

Redrawing the Industrial Map in China: A Spatial Political Economy Perspective*

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Abstract

Chinese provinces' industrial structures have become increasingly similar. This paper develops a quantitative spatial political-economy model to recover provincial industrial priorities from observed subsidies, accounting for trade, production networks, and national external economies of scale. Recovered priorities become more similar across inland and coastal provinces and align with national and provincial development plans. Removing recovered sectoral priorities reduces national welfare, yet redesigned priorities would raise welfare by 1.12 percent in 2012 while holding each province's real subsidy budget fixed. These findings show that increasing industrial similarity under local sectoral priorities is consistent with national scale spillovers, while redesigning those priorities can further improve welfare within existing fiscal resources.

Keywords: industrial policy, provincial government, spatial equilibrium, external economies of scale, recovered priorities, China.

JEL codes: F12, H71, O25, R12, R58.

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1 Introduction

Industrial policy is often a local decision with national consequences. Local governments subsidize industries to expand production within their jurisdictions, but the policies also affect other regions through trade and productivity spillovers. Whether this competition improves national welfare depends on how they choose subsidies when competing with each other and which industries different governments prioritize. However, these objectives are not directly observable from the data. Observed subsidies and production are equilibrium outcomes: governments choose subsidies in response to their economic returns, while firms adjust production in response to government support. This paper recovers local governments' priorities through a revealed-preference approach, examines how these priorities shape the allocation of production, and asks whether redesigning them can improve national welfare.

China provides a setting to study these questions. I document that Chinese provinces have become increasingly similar in their industrial composition. Vehicle production is widespread across the country: in 2016, 27 of China's 31 provincial-level regions produced at least 10,000 vehicles. With higher subsidy rates, the share of ICT's¹ value added in inland manufacturing increased between 2007 and 2016. These patterns raise concerns that provincial governments compete to develop the same industries, leading to wasteful duplication of production. To address this concern, I develop a framework that uses observed production and subsidies to recover provincial governments' objectives and evaluate the welfare effects of their industrial priorities.

Building on quantitative trade and spatial models ([Eaton and Kortum 2002](#), [Allen and Arkolakis 2014](#)), I study provincial subsidy competition in an economy linked by trade and intermediate inputs ([Ferrari and Ossa 2023](#)).² Provincial governments value both resident welfare and local sectoral value added, with sectoral priorities entering their objectives in the spirit of [Grossman and Helpman \(1994\)](#). I then use observed production and subsidies to recover the additional value provincial governments attach to developing particular industries. I examine how these priorities differ across provinces, assess their relationship with development plans and industrial growth, and evaluate their welfare effects. Finally, I ask whether redesigned priorities can improve national welfare within each province's observed subsidy budget.

The model describes competition among provincial governments in a multi-region, multi-sector economy. Production uses labor, a fixed factor and intermediate inputs, and provinces trade goods with one another ([Caliendo, Parro, Rossi-Hansberg, and Sarte 2018](#)). National

¹Here, ICT refers to computer, communications-equipment, and other electronic-equipment manufacturing.

²For related trade and spatial models, see also [Krugman \(1991\)](#), [Caliendo and Parro \(2015\)](#), [Tombe and Zhu \(2019\)](#). For a review of quantitative spatial economics, see [Redding and Rossi-Hansberg \(2017\)](#).

external economies of scale allow expansion in an industry to raise its productivity in every province, following [Bartelme, Costinot, Donaldson, and Rodríguez-Clare \(2025\)](#). Each government chooses subsidies to maximize an objective that values local sectoral real value added in addition to resident welfare. The governments also engage in Nash competition, each take other provinces’ policies as given and accounts for the effects of subsidies on equilibrium outcomes such as prices and trade patterns.

Provincial industrial priorities measure the additional value a government places on local sectoral value added beyond the benefits already included in resident welfare. To understand why government priorities are important, suppose one province is more productive in ICT than another. When both governments place the same priority on ICT, subsidies can have different effects on local production and resident welfare, leading them to choose different subsidy rates. A higher observed subsidy therefore need not indicate a stronger industrial priority. To recover their objectives, I calculate the marginal equilibrium responses to each province’s policies and use the government’s first-order conditions to infer its priorities ([Ossa 2014, Adão, Becko, Costinot, and Donaldson 2026a](#)). Given the marginal responses, the first order conditions form a linear system in the unknown weights. This revealed-preference approach separates the additional value governments attach to industrial development from the marginal welfare for consumers.

The quantitative analysis covers 30 provinces³ and 47 industries in China in 2007, 2012, and 2017. I combine production data, firms’ reported cash subsidies and tax relief, and interregional input-output tables. The recovered priorities show increasing alignment between inland and coastal provinces. Most of the increase occurs between 2007 and 2012 and persists in 2017. The ICT sector illustrates this change: inland governments place high priorities in the ICT industry, narrowing the difference from coastal governments. The increasing similarity in industrial composition is therefore accompanied by greater alignment in the industries provincial governments prioritize.

National and provincial development plans provide independent evidence on the interpretation of these priorities because neither enters the recovery. Industries identified for development in national Five-Year Plans receive higher recovered weights. Within industries and years, a province’s priority is also positively associated with designation in its own development plan, even after controlling for its subsidy rate. Priorities are higher in industries with faster preceding growth in all three periods and their relationship with subsequent growth is strongest in the early period. Together, these findings connect the recovered objectives to stated policy agendas and local industrial development.

I next distinguish the effects of observed subsidies from those of the recovered priorities.

³Excluding Tibet, Macau, Hong Kong and Taiwan due to data coverage.

Removing all subsidies lowers national welfare by 0.25 percent in the 2012 economy. Removing sectoral priorities while allowing provincial governments to compete by choosing subsidies to maximize resident welfare lowers national welfare by 0.10 percent. Under these welfare-only objectives, governments increase total subsidy spending but reduce manufacturing’s share from 46.53 to 14.96 percent. This shift speaks to the debate over whether local governments place too much emphasis on manufacturing relative to services and housing.⁴ In the model, the contraction of manufacturing reduces national productivity in industries with external economies of scale, hence reducing national welfare. Provincial governments account for the productivity gains only to the extent that they benefit their own residents. The observed priorities partly offset this limited incentive to support industries with national benefits.

The observed allocation delivers higher welfare than either alternative, but the composition of provincial priorities can be improved. I explore this through a two-step approach. A Ramsey planner first chooses a coordinated subsidy schedule that maximizes national welfare subject to constraints on each province’s real subsidy spending. I then derive redesigned priorities that give provincial governments incentives to choose this schedule under local financing. The constrained-efficient equilibrium raises national welfare by 1.12 percent in 2012, with gains in all 30 provinces and unchanged real subsidy spending in each province. Support shifts toward several upstream industries that supply intermediate inputs to other industries. Their expansion raises national industry productivity, and production networks transmit the benefits to other industries in all provinces. The welfare effect therefore depends on the industries being prioritized and the benefits they generate through trade and input-output linkages.

The remainder of the paper proceeds as follows. Section 2 documents the changes in industrial composition and describes the institutional setting. Section 3 presents the model, and Section 4 recovers and examines provincial priorities. Section 5 evaluates their effects on production and welfare. Section 6 studies the redesign of provincial priorities, and Section 7 concludes.

Related Literature. This paper contributes to four strands of literature. First, it relates to research on misallocation and regional specialization in China. [Hsieh and Klenow \(2009\)](#) and [Brandt, Tombe, and Zhu \(2013\)](#) quantify productivity losses from resource misallocation across firms, provinces, and sectors. [Young \(2000\)](#) examines local protection and regional specialization, while [Tombe and Zhu \(2019\)](#) study the effects of trade and migration frictions

⁴[Lu et al. \(2026\)](#) document preferential land pricing for manufacturing relative to services and study its relationship with local government objectives. [Henderson, Su, Zhang, and Zheng \(2022\)](#) examine how local leaders’ emphasis on industrial output affects the allocation of land between industrial and residential uses and the welfare of residents.

on productivity.⁵ I connect the allocation of production across provinces and industries to the objectives behind provincial subsidy choices. The welfare analysis accounts for national productivity spillovers, which allow support for an industry to generate benefits beyond the province providing it.

Second, the paper contributes to quantitative analyses of industrial policy and subsidy competition. [Liu \(2019\)](#) studies industrial policy in production networks, [Fajgelbaum and Gaubert \(2020\)](#) study optimal spatial policies, and [Bartelme, Costinot, Donaldson, and Rodríguez-Clare \(2025\)](#) estimate external economies of scale and quantify the gains from industrial policy. [Ferrari and Ossa \(2023\)](#) study subsidy competition among U.S. states and compare noncooperative and cooperative policies. I combine provincial policy competition with heterogeneous industrial priorities and national productivity spillovers. This allows me to evaluate how the objectives behind observed subsidies affect welfare and to examine how changing those objectives can implement a constrained-efficient allocation within existing provincial budgets.

Third, the paper relates to China’s central–local political economy. [Jin, Qian, and Weingast \(2005\)](#) study fiscal incentives under decentralization. [Xu \(2011\)](#) and [Bai, Hsieh, and Song \(2020\)](#) describe the incentives and discretion of local governments. Using textual analysis with large language models, [Fang, Li, and Lu \(2026\)](#) show how local industrial support reflects local economic conditions and upper-level policy priorities, while [Wang and Yang \(2025\)](#) examine how local officials’ incentives affect policy experimentation and national policy learning. I recover provincial industrial priorities from observed policy choices and compare them with national and provincial development plans. This comparison connects local governments’ economic objectives to stated policy agendas without imposing those agendas in the recovery.

