereas the sector classifications for the OECD ICIO Table are based on the International Standard Industrial Classification of All Economic Activities, Revision 4 (see Table E.2).

Mainland China's 8 Regions

TABLE E.3
Mainland China's 8 Regions

8 Regions	31 Provinces
A. Northeast	1.Heilongjiang, 2.Jilin, 3.Liaoning
B. Beijing and Tianjin	4.Beijing, 5.Tianjin
C. Northern Coastal	6.Hebei, 7.Shandong
D. Eastern Coastal	8.Jiangsu, 9.Shanghai, 10.Zhejiang
E. Southern Coastal	11.Fujian, 12.Guangdong, 13.Hainan
F. Central	14.Shanxi, 15.Henan, 16.Anhui, 17.Hubei, 18.Hunan, 19.Jiangxi
G. Northwest	20.Inner Mongolia, 21.Shaanxi, 22.Ningxia, 23.Gansu, 24.Qinghai, 25. Xinjiang
H. Southwest	26.Sichuan, 27.Chongqing, 28.Guangxi, 29.Yunnan, 30.Guizhou, 31Tibet

Table E.3 shows the classification of mainland China's 8 regions.

E.2. Labor flow matrix and Country Level Total Employment

The data on inter-provincial labor migration in China are derived from the China Population Census (2000) and the China Population 1% Sampling Survey (2005, 2015). These national census datasets exclude individuals in active military service and report, for each survey year, both the hukou registration province and the province of residence. The official reports are available in two formats: confidential micro-level data and provincial-level aggregates. The provincial-level reports specify the number of individuals residing in province A but registered in province B. In this study, due to data availability constraints, I use the provincial-level data to construct China's labor flow matrix at the regional level.

I compute inter-provincial population flow shares for the years 2000, 2005, and 2015. In the absence of population flow data for 2002 and 2007, I approximate these years using the data from 2000 and 2005, respectively. Aggregate labor force data are obtained from PWT 10.01, which reports the number of persons engaged (in millions) by country and year.

E.3. Add the aggregated rest of the world (ROW) to the China regional-level IO Table

This section details the integration of the aggregated rest of the world (ROW) into the China regional-level Input-Output (IO) Table. The resulting unified IO Table encompasses sector-level bilateral trade flows among 9 regions (8 Chinese regions plus ROW). This table was constructed using the OECD ICIO Table and the China MRIO Table, with all values scaled and recorded at current prices, expressed in millions of dollars.

To assess the accuracy of the merged unified IO Table, I calculated and compared the key variable—trade share of GDP—from various sources, as illustrated in Table E.4. The comparison reveals that the unified IO Table aligns well with both the original China IO Table and the World IO Table. Specifically, the trade share of GDP and its sectoral components for each year and trade type (imports, exports, and inter-regional trade within China) from different sources are nearly identical. Consequently, the unified IO Table provides a consistent basis for related quantitative analysis.