Methodologically, the paper builds on research that recovers government objectives from observed policies. In public finance, the inverse-optimum approach uses policy choices to infer the social weights that rationalize existing tax and transfer systems ([Bourguignon and Spadaro 2012](#), [Hendren 2020](#)). In trade, [Ossa \(2014\)](#) and [Adão, Becko, Costinot, and Donaldson \(2026a\)](#) recover political or welfare weights from observed tariffs. I apply this approach to provincial subsidy competition, recovering the additional value governments attach to local sectoral activity beyond local welfare objectives. The exercise identifies a vector of industrial priorities for each province and uses the same method to construct redesigned objectives.

⁵See also [Bai, Du, Tao, and Tong \(2004\)](#) on local protection and regional specialization, [Lu and Tao \(2009\)](#) on industrial agglomeration, and [Hsieh and Song \(2015\)](#) on the transformation of the state sector and aggregate growth.

2 Provincial Similarity and Institutional Background

This section first documents the increasing similarity of industrial composition across provinces, particularly between inland and coastal provinces. It then describes China’s political system, focusing on vertical accountability, horizontal competition, and the instruments provincial governments use for industrial policy. While subsidies and production would reflect information about provincial objectives, they are endogenous outcomes that depends on fundamentals such as productivity, trade costs and external economies of scale. Therefore, a structural model is needed to recover the objectives through a revealed-preference approach and evaluate the consequences for production and welfare.

2.1 Increasing provincial industrial similarity

Market integration creates opportunities for regions to specialize. When producers can serve customers elsewhere at lower cost, one region can devote a larger share of its resources to industries in which it has a comparative advantage, produce more in those industries and obtain other goods through trade. These forces would lead regions to specialize in different activities, as in the framework of [Krugman and Venables \(1996\)](#). Historical experience provides examples of this process. Regional manufacturing specialization in the United States increased between 1860 and 1914 ([Kim 1995](#)) during the railroad boom. European countries also became more specialized from the early 1980s to the mid-1990s during a period of deepening integration ([Midelfart-Knarvik, Overman, Redding, and Venables 2004](#)).

To understand industrial similarity across China’s provinces, I begin with two examples before moving to the broader analysis. Vehicle production is widespread across many provinces. [Figure 1](#) shows that 27 of China’s 31 provincial-level regions produced at least 10,000 vehicles in 2016. By comparison, Ward’s reports car and truck production in 14 U.S. states in 2015 ([Appendix Figure F.1](#)). Across its five-year observations from 1960 to 2020, the number of states with reported production ranges from 14 to 26 ([Appendix Figure F.2](#)).

The ICT sector illustrates how the composition of inland manufacturing has changed over time. The left panel of [Figure 2](#) reports ICT’s share of regional manufacturing value added. Between 2007 and 2016, ICT’s value-added share increased inland while remaining relatively stable on the coast. The right panel shows that subsidies relative to ICT value added were higher inland than on the coast during the same period. This suggests that inland provinces have been actively supporting the growth of the ICT sector, attracting more investment and



Figure 1: Vehicle production across China, 2016

Notes: The lowest category includes unreported production and output below 10,000 vehicles. Source: *China Statistical Yearbook 2017*.

production to these regions.⁶

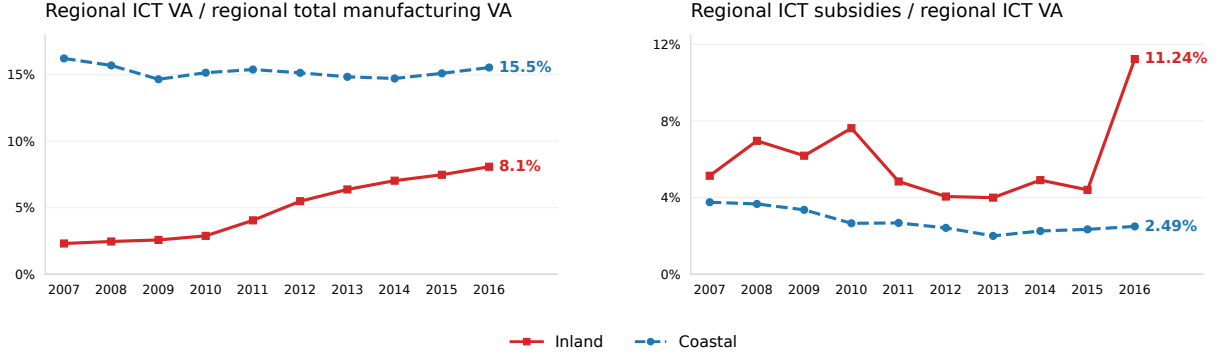


Figure 2: Regional production and fiscal support: an illustration from ICT

Notes: The left panel shows ICT’s share of regional manufacturing real value added. The right panel shows subsidies and tax relief as a share of ICT value added.

Beyond the above examples, the pattern of increasing similarity in industrial composition across provinces holds for all manufacturing sectors. To document this pattern, I use sectoral shares of provincial manufacturing value added to capture differences in industrial composition despite differences in the overall size of manufacturing. For each province o , define

$$x_{os} = \frac{VA_{os}}{\sum_s VA_{os}}, \quad \mathbf{x}_o = [x_{o1}, x_{o2}, \dots, x_{o29}]',$$

where VA_{os} is the real value added of sector s in province o , x_{os} is the share of sector s in province o ’s total manufacturing value added and the vector $\mathbf{x}_o$ collects these shares for all sectors in province o . I compute three year averages of value-added to smooth out short-run fluctuations year to year.

For two share vectors, cosine similarity is defined by

$$\text{Cos}(\mathbf{x}, \mathbf{y}) = \frac{\mathbf{x}'\mathbf{y}}{\|\mathbf{x}\|\|\mathbf{y}\|}. \quad (1)$$

For nonnegative value-added shares, the cosine lies between zero and one, with one indicating identical industrial composition. A higher cosine corresponds to a smaller angle between the two share vectors and hence more similar vectors. To illustrate how each province’s industrial composition evolves, I calculate this measure for each province against a fixed coastal benchmark, defined as the average of the coastal provinces’ manufacturing-share in

⁶One might argue that there was knowledge spillover during this period from coastal to inland, productivity in inland ICT sector increases relative to other manufacturing sectors, hence the value-added share went up. Neither my static model nor the quantitative exercise rule out this possibility. Section 3 discuss this in more detail.

2006–08. Changes in the cosine therefore reflect changes in the province’s own production shares.

Figure 3 reports the regional averages. The inland mean cosine rises from 0.619 in 2006–08 to 0.688 in 2015–18. The coastal mean remains high, moving from 0.830 to 0.810 over the same period. Inland provinces therefore move closer to the earlier coastal industrial mix, narrowing the gap between the two groups.

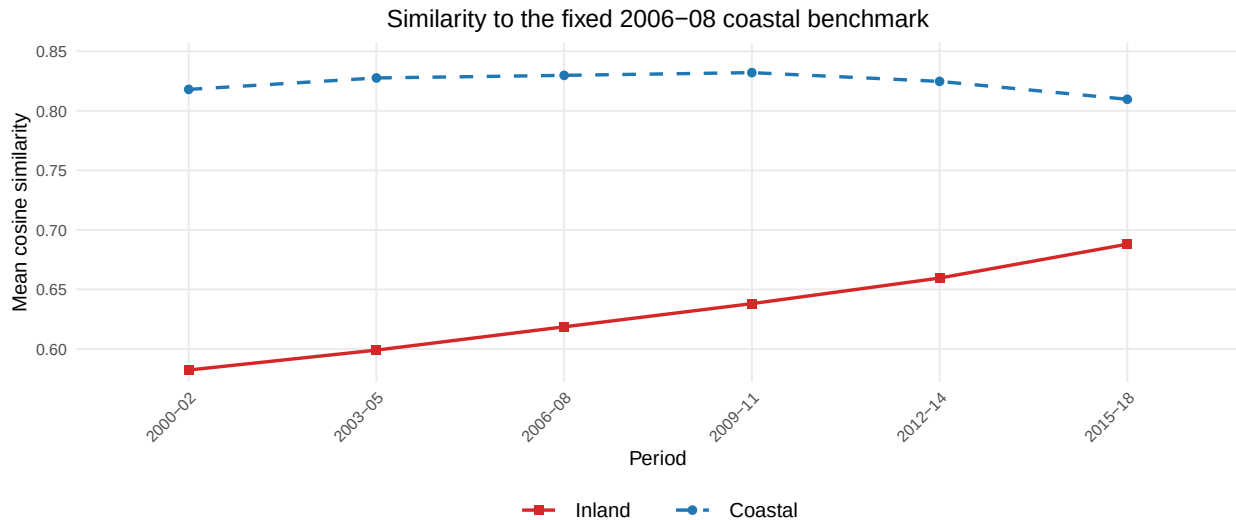


Figure 3: Industrial composition relative to a fixed coastal benchmark

This fact is robust to a set of different measures. Comparing provinces with one another in each three-year period, the average cosine similarity across inland–coastal pairs rises from 0.521 in 2006–08 to 0.594 in 2015–18. Similarity within each region changes little over the same period: the inland-pair mean remains at 0.615, while the coastal-pair mean moves from 0.659 to 0.654.⁷ Appendix Table F.1 reports these comparisons. An alternative measure, Krugman specialization index, gives a similar account of the inland change. The mean Krugman specialization index for inland provinces, which measures their distance from the industrial composition of the rest of China, falls from 0.379 to 0.331 (Appendix Figure F.3). Beyond value-added, the increase in inland–coastal similarity is also present in manufacturing employment shares (Appendix Figure F.5).

These changes occurred during an expansion of China’s transport network. The National Trunk Highway System added about 35,000 kilometers of high-speed roads between 1992 and 2007, connecting provincial capitals and other major cities (Faber 2014). Egger, Loumeau, and Loumeau (2023) document improvements in the extent and quality of road and rail

⁷Inland–coastal pair refers to two provinces, one inland and one coastal. Inland-pair and coastal-pair refers to both provinces being inland and coastal, respectively.

connections between 2000 and 2013. Accounting for changes in network coverage and design speeds, [Ma and Tang \(2024\)](#) calculate that the median reduction in travel time across city pairs between 1994 and 2017 was 32 percent by road and 37 percent by freight rail. This evidence points to reduction in transport cost, allowing firms to have better market access. In standard trade and spatial models, this would allow provinces to better specialize in their comparative advantage.

2.2 China’s political system and provincial industrial policy

China combines centralized control over personnel with local responsibility for economic affairs and other responsibilities. The central leadership controls key appointments, while local governments decide sectoral investments, infrastructure provision, and local economic development ([Xu 2011](#)). Provinces occupy an intermediate position in this hierarchy. Provincial leaders answer to the central authorities and oversee the cities and counties within their jurisdictions. Their policy choices therefore reflect both the demands of higher levels of government and the economic conditions they face locally.

Local economic performance is believed to be an important aspect of officials’ careers. Through the Chinese Communist Party’s personnel hierarchy, higher authorities evaluate officials and control their appointment, promotion, and reassignment. Evidence from leaders over 1979–1995 shows that better economic performance was associated with a higher probability of promotion and a lower probability of termination ([Li and Zhou 2005](#)). These career incentives encourage officials to pursue local economic growth. At the same time, officials are responsible for multiple policy tasks, such as environmental regulations and social stability. [Zhou \(2022\)](#) describes how officials operate within these overlapping demands while retaining discretion over implementation. Provincial objectives can therefore reflect both economic performance and the tasks for which officials are held accountable.

Horizontal competition reinforces these incentives. Provincial governments compete to attract investment and expand production in particular industries. The territorial organization of government allows higher authorities to compare economic performance across jurisdictions with similar administrative responsibilities ([Xu 2011](#)). Fiscal incentives further strengthen their interest in local industrial development: under the earlier fiscal-contracting system, stronger marginal revenue-retention incentives were associated with faster development of the nonstate sector ([Jin, Qian, and Weingast 2005](#)). This competition often takes the form of selective support for firms and investment projects in the industries that local governments seek to develop ([Bai, Hsieh, and Song 2020](#)). Provincial governments thus compete through choices about which industries to develop and how to attract investment in those industries.

Provincial and lower-level governments have several instruments for pursuing these objectives. Cash subsidies and tax relief can be combined with land provision, infrastructure, and assistance with administrative approvals. Many of these interventions are implemented by municipal governments and development-zone authorities that work directly with firms. The studies collected in [Zeng \(2010\)](#) describe how local governments support industrial development through roads, utilities, business services, and specialized zones. [Bai, Hsieh, and Song \(2020\)](#) show how political and administrative discretion can also be used to provide firm-specific arrangements for favored private businesses. Local support can consequently affect both the direct cost of production and the conditions under which a firm invests and operates. This paper uses observed output and subsidies to recover provincial industrial priorities, taking other policy instruments as given when evaluating subsidy changes. The recovered priorities therefore describe government objectives conditional on the existing policy environment.

[Xiong \(2026\)](#) describes this competition as an industrial tournament in which local governments want to build industries around major producers. Attracting a major producer can bring demand for local suppliers and encourage related firms to locate nearby. These potential benefits, together with fiscal and career incentives, give officials reasons to favor particular industries. Section 4.4 compares the recovered priorities with national and provincial plans as well as industrial growth. These comparisons assess their relationship with observable policy agendas and industrial performance, without separately identifying the underlying motives.

Apart from the political setting, industrial policies are used to address market failures to improve efficiency. External economies of scale provide one such rationale: when an industry’s expansion raises the productivity of other firms, it creates benefits that individual producers do not fully internalize ([Chipman 1970](#), [Ethier 1982](#)). [Bartelme, Costinot, Donaldson, and Rodríguez-Clare \(2025\)](#) estimate external economies of scale across manufacturing industries and quantify the gains from industrial policy. This reasoning gives governments a potential welfare rationale for supporting particular industries, in addition to the fiscal and career incentives described above.

The composition of the observed increase in provincial similarity makes this possibility relevant. Using scale elasticities based on the estimates of [Bartelme, Costinot, Donaldson, and Rodríguez-Clare \(2025\)](#), Appendix Figure F.6 compares inland similarity to the fixed coastal benchmark within two groups of manufacturing industries, split at the median scale elasticity. Similarity rises among industries with larger external economies of scale and changes little among the remaining industries. If expanding an industry generates productivity gains across China, several provinces’ support for that industry may have benefits beyond their own

borders. On the other hand, such support also uses fiscal resources and draws labor and inputs away from other activities. Its welfare consequences depend on both sides of this trade-off.

Neither observed subsidies nor output directly identify provincial priorities because they are endogenous equilibrium outcomes. Firms respond to subsidies, productivity, market access, and input costs. Governments choose subsidies to maximize their objectives evaluated at the resulting competitive equilibrium. Two provinces with similar objectives can therefore choose different subsidy rates if the marginal effects of subsidies on production and resident welfare differ. Conversely, similar rates can reflect different objectives and industrial priorities. Production shares also reflect both economic fundamentals and policy support. Recovering provincial priorities requires accounting for these general equilibrium effects, including those transmitted across provinces through trade, national productivity spillovers and input-output linkages. Section 3 develops a structural model for this revealed-preference exercise.

3 Model

Based on the observed facts and understanding of the institutional setting, this section develops a spatial political economy model to capture provincial competition and government objectives. The model builds on a multi-region multi-sector Armington trade model with external economies of scale, and introduces government objectives. I first present the competitive equilibrium for households and firms, taking subsidy rates as given. I then discuss how provincial governments choose subsidies to maximize their objectives, evaluated at the competitive equilibrium. The resulting recovery procedure uses governments' first-order conditions to derive the additional value provincial officials attach to local sectoral activity. The recovered priorities summarize the forces behind provincial industrial development and provide a basis for evaluating their welfare consequences.

The economy contains provinces $o, r \in \mathcal{R}$ and industries $s, j \in \mathcal{S}$. Goods are traded among provinces and differentiated by their province of origin within each industry, following [Armington \(1969\)](#). Production uses labor, a fixed factor that can be interpreted as capital, and intermediate inputs, with input-output linkages across industries as in [Caliendo and Parro \(2015\)](#). National external economies of scale follow the composite-input formulation of [Bartelme, Costinot, Donaldson, and Rodríguez-Clare \(2025\)](#). Provincial populations and fixed-factor endowments are immobile across provinces, while both factors can move between

industries within a province.⁸

3.1 Production technology and firm behavior

The production technology in province o and industry s is given by

$$q_{os} = \bar{A}_{os} \Psi_s F_{os}, \quad F_{os} = \left(K_{os}^{\alpha_s} L_{os}^{1-\alpha_s} \right)^{1-\gamma_s} \prod_j M_{os,j}^{\gamma_{sj}}, \quad \sum_j \gamma_{sj} = \gamma_s. \quad (2)$$

Here $\bar{A}_{os}$ is fundamental productivity, L_{os} is effective labor, K_{os} is the fixed factor, and $M_{os,j}$ is the quantity of intermediate input j . The composite F_{os} aggregates these inputs with constant returns to scale. The value-added share is $1 - \gamma_s$, while α_s is the fixed factor's share of primary-factor payments.

National productivity depends on the physical input composite employed in industry s across all provinces:

$$Z_s = \sum_{o \in \mathcal{R}} a_{os} F_{os}, \quad \Psi_s = Z_s^{\phi_s}, \quad \phi_s \geq 0. \quad (3)$$

The fixed coefficients $a_{os} > 0$ express provincial composites in common sectoral units. An increase in Z_s raises productivity in industry s in every province.

Firms take the national productivity multiplier Ψ_s as given.⁹ Let p_{os} denote the factory-gate output price, r_o the fixed-factor rent, w_{os} the wage per efficiency unit, and P_{oj} the price of intermediate input j . A subsidy τ_{os} reimburses the fraction τ_{os} of the firm's expenditure on all inputs. Negative rates are taxes, and all rates satisfy $\tau_{os} < 1$. Firms choose output and inputs to maximize profits:

$$\begin{aligned} \max_{\substack{q_{os}, K_{os}, L_{os} \geq 0 \\ M_{os,j} \geq 0 \forall j}} \quad & p_{os} q_{os} - (1 - \tau_{os}) \left(r_o K_{os} + w_{os} L_{os} + \sum_j P_{oj} M_{os,j} \right) \\ \text{subject to} \quad & q_{os} \leq \bar{A}_{os} \Psi_s \left(K_{os}^{\alpha_s} L_{os}^{1-\alpha_s} \right)^{1-\gamma_s} \prod_j M_{os,j}^{\gamma_{sj}}. \end{aligned} \quad (4)$$

Because the reimbursement applies to all inputs at the same rate, it leaves the cost-minimizing input mix unchanged at given input prices. Cost minimization yields the gross

⁸The model can be easily extended to allow for labor mobility. However, population mobility across provinces in China is very low, averaging less than 1% of provincial populations, which has no quantitative effect on the results.