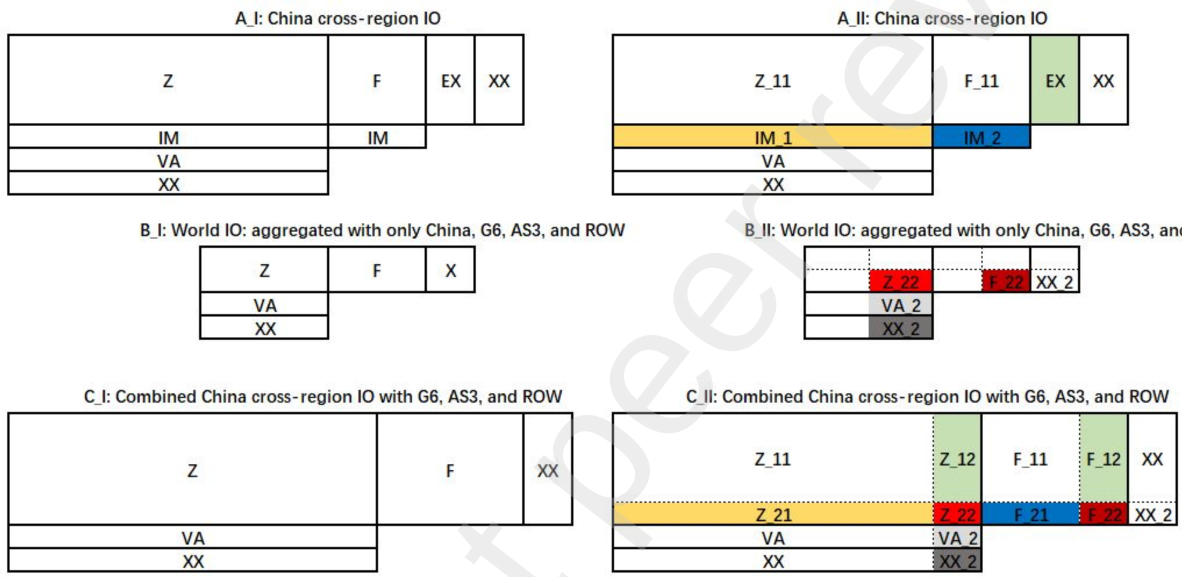

Figure E.1

An example of the China IO Table, the World IO Table, and the combined unified IO Table

The left side of Figure E.1 displays a schematic representation of three tables: the China cross-region IO Table, the World IO Table, and the combined unified IO Table. The right side shows these tables with added colors and annotations to illustrate how the China cross-region IO Table and the World IO Table are merged to form the unified IO Table.

In all these tables, area Z represents sector-level bilateral trade flows of intermediate goods, while area F represents trade flows of final goods. Each row indicates a source location-sector, and each column denotes a destination location-sector or destination location. The last column (area XX) reflects the gross output for each location-sector. The bottom two rows (areas VA and XX) illustrate the value added and total input for each location-sector.

Specifically, Table A in Figure E.1 presents the collapsed China cross-region IO Table, encompassing 8 regions and 3 sectors (agriculture, industry, services), aggregated across sectors and regions from China's regional IO table. Table B in Figure E.1 depicts the World IO Table, including 2 regions (China and ROW) and 3 sectors, aggregated from the OECD ICIO Table. Table C in Figure E.1 provides a schematic IO Table with 9 regions (8 Chinese regions plus ROW) and 3 sectors, created by merging data from Parts A and B of Figure E.1.

Steps for merging the World IO Table with the China cross-region IO Table

Step 1 Scaling Z_{11}, F_{11}, IM, and EX in the China IO table to match the sectoral aggregate values in the World IO table.

Since Table AII is recorded at current prices in ten thousand yuan, I scale the values of Z_{11}, F_{11}, IM, EX, and VA in Table AII so that their aggregate totals match the corresponding sectoral values in the World IO table. Consequently, the scaled Table AII is now recorded at current prices in millions of dollars.

Step 2 Areas Z_{11} and F_{11} in the unified IO table.

The values for areas Z_{11} and F_{11} in Table CII are derived directly from the scaled values of Z_{11} and F_{11} in Table AII.

Step 3 Areas Z_{12}, F_{12}, Z_{21}, and F_{21} in the unified IO table.

The aggregation across columns for areas Z_{12} and F_{12} in Table CII corresponds to the scaled value of area EX in Table AII. Specifically, areas Z_{12} and F_{12} in the unified IO table collectively match the scaled EX in Table AII. Allocation ratios for each row in Z_{12} and F_{12} of Table CII are calculated using data from the World IO table, which provides insights into China's sectoral export distribution. These ratios are applied uniformly across China's eight regions to estimate sectoral export allocations for each region.

Similarly, the aggregation across rows for areas Z_{21} and F_{21} in Table CII aligns with the scaled values of areas IM_1 and IM_2 in Table AII. Thus, areas Z_{21} and F_{21} in the unified IO table match the scaled IM_1 and IM_2 in Table AII. Allocation ratios for each column in Table CII are derived from the World IO table, reflecting China's sectoral import distribution. These ratios are used to estimate sectoral import allocations for each of China's eight regions. Consequently, the sectoral imports and exports of China's regions in Table CII are consistent with the aggregate values in the World IO table.

Step 4 Areas Z_{22} and F_{22} in the unified IO table.

Areas Z_{22} and F_{22} in the unified IO table are directly obtained from their counterparts in the World IO table, representing sectoral trade flows within ROW.