⁹This formulation can be interpreted as a continuum of perfectly competitive, atomistic firms producing the same good within each province-industry. Each firm's contribution to national productivity is negligible. Identical technologies and input prices imply common input proportions. With constant returns to scale, the production function also describes province-industry aggregates.

cost of one unit of the input composite:

$$u_{os} = C_s \left(r_o^{\alpha_s} w_{os}^{1-\alpha_s} \right)^{1-\gamma_s} \prod_j P_{oj}^{\gamma_{sj}}, \quad (5)$$

where C_s is a constant that depends on the cost shares.¹⁰

Let B_{os} denote the input bill before reimbursement, R_{os} sales revenue, and S_{os} subsidy expenditure. Constant returns to scale and perfect competition imply zero profits for active producers, so

$$B_{os} = u_{os} F_{os}, \quad R_{os} = (1 - \tau_{os}) B_{os}, \quad S_{os} = \tau_{os} B_{os}. \quad (6)$$

For an active producer, the factory-gate price therefore equals marginal cost net of the subsidy:

$$p_{os} = \frac{(1 - \tau_{os}) u_{os}}{\bar{A}_{os} \Psi_s}. \quad (7)$$

The government finances a share τ_{os} of the gross input bill, leaving producers to bear the net cost $(1 - \tau_{os}) B_{os}$. Workers, fixed-factor owners, and intermediate suppliers receive total payments of B_{os} , financed jointly by sales revenue and the subsidy. Cost minimization implies factor payments

$$w_{os} L_{os} = (1 - \alpha_s)(1 - \gamma_s) B_{os}, \quad r_o K_{os} = \alpha_s(1 - \gamma_s) B_{os}. \quad (8)$$

3.2 Worker allocation and consumption

Province o has $\bar{L}_o$ workers with heterogeneous sectoral skills. A worker h draws independent sectoral skills with Fréchet distribution $\Pr(\epsilon_{hs} \leq e) = \exp(-e^{-\zeta})$, where $\zeta > 1$. Taking sectoral wages as given, the worker chooses the sector that maximizes earnings:

$$s_h^* \in \arg \max_s w_{os} \epsilon_{hs}, \quad (9)$$

where the choice is over available sectors. Aggregating these choices gives the employment shares, mean labor earnings, and effective labor supplied to each sector:

$$\lambda_{os} = \frac{w_{os}^\zeta}{\sum_j w_{oj}^\zeta}, \quad y_o = \Gamma(1 - 1/\zeta) \left(\sum_j w_{oj}^\zeta \right)^{1/\zeta}, \quad L_{os} = \frac{\lambda_{os} \bar{L}_o y_o}{w_{os}}. \quad (10)$$

¹⁰Specifically,

$$C_s = [\alpha_s(1 - \gamma_s)]^{-\alpha_s(1-\gamma_s)} [(1 - \alpha_s)(1 - \gamma_s)]^{-(1-\alpha_s)(1-\gamma_s)} \prod_{j: \gamma_{sj} > 0} \gamma_{sj}^{-\gamma_{sj}}.$$

Here λ_{os} is the employment share and y_o is mean labor earnings. As an industry draws a larger share of workers, it attracts workers with lower relative productivity in that occupation and must offer a higher efficiency wage relative to other industries. The parameter ζ governs how strongly employment shares respond to relative wages.

Residents earn labor income and own the provincial fixed-factor endowment $\bar{K}_o$, which has a common rent r_o across industries.¹¹ The government finances net subsidy spending through a lump-sum levy $T_o = \sum_s \tau_{os} B_{os}$. I abstract from interprovincial fiscal transfers.¹²

To account for trade imbalances, let D_o denote the net inflow to province o . A positive D_o finances a trade deficit, while a negative value corresponds to a trade surplus. Since trade takes place among domestic provinces, $\sum_{o \in \mathcal{R}} D_o = 0$. Household disposable income is

$$Y_o = y_o \bar{L}_o + r_o \bar{K}_o - T_o + D_o. \quad (11)$$

Final and intermediate users in destination r purchase the sectoral composite in sector s . Goods from different provinces are imperfect substitutes, and the sectoral composite is a CES aggregator of the delivered quantities:

$$Q_{rs} = \left(\sum_{o \in \mathcal{R}} x_{ro,s}^{(\sigma_s-1)/\sigma_s} \right)^{\sigma_s/(\sigma_s-1)}, \quad \theta_s = \sigma_s - 1 > 0, \quad (12)$$

where $x_{ro,s}$ is the quantity delivered from province o to province r . Shipping requires $\kappa_{ro}^s \geq 1$ units at origin per unit delivered, with $\kappa_{oo}^s = 1$.

Let C_{os} denote household consumption of the industry- s composite. Given sectoral prices and disposable income, the representative household chooses consumption to maximize Cobb–Douglas utility:

$$\max_{\{C_{os} \geq 0\}_s} \prod_{s: \beta_s > 0} C_{os}^{\beta_s} \quad \text{subject to} \quad \sum_s P_{os} C_{os} \leq Y_o, \quad (13)$$

where $\beta_s \geq 0$ and $\sum_s \beta_s = 1$. The solution satisfies $P_{os} C_{os} = \beta_s Y_o$, so the household allocates a constant share of disposable income to each industry. Its consumption price index and

¹¹Equivalently, the government can own the fixed factor and transfer its rental income to residents net of subsidy spending, using a lump-sum levy if spending exceeds rental income.

¹²This is different from assuming balanced trade. This assumption means that local governments are responsible for financing their own subsidies, while trade can still be imbalanced. This assumption lets me study provincial industrial priorities under local financing, without considering central government intervention. While the central government in China provides transfers, most of them have very specific purposes and provincial governments cannot use those transfers for industrial support.

indirect utility are

$$P_o^c = \prod_{s: \beta_s > 0} (P_{os}/\beta_s)^{\beta_s}, \quad W_o = \frac{Y_o}{P_o^c}. \quad (14)$$

3.3 Competitive equilibrium

For a given subsidy profile, the competitive equilibrium is characterized as follows. Cost minimization over the origins in the sectoral composite yields the price index and expenditure shares

$$P_{rs} = \left[\sum_{o \in \mathcal{R}} (\kappa_{ro}^s p_{os})^{-\theta_s} \right]^{-1/\theta_s}, \quad \pi_{ro,s} = \frac{(\kappa_{ro}^s p_{os})^{-\theta_s}}{\sum_{m \in \mathcal{R}} (\kappa_{rm}^s p_{ms})^{-\theta_s}}. \quad (15)$$

Here $\pi_{ro,s}$ is the share of destination r 's expenditure on industry s supplied by province o . These trade shares depend on the equilibrium delivered prices of all available producers.

Total expenditure on industry s in destination r consists of household consumption and intermediate purchases. Goods-market clearing equates each origin's sales revenue with expenditure on its goods across destinations:

$$E_{rs} = \beta_s Y_r + \sum_j \gamma_{js} B_{rj}, \quad (16)$$

$$R_{os} = \sum_{r \in \mathcal{R}} \pi_{ro,s} E_{rs}. \quad (17)$$

Effective labor demanded by firms must equal the occupational supply in equation (10). The fixed-factor market clears when

$$\sum_s K_{os} = \bar{K}_o. \quad (18)$$

Together with the factor payments in equation (8), these conditions imply $y_o \bar{L}_o + r_o \bar{K}_o = \sum_s (1 - \gamma_s) B_{os}$. After financing subsidy expenditure, disposable income can therefore be written as

$$Y_o = \sum_s (1 - \gamma_s - \tau_{os}) B_{os} + D_o. \quad (19)$$

These accounts imply $\sum_s (E_{os} - R_{os}) = D_o$. For a reference province $o^* \in \mathcal{R}$, prices are normalized by $P_{o^*}^c = 1$, with D_o expressed in the same numeraire.

Definition 1 (Competitive equilibrium). Given the model's primitives, a subsidy profile $\tau = (\tau_o)_{o \in \mathcal{R}}$, and trade imbalances $\{D_o\}_{o \in \mathcal{R}}$ satisfying $\sum_o D_o = 0$, a competitive equilibrium consists of prices, production and input choices, consumption and trade, labor sectoral choices, and fiscal payments such that:

- (i) Firms solve the profit-maximization problem in equation (4), taking prices and national productivity multipliers as given.

- (ii) Workers choose sectors according to equation (9), and households solve the consumption problem in equation (13). Final and intermediate users minimize the cost of their sectoral composites.
- (iii) Goods markets clear according to equations (16) and (17). Firms' effective labor demands equal the occupational supplies in equation (10), and the fixed-factor market clears according to equation (18).
- (iv) Each provincial government balances its budget, $T_o = \sum_s \tau_{os} B_{os}$, and household disposable income satisfies equation (11). National input pools and productivity multipliers satisfy equation (3).

Appendix B gives the equilibrium conditions and their exact-change representation.

3.4 Government objectives and Nash equilibrium

The competitive equilibrium describes the economy under a given subsidy schedule chosen by provincial governments. The institutional setting in Section 2.2 combines accountability to national authorities with competition for local economic activity. Provincial officials can value industries because of GDP and promotion incentives, assigned industrial goals, or expectations about future growth. These motives can lead them to support sectoral expansion beyond the amount justified by the welfare gains received by their residents. I represent these considerations with an additional valuation of sectoral activity, in the spirit of the flexible political objectives in Grossman and Helpman (1994) and Ossa (2014). Government o chooses its subsidy vector $\tau_o = (\tau_{os})_{s \in \mathcal{S}}$ to maximize

$$g_o(\tau; \vartheta_o) = \log W_o(\tau) + \sum_s \vartheta_{os} \log V_{os}(\tau), \quad V_{os} = \frac{(1 - \gamma_s) B_{os}}{P_o^c}. \quad (20)$$

The first term is the log of resident welfare, while the second term is a weighted sum of log sectoral activities. The weights ϑ_{os} are the unobserved priorities that summarize the additional value officials attach to local sectoral activity.

The government holds rival subsidies fixed, anticipates the competitive-equilibrium response to each candidate policy, and finances its resulting subsidy bill. Each local government understands the changes in factor prices, interprovincial trade, consumer prices, and national productivity when evaluating the welfare and activity consequences of its own policy choices.

The priorities have two interpretations.

Government Indifference Curve: A priority ϑ_{os} measures the welfare sacrifice the government accepts for a proportional increase in sectoral real value added: holding the objective

and other activity terms fixed, $d \log W_o = -\vartheta_{os} d \log V_{os}$. For example, $\vartheta_{os} = 0.2$ means the government is willing to reduce resident welfare by 0.2% to increase the real value added of industry s by 1%, ceteris paribus.

Hypothetical Consumer: To interpret the priorities, consider a hypothetical consumer who values provincial real sectoral value added with Cobb–Douglas weights $\tilde{\beta}_{os}$. These weights combine household consumption shares with the government’s industrial priorities:

$$\tilde{\beta}_{os} = \frac{\beta_s + \vartheta_{os}}{1 + \sum_j \vartheta_{oj}}. \quad (21)$$

When all priorities are zero, these weights coincide with household consumption shares. A higher priority for an industry increases its weight relative to other industries.¹³

These weights summarize sectoral objectives beyond the local economic benefits already included in resident welfare. Recovering them allows the empirical analysis to ask whether provinces increasingly value the same industries after accounting for the different economic returns those industries offer. The specification permits these motives to differ across provinces and years without assigning each weight to a particular political mechanism. National and provincial plans, together with prior and subsequent growth, provide separate evidence on the economic content of the recovered objectives in Section 4.4.

The governments maximize their objectives by choosing subsidies, taking the other provinces’ subsidies as given. A Nash equilibrium is a subsidy profile and its associated competitive equilibrium such that no province can improve its objective by unilaterally changing its own subsidies. The following definition formalizes this concept.

Definition 2 (Nash equilibrium). Given provincial priorities $\{\vartheta_o\}_{o \in \mathcal{R}}$, a Nash equilibrium is a subsidy profile τ^* and the competitive equilibrium induced by it such that

$$g_o(\tau_o^*, \tau_{-o}^*; \vartheta_o) \geq g_o(\tau_o', \tau_{-o}^*; \vartheta_o) \quad (22)$$

for every province $o \in \mathcal{R}$ and every feasible unilateral deviation $\tau_o' = (\tau_{os}')_{s \in \mathcal{S}}$. Here τ_{-o}^* denotes the subsidy vectors of all other provinces. A deviation is feasible if $\tau_{os}' < 1$ in every industry and the resulting competitive equilibrium yields a well-defined government objective. Both payoffs are evaluated at the competitive equilibrium induced by the corresponding subsidy profile.

¹³Technically, this interpretation requires $\beta_s + \vartheta_{os} \geq 0$ for all industries and $1 + \sum_j \vartheta_{oj} > 0$, which may not always hold.

3.5 Recovering priorities from subsidies and output

The government's optimality conditions link its unobserved priorities to the observed subsidy schedule. At an interior choice, a marginal increase in any subsidy must balance the resulting welfare change against the changes in all sectoral activities the government values. We can therefore evaluate those equilibrium responses at observed policies and ask which priority vector makes these tradeoffs consistent with provincial choices. For each industry $k \in \mathcal{S}$, define

$$(a_o)_k = \frac{\partial \log W_o}{\partial \tau_{ok}}, \quad (\mathcal{B}_o)_{ks} = \frac{\partial \log V_{os}}{\partial \tau_{ok}}. \quad (23)$$

where a_o is the vector of marginal welfare returns and $\mathcal{B}_o$ is the activity-response matrix. Rows of $\mathcal{B}_o$ index sectoral subsidies and columns index sectoral activities. Every derivative includes the adjustment of private allocations and national EES, holding all other subsidy rates fixed. At an interior provincial optimum,

$$a_o + \mathcal{B}_o \vartheta_o = 0. \quad (24)$$

With a nonsingular square response matrix, these conditions uniquely recover $\vartheta_o = -\mathcal{B}_o^{-1}a_o$. Economic conditions enter through the welfare return and the activity-response matrix. The recovered weights describe the additional valuations required to balance those marginal responses at the observed policies.

The marginal welfare return has three components:

$$(a_o)_k = \underbrace{\sum_s \frac{(1 - \gamma_s - \tau_{os})B_{os}}{Y_o} \frac{\partial \log B_{os}}{\partial \tau_{ok}}}_{\text{Income response}} - \underbrace{\frac{B_{ok}}{Y_o}}_{\text{Direct subsidy cost}} - \underbrace{\sum_s \beta_s \frac{\partial \log P_{os}}{\partial \tau_{ok}}}_{\text{Consumer price response}}. \quad (25)$$

The first term measures how changes in sectoral input bills affect disposable income. An additional unit of B_{os} generates $1 - \gamma_s$ units of factor income and requires τ_{os} units of subsidy spending, leaving a net contribution of $1 - \gamma_s - \tau_{os}$. The second term is the direct cost of increasing the subsidy rate in industry k , holding its input bill fixed, relative to disposable income. The third term captures changes in the consumption price index, with lower prices raising resident welfare.

Off-diagonal activity responses in $\mathcal{B}_o$ additionally capture the government's valuation of effects on other local industries. These are the reasons subsidy rates need not rank priorities: the same observed rate can reflect different combinations of resident-welfare returns and sectoral objectives.

The next section applies this recovery to provincial production, subsidy, and trade

data. I examine how the recovered priorities differ across provinces and over time, and use development plans and industrial growth to assess their economic interpretation.

4 Recovering Provincial Priorities

This section takes the model to the data to recover provincial industrial priorities. It first introduces the data and explains how observed production, subsidies, and trade enter the recovery. It then examines how the recovered priorities differ across provinces and change over time, and how they relate to national and provincial development plans and industrial growth. These comparisons help interpret the objectives behind provincial support before examining their consequences for production and welfare.

4.1 Data

The quantitative analysis covers 30 provinces and 47 industries in 2007, 2012, and 2017. Production data come from the *China Industry Statistical Yearbook* and provincial input-output tables. The China Tax Survey provides cash subsidies and tax relief, which I combine into a measure of support for each province-industry pair. Each benchmark combines production and policy observations from nearby years to attenuate short-run fluctuations. Appendix A describes the coverage, timing, and construction of these measures.

The interregional input-output tables compiled by [Li et al. \(2023\)](#) provide trade flows between provinces and with the rest of the world. These flows describe where each province’s industries buy their inputs and sell their output. In the baseline, I hold the cost shares γ_s and γ_{sj} and consumption shares β_s fixed across periods using the 2007 national input-output table. Allowing these shares to vary has no impact on the qualitative conclusions and minimal effects on the quantitative results. Provincial production, subsidies, and trade vary across periods.

I use development plans and manufacturing growth to assess the economic interpretation of the recovered priorities. The Eleventh, Twelfth, and Thirteenth national Five-Year Plans identify industries for development in the three benchmark periods ([National People’s Congress 2006, 2011, 2016](#)). The CNRDS Industrial Policy Research Database records industries designated for support in provincial plans ([Chinese Research Data Services 2026](#)). The annual manufacturing panel provides measures of industrial growth before and after each benchmark. These plan indicators and growth outcomes do not enter the recovery. Their construction and the industry concordances are described in Appendix A.

4.2 Implementing the recovery

The recovery exercise treats provincial governments as choosing subsidies in 43 industries, holding policies in four public-service industries at their observed values. However, all 47 industries enter production, demand, and market clearing, so responses in the public-service industries also affect the returns to intervention through equilibrium effects. Appendix A reports the industry coverage and the treatment of missing policy observations.

The observed subsidy measure must first be expressed in the units of the model. Let s_{os} denote reported subsidies divided by reported output, interpreted as receipts from purchasers. The model’s subsidy rate measures the share of the gross input bill financed by the government:

$$\tau_{os} = \frac{s_{os}}{1 + s_{os}}, \quad \frac{S_{os}}{R_{os}} = s_{os}, \quad B_{os} = \frac{R_{os}}{1 - \tau_{os}}. \quad (26)$$

As the model implies, input bill is partially financed by the government subsidies, reducing the producers’ payment. Calibrated Cobb-Douglas cost shares determines the payments to labor, the fixed factor, and intermediate input producers. I reconcile the observed trade profiles with the resulting production and expenditure accounts while preserving observed output. The adjusted flows provide the trade shares used to calculate policy responses. Appendix B describes the accounting conventions and trade reconciliation.

China’s trade with the rest of the world is significant, hence I add foreign trade to account for China’s imports and exports. The rest of the world supplies imports at fixed prices and allocates fixed expenditure in each industry across Chinese producers through the same CES demand system.¹⁴ Export shares and quantities respond to provincial policies, while national productivity spillovers continue to depend only on production inputs employed in China. Appendix B.3 presents the model extension with foreign trade.