Step 5 Areas VA and VA_2 in the unified IO table.

Areas VA and VA_2 in the unified IO table are calculated as the difference between sectoral total outputs and sectoral total intermediate inputs. For the unified IO Table CII with 9 regions and 3 sectors, zero values are replaced with 10^{-9}.

Data Accuracy Check

To assess the accuracy of the data in the unified IO table, I compute and compare the key variable, the trade share of GDP, from multiple sources. As shown in Table E.4, the table presents the values of the trade share of GDP and its sectoral components for each year and trade type (imports, exports, and inter-regional trade within China), derived from various sources. The observations in Table E.4 indicate that the trade share indices and their components from different sources are nearly identical, with the exception of the inner trade share of GDP. The value from the unified IO table exhibits slight deviations compared to the China IO table. Nevertheless, the inner trade share from the unified IO table maintains the same trend as its counterpart from the China IO table. In the main text, we use the unified IO table for the quantitative analysis.

TABLE E.4

TRADE SHARE DATA FROM DIFFERENT SOURCES

China Trade Share (% of GDP)		**Import (% GDP)**			**Export (% of GDP)**			**Inner Trade (% GDP)**	
		Source			**Source**			**Source**	
		Unfied IO	OECD IO	WDI	Unfied IO	OECD IO	WDI	Unfied IO	China IO
Total	2002	19.60	19.60	20.10	22.30	22.30	22.64	26.85	26.95
	2007	23.10	23.10	26.76	32.42	32.42	35.43	47.98	51.93
	2015	16.04	16.04	18.11	20.06	20.06	21.35	48.04	50.53
Agricultural Component	2002	0.41	0.41	-	0.32	0.32	-	1.23	1.37
	2007	0.56	0.56	-	0.23	0.23	-	2.43	2.34
	2015	0.51	0.51	-	0.14	0.14	-	2.41	2.23
Industry Component	2002	13.64	13.64	-	16.98	16.98	-	21.25	20.84
	2007	16.65	16.65	-	26.42	26.42	-	34.63	38.89
	2015	10.12	10.12	-	16.35	16.35	-	29.16	30.52
Services Component	2002	5.54	5.54	-	5.00	5.00	-	4.37	4.74
	2007	5.88	5.88	-	5.78	5.78	-	10.93	10.69
	2015	5.41	5.41	-	3.57	3.57	-	16.46	17.79

Notes: This table lists the values of the trade share of GDP and its sectoral components for each year and each type of trade (imports, exports, and trade across China's regions) as calculated from different sources. The World IO tables are from the OECD dataset.

TABLE E.5
INPUT-OUTPUT LINKAGE COEFFICIENTS OF CHINESE REGIONS

Input-Output linkages	Destination sector					
	Agriculture	Industry	Services	Agriculture	Industry	Services
Source sector	Average cross China regions			China		
Agriculture	0.18	0.05	0.01	0.15	0.05	0.02
Industry	0.21	0.54	0.28	0.20	0.56	0.29
Services	0.06	0.12	0.23	0.07	0.13	0.21
Source sector	NorthEast			BeijingTianjin		
Agriculture	0.18	0.06	0.01	0.23	0.02	0.01
Industry	0.22	0.50	0.29	0.29	0.60	0.27
Services	0.05	0.12	0.21	0.10	0.13	0.27
	NorthernCoastal			EasternCoastal		
Agriculture	0.17	0.07	0.01	0.12	0.03	0.01
Industry	0.25	0.62	0.32	0.23	0.60	0.27
Services	0.04	0.10	0.21	0.06	0.11	0.25
	SouthernCoastal			Central		
Agriculture	0.13	0.03	0.01	0.18	0.08	0.01
Industry	0.20	0.57	0.23	0.19	0.53	0.29
Services	0.06	0.11	0.22	0.04	0.13	0.23
	NorthWest			SouthWest		
Agriculture	0.20	0.07	0.01	0.19	0.07	0.01
Industry	0.18	0.47	0.29	0.15	0.47	0.29
Services	0.06	0.12	0.20	0.04	0.15	0.25

Notes: The input-output linkages for China's regions and the average column are calculated from take average directly from input-output linkage coefficients of all China's region.