The elasticities determine how production, trade, and labor allocation respond to subsidies. I calibrate trade elasticities to [Giri, Yi, and Yilmazkuday \(2021\)](#) and national scale elasticities to [Bartelme, Costinot, Donaldson, and Rodríguez-Clare \(2025\)](#). Due to data limitation, the scale elasticities is only estimated for manufacturing industries, and is 0 for others. While these do affect the estimation results, it is standard in the literature to assume that agriculture and services have much lower external economies of scale, comparing to manufacturing. The Roy elasticity parameter is $\zeta \simeq 1.39$, based on an auxiliary calibration using employment and earnings. These parameters are held fixed across periods. Appendix B.5 reports the values, industry mapping, and occupational calibration.

¹⁴These are additional assumption I impose, technically this indicates perfectly elastic import supply and unit price elasticity of foreign demand. I conducted sensitivity checks to ensure that the results are robust to impose different price elasticities, following [Adão, Becko, Costinot, and Donaldson \(2026b\)](#).

I analytically differentiate the competitive-equilibrium conditions at each benchmark to obtain the marginal welfare and activity responses in [equation \(23\)](#). These responses can be calculated from the benchmark accounts and calibrated parameters without separately estimating bilateral trade costs or fundamental productivity.¹⁵ The derivatives incorporate adjustments in factor prices, trade flows, and national productivity.

I use these responses to solve the provincial first-order conditions for priorities. The response matrices are full rank in all 90 province-years, yielding a unique priority vector in each case.

The first-order conditions alone do not establish that the observed subsidies are global best responses. In the absence of a general proof of global optimality, I assess provincial optimality numerically. At the recovered priorities, the Hessian of province o 's objective with respect to its subsidy vector is

$$H_o = D_{\tau_o}^2 \log W_o + \sum_s \vartheta_{os} D_{\tau_o}^2 \log V_{os}. \quad (27)$$

Checking the full Hessian allows for simultaneous changes in several subsidies. The Hessians are negative definite in all 90 province-years. On a regular competitive-equilibrium branch, this condition and stationarity establish strict local optimality for every province, so the observed profile is a strict local Nash equilibrium at each benchmark. These checks do not rule out profitable finite deviations.¹⁶ [Appendix C](#) derives the analytical derivatives and optimality conditions, and [Appendix Table C.1](#) reports the first-order residuals, conditioning of the inverse systems, and curvature checks.

Because there is one priority per first-order condition, the plan and growth comparisons below provide a separate assessment of the economic interpretation of the recovered weights.

4.3 Similarity of provincial priorities

I first ask whether the increasing similarity in industrial composition documented in [Section 2](#) is accompanied by increasing alignment of provincial priorities. [Figure 4](#) reports pairwise cosine similarity across the 43 policy sectors. For each province pair, the comparison uses

¹⁵Fundamental productivity and bilateral trade costs are held fixed when subsidies vary, so their log derivatives are zero. Under CES demand and Cobb–Douglas production, their effects on marginal responses are summarized by benchmark trade, cost, and income shares. National productivity remains endogenous, with its response governed by the scale elasticities and calibrated shares in national input pools. [Appendix C.1](#) derives the response system.

¹⁶For the redesigned priorities in [Section 6](#), I additionally search for profitable unilateral deviations from alternative starting policies and evaluate finite deviations. None is found, providing numerical support for global best responses; [Appendix E](#) reports these checks. [Ferrari and Ossa \(2023\)](#), following [Ossa \(2014\)](#), assess their numerical Nash equilibrium by repeating best-response iteration from different starting values.

sectors with recovered priorities in both provinces at every benchmark, holding the sector set fixed over time. The measure uses signed priorities and captures their alignment across industries, rather than the overall weight placed on industrial development relative to resident welfare. The mean inland–coastal cosine rises from 0.20 in 2007 to 0.34 in 2012 and 0.35 in 2017. Similarity increases in 76 percent of inland–coastal pairs between 2007 and 2012, so the rise in the average reflects a movement shared by most pairs. The principal change is a broad increase in alignment by 2012 that persists at the end of the sample. Inland and coastal provinces have therefore become more similar along two economically distinct dimensions: the composition of production and the composition of the objectives underlying local policy.

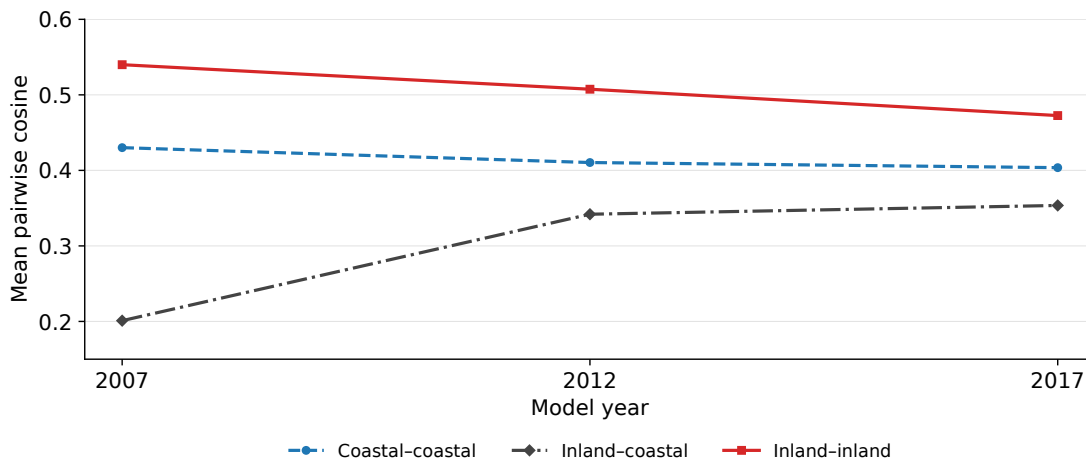


Figure 4: Similarity of provincial priorities across the 43 policy sectors

The within-region comparisons show how the alignment of provincial objectives changes within each group. Similarity among coastal provinces declines moderately, while similarity among inland provinces falls from a higher initial level. The initial distinction between inland and coastal sectoral priorities thus narrows even as priorities become less aligned within each group. Among provinces, their priorities continue to be heterogeneous, but the cross-region comparison shows a growing alignment in the activities governments want to develop. This pattern is consistent with governments sharing a broader industrial agenda while continuing to pursue different combinations of local activities. The manufacturing-only series also rises, Appendix F reports both series.

The ICT sector illustrates how priorities of different regions change. Its mean inland priority rises from 0.0023 in 2007 to 0.0080 in 2012 and 0.0179 in 2017, and its rank among inland sector means improves from fourteenth to fifth to third. The coastal mean falls from 0.0504 to 0.0332 over the same period, but remains above the inland mean. The regional difference therefore narrows through both higher inland priority and a lower coastal average. This finding adds an interpretation to the inland expansion shown earlier: conditional on

any changes in fundamentals, such as productivity catch up, inland governments place more weight on particular industries.

4.4 Priorities, development plans, and industrial growth

The recovered priorities can reflect several motives for provincial industrial support. Political-economy models such as [Grossman and Helpman \(1994\)](#) allow policy to depend on sectoral concerns as well as aggregate welfare. In China, GDP and promotion incentives may lead officials to place greater weight on industries that contribute to local economic performance, while national development goals can direct their attention toward particular industries. [Xiong \(2026\)](#) describes how central direction and local competition interact in an industrial tournament. Officials may also favor industries they expect to drive future growth, so the priorities recovered in this static model can reflect expectations about future economic performance.

These interpretations motivate comparisons with evidence outside the recovery. National Five-Year Plans identify industries consistent with the central agenda, while provincial plans record which industries individual governments designate for support. Prior growth indicates whether higher priorities are associated with an established record of local expansion. Subsequent growth shows whether those priorities are also associated with later development, conditional on past performance and observed subsidies. These comparisons help assess the economic interpretation of the weights without separately identifying the motives behind them.

National and provincial five-year plans. I treat national and provincial plans differently as they have different purpose. The national comparison asks whether provincial priorities align with national development objectives. The provincial comparison asks whether recovered priorities contain information about stated local objectives beyond observed subsidy rates. I match the Eleventh, Twelfth, and Thirteenth national Five-Year Plans to the 2007, 2012, and 2017 economies. A national support indicator equals one when an activity identified for development in the plan maps to the corresponding sector. I first regress recovered priorities, standardized within each benchmark year and set of industries, on the national support indicator, including province fixed effects. The coefficient measures the priority difference between nationally supported and unsupported industries in standard-deviation units, allowing the overall level of priorities to differ across provinces.

Nationally supported industries receive higher recovered priorities in all three economies (Table 1). Within manufacturing, the estimated difference is 0.39 standard deviation in 2007, 0.42 in 2012, and 0.45 in 2017. Across all 43 policy sectors, the corresponding differences

are 0.36, 0.44, and 0.39. The manufacturing point estimates suggest a modest increase in alignment with national plans over time. Across the broader set of industries, the association remains positive but does not increase steadily. The industries identified for development by the national government are also those for which provincial governments place greater value on local expansion beyond its contribution to resident welfare. National development objectives are therefore reflected in the priorities inferred from provincial subsidy choices and production outcomes.

Table 1: National Five-Year Plans and recovered priorities

Recovered priority (standard deviations)	2007	2012	2017
<i>Panel A: Manufacturing sectors</i>			
National FYP support	0.39** (0.15)	0.42*** (0.16)	0.45** (0.18)
Observations	868	865	866
<i>Panel B: All 43 policy sectors</i>			
National FYP support	0.36*** (0.10)	0.44*** (0.12)	0.39*** (0.10)
Observations	1,288	1,285	1,286
Province fixed effects	Yes	Yes	Yes
Sector-clustered standard errors	Yes	Yes	Yes

Notes: Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Provincial plans record each government’s choices about which industries to support. These choices can reflect both national development objectives and local economic conditions. Comparing provinces’ designations within the same industry and year allows me to examine whether recovered priorities correspond to these differences in stated objectives. It also makes it possible to assess whether recovering priorities adds information beyond observing subsidy rates directly. The CNRDS Industrial Policy Research Database records locally supported industries and the associated passages in provincial Five-Year Plans ([Chinese Research Data Services 2026](#)). I match the named activities to the model sectors and define $D_{os,t} = 1$ when a retained passage records local key support for sector s in province o . I regress the provincial support indicator on recovered priorities and observed subsidy rates, pooling the three benchmarks:

$$100D_{os,t} = b_{\vartheta}z_t(\vartheta_{os,t}) + b_{\tau}z_t(\tau_{os,t}) + \delta_{o,t} + \delta_{s,t} + \epsilon_{os,t}, \quad (28)$$

where z_t standardizes each predictor within year over the common estimation sample. Province-year fixed effects absorb differences in the overall propensity to designate industries, while

sector-year fixed effects absorb common industry-year patterns. The remaining variation compares provinces' industry designations after accounting for these differences. Including both priorities and subsidies asks whether a province's stated support is associated with the valuation inferred from its policy choices after accounting for the level of support itself. This comparison directly examines the economic distinction motivating the recovery: observed rates reflect both the desire to expand an industry and the equilibrium returns to doing so.

Table 2 shows that recovered priorities contain information about local objectives beyond observed subsidies. A one-standard-deviation higher priority is associated with a 3.68 percentage point higher probability of designation in a provincial plan in the priority-only specification and 3.66 points when subsidies are included. The observed subsidy coefficient is 1.11 points in the joint specification and is not statistically significant. The priority association changes little when the subsidy rate enters, indicating that it contains information about stated objectives beyond that contained in the subsidy rate. This result supports using the recovered weights to describe the objectives behind industrial policy when provinces face different economic opportunities and costs of intervention.

Table 2: Provincial Five-Year Plans, priorities, and subsidies

Provincial FYP support (percentage points)	(1)	(2)	(3)
Recovered priority (1 SD)	—	3.68** (1.44)	3.66** (1.41)
Observed subsidy rate (1 SD)	1.17 (0.77)	—	1.11 (0.76)
Province-year fixed effects	Yes	Yes	Yes
Sector-year fixed effects	Yes	Yes	Yes
Observations	3,847	3,847	3,847

Notes: The sample pools the 43 policy sectors in 2007, 2012, and 2017. Standard errors clustered by province and sector are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The two comparisons connect recovered priorities to national development objectives and to differences in provinces' stated industrial objectives. National plans describe a common direction for industrial development, while provincial plans record which industries individual governments choose to support. The positive relationship with provincial designations remains after accounting for common sector-year effects, so the correspondence extends beyond a shared national emphasis on particular industries. Neither plan indicator enters the recovery of priorities. Therefore, the relationships provide independent evidence that the recovered weights describe government development objectives.

This interpretation is consistent with evidence on how central direction and local incentives shape policy choices. Fang, Li, and Lu (2026) find that local industrial support reflects both

local economic conditions and upper-level policy priorities, with city policies becoming more closely aligned with provincial policies after 2013. The modest increase in the manufacturing coefficients reported here points to closer alignment between recovered provincial priorities and national plans. [Wang and Yang \(2025\)](#) show that local officials devote additional effort to centrally initiated policy experiments and that the central government’s interpretation of the results can affect the policies adopted nationwide. National direction can thus influence local choices, while local incentives and implementation can also influence national policy. Together, these two exercises clarify the information contained in the recovered priorities and support their economic interpretation as measures of government industrial objectives. They do not, however, explain how these priorities are formed. Modeling the formation of government objectives is beyond the scope of this paper.

Priorities and industrial growth. The plan comparisons connect recovered priorities to stated intentions. Manufacturing growth offers a complementary perspective on the industries receiving those priorities: do governments place greater weight on industries that have shown to expand faster in the past, and do the weights contain information about their subsequent development? These two comparisons address different aspects of policy selection. Prior growth describes the industrial performance associated with the government’s valuation at the benchmark. Subsequent growth indicates whether that valuation is also associated with later expansion after accounting for earlier performance. The prior-growth regression relates annualized log real value-added growth to the standardized priority, the log initial manufacturing share, and province and sector fixed effects. The subsequent-growth regression additionally controls for the observed subsidy rate and prior growth. The common specification distinguishes a priority’s relationship with past expansion from its additional association with later performance.

Priorities are higher in sectors with faster preceding growth (Table 3, Panel A). A one-standard-deviation higher priority is associated with 4.91 percentage points faster annual growth over 2002–05, 2.43 points over 2007–10, and 2.29 points over 2012–15. All three estimates are statistically significant. Thus, across each benchmark, the industries valued more highly by provincial governments tend to be those that have already expanded faster locally, conditional on their initial shares and the common province and sector effects. The relationship is consistent with governments placing greater weight on industries with an established record of local expansion. It connects the recovered objectives to a feature of industrial development that officials can observe when deciding which activities to support.

The relationship with subsequent growth is strongest for the 2007 benchmark. A one-standard-deviation higher 2007 priority is associated with 3.21 percentage points faster annual growth over 2008–11, conditional on subsidies, initial shares, and preceding growth. The later

Table 3: Recovered priorities and manufacturing growth

Benchmark year	2007	2012	2017
<i>Panel A: Prior annualized log real-VA growth (p.p.)</i>			
Growth window	2002–05	2007–10	2012–15
Recovered priority (1 SD)	4.91 ^{***} (1.57)	2.43 ^{***} (0.78)	2.29 ^{**} (0.91)
Observations	866	861	853
<i>Panel B: Subsequent annualized log real-VA growth (p.p.)</i>			
Growth window	2008–11	2013–16	2018–21
Recovered priority (1 SD)	3.21 ^{**} (1.22)	0.91 (0.62)	0.28 (0.36)
Observed subsidy rate (p.p.)	0.004 (1.98)	0.33 (0.65)	0.45 (0.34)
Observations	850	854	844
Province and sector fixed effects	Yes	Yes	Yes
Log initial VA share	Yes	Yes	Yes
Prior growth in Panel B	Yes	Yes	Yes

Notes: Standard errors clustered by province are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

coefficients are positive but smaller and statistically insignificant. None of the subsidy coefficients is statistically significant in these conditional specifications. The distinction between the two panels matters for interpreting what the weights imply. Their relationship with prior industrial performance appears across all three benchmarks, while additional information about subsequent growth appears most clearly in the early period. The growth evidence therefore provides a consistent connection between priorities and industries' development histories, with a less uniform relationship to their later expansion.

These growth relationships can reflect the accumulated effects of earlier support, governments' responses to industrial performance, and expectations about future opportunities. They are conditional associations and do not identify the causal effect of changing a government's objective. Together, the evidence connects the recovered valuations to national policy direction, provincial industry choices, and the development of local industries. It also clarifies the question that remains for the welfare analysis. The expansion of a highly valued local industry can raise national productivity, draw resources away from other activities, and require fiscal resources from residents. Neither the government's willingness to support it nor its observed growth establishes the balance of these effects. The next section first removes observed subsidies and then changes the objectives themselves, allowing governments to choose new support schedules and evaluating the resulting consequences for production and national welfare.

5 Priorities, Production, and Welfare

This section examines how provincial industrial priorities affect production and welfare. I first remove observed subsidies to assess their contribution to national welfare. I then remove sectoral priorities and allow provincial governments to choose new subsidies solely to maximize resident welfare. Both experiments lower national welfare, but the loss is smaller when governments can choose new subsidies to maximize resident welfare. Removing priorities also shifts support away from manufacturing, reducing activity in industries that generate national productivity spillovers. The results suggest that observed priorities partly offset provincial governments' limited incentives to support production whose benefits extend beyond their borders. I then examine the mechanisms behind these effects and their relationship to industrial similarity.

I compute the counterfactual equilibria in exact changes relative to each benchmark, following [Dekle, Eaton, and Kortum \(2008\)](#) and [Caliendo and Parro \(2015\)](#). The system uses benchmark expenditure shares and calibrated parameters. A hat denotes the ratio of a counterfactual value to its benchmark value. Appendix [B.4](#) presents the exact-change system.

Each experiment holds fundamental productivity, trade costs, preferences, and provincial factor endowments fixed. The set of active province–industry pairs also remains unchanged. I hold trade imbalances D_o fixed in nominal terms in the external numeraire, together with foreign supply prices and foreign expenditure on each Chinese sectoral composite. Wages, rents, prices, trade flows, sectoral allocations, and national productivity adjust in equilibrium. National welfare is the geometric average of provincial welfare with fixed baseline value-added weights,

$$\widehat{\mathcal{W}} = \exp \left(\sum_o \omega_o \log \widehat{W}_o \right), \quad \omega_o = \frac{\sum_s (1 - \gamma_s) B_{os}^b}{\sum_{r,s} (1 - \gamma_s) B_{rs}^b}. \quad (29)$$

Here superscript b denotes the benchmark, and reported welfare changes equal $100(\widehat{\mathcal{W}} - 1)$. I also report aggregate real value added, the sum of provincial factor incomes deflated by provincial consumption prices. This measure records real factor earnings before subsidy financing. Resident welfare also accounts for subsidy payments and trade imbalances. The two national measures differ in aggregation as well: real value added sums provincial amounts, while the welfare index aggregates proportional changes using fixed weights. Appendix [D](#) provides the aggregation and welfare-accounting formulas.

5.1 Removing subsidies

The first experiment sets every subsidy rate to zero and solves for the resulting competitive equilibrium. This experiment compares competitive equilibria under the observed and zero-

subsidy schedules; it does not solve a new government policy problem. Households no longer finance subsidies, while firms lose the reimbursement of their input costs. Changes in production then affect factor earnings, consumer prices, and the national input pools that determine industry productivity.

Table 4: Removing all subsidies

Change from observed economy	2007	2012	2017
National welfare (percent)	−0.406	−0.250	−0.267
Aggregate real value added (percent)	−2.920	−2.349	−2.639
Largest provincial welfare loss (percent)	−0.968	−0.898	−1.027
Largest provincial welfare gain (percent)	+0.064	+0.281	+0.694
Manufacturing similarity (percent change)	−0.59	−0.23	−0.71
Provinces gaining in welfare	4/30	4/30	5/30

Removing subsidies lowers national welfare by 0.41 percent in 2007, 0.25 percent in 2012, and 0.27 percent in 2017 (table 4). Aggregate real value added falls by 2.92, 2.35, and 2.64 percent, respectively. Most provinces lose under this counterfactual: only four gain in 2007 and 2012, and five gain in 2017. The benefits of the observed subsidies therefore extend across much of the country, even though each province finances its own support.

The welfare result depends on national external economies of scale. Holding productivity fixed, removing the same policies raises welfare. When productivity responds, however, the contraction in manufacturing input use reduces national industry scale and lowers productivity throughout the affected industries. These losses outweigh the gains from removing subsidies. Calibrated scale elasticities are positive in 25 manufacturing industries. Other industries respond through intermediate demand, input prices, and factor markets.

Removing subsidies also reduces average inland–coastal manufacturing similarity by 0.59 percent in 2007, 0.23 percent in 2012, and 0.71 percent in 2017. The observed policy schedule therefore supports both greater manufacturing scale and a more similar industrial composition across inland and coastal provinces. The declines in 2007 and 2012 are approximately 30 percent of the average annual increase in similarity over the following five years.¹⁷

5.2 Removing sectoral priorities

The second experiment removes sectoral priorities while allowing governments to continue using subsidies. Setting $\vartheta_{os} = 0$, each government maximizes $\log W_o$, taking other provinces’ policies as given and anticipating the national productivity response to its decisions. In this

¹⁷I compare a static counterfactual with the observed pace of change, using the same 29 manufacturing sectors and 209 inland–coastal pairs at both endpoints.

counterfactual, I restrict provincial governments to nonnegative subsidies, $\tau_{os} \in [0, 1)$. This restriction reflects the greater central control over taxes relative to subsidies in China. I focus on 2012, when all observed rates in the policy sectors satisfy the nonnegativity restriction. The resulting policy profile satisfies the local Nash conditions described in Appendix C.

Removing priorities lowers national welfare by 0.10 percent, even though aggregate real value added rises by 0.32 percent. Governments increase total subsidy spending but redirect support from manufacturing toward nonmanufacturing.

Manufacturing receives 46.53 percent of observed subsidy expenditure but only 14.96 percent under welfare-only provincial objectives. The share going to the five priority industries falls from 19.91 to 0.33 percent, while the coastal share rises from 54.53 to 67.31 percent (table 5). Nominal subsidy spending increases from 2.10 to 2.51 percent of baseline factor income. Governments continue to find local benefits from subsidizing production, but place much less of their support in manufacturing.

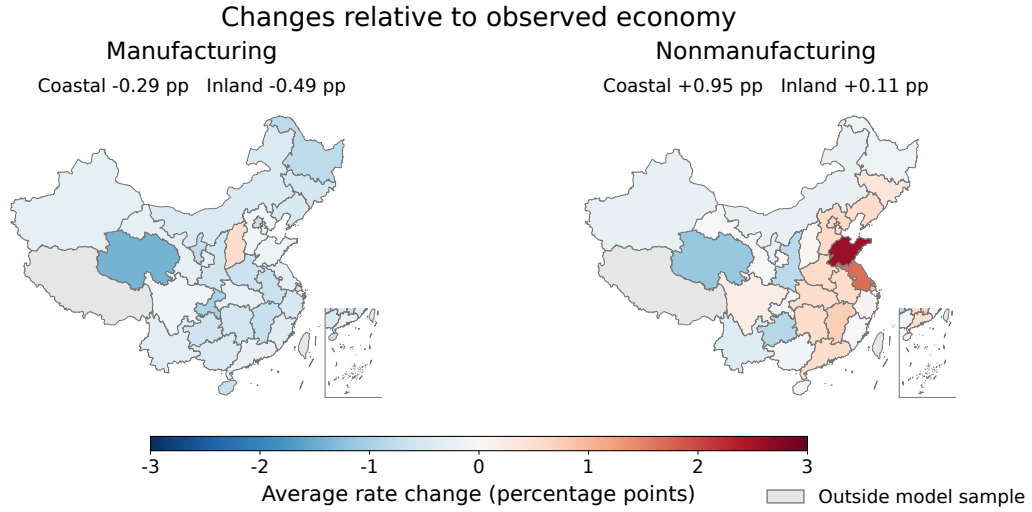
Table 5: Removing priorities reallocates subsidy expenditure, 2012

	Observed	Welfare-only Nash
<i>Share of subsidy expenditure (percent)</i>		
Manufacturing	46.53	14.96
Five priority industries	19.91	0.33
Coastal provinces	54.53	67.31
Total expenditure / baseline factor VA (percent)	2.10	2.51

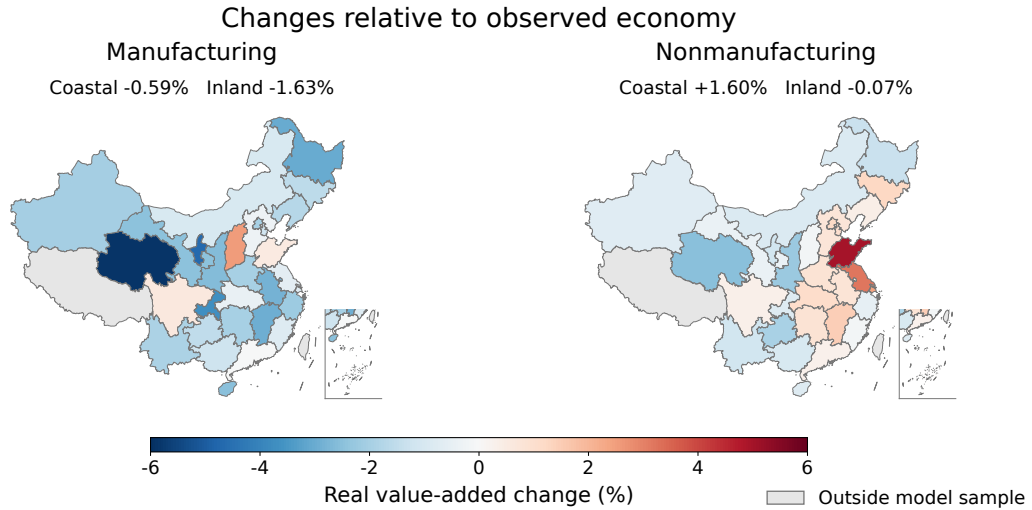
Notes: The five priority industries are communication equipment, transport equipment, pharmaceuticals, special machinery, and general machinery.

Figure 5 shows that manufacturing support falls more inland, while the increase in nonmanufacturing support is concentrated on the coast. Workers and fixed factors reallocate between industries within each province. Manufacturing real value added falls by 0.59 percent on the coast and 1.63 percent inland. Nonmanufacturing real value added rises by 1.60 percent on the coast and is approximately unchanged inland, falling by 0.07 percent. Nationally, manufacturing contracts by 0.94 percent and nonmanufacturing expands by 0.90 percent, shifting activity away from industries that generate national productivity spillovers.

Despite the manufacturing contraction, the inland–coastal manufacturing cosine rises slightly, from 0.5780 to 0.5821. Provinces become more similar in their relative industrial composition while manufacturing real value added falls. Removing priorities therefore differs from eliminating subsidies: governments replace the observed support with a new policy schedule, and the resulting industrial composition is slightly more similar even though national welfare falls.



(a) Changes in subsidy rates, percentage points



(b) Changes in real value added, percent

Figure 5: Removing priorities reallocates support and production, 2012

Notes: Changes are relative to the observed economy. Nonmanufacturing subsidy rates cover 14 policy sectors; nonmanufacturing value added covers all 18 sectors. Gray areas are outside the sample.

The welfare losses are larger inland, where the withdrawal of manufacturing support is stronger (figure 6). Coastal welfare falls by 0.06 percent and inland welfare by 0.15 percent, compared with losses of 0.19 and 0.33 percent when all subsidies are removed. Eight provinces gain under priority removal, compared with four under subsidy removal, and provincial changes range from a loss of 0.92 percent to a gain of 0.52 percent. Allowing governments to choose new subsidies reduces the welfare losses relative to eliminating subsidies, but inland provinces remain particularly exposed to the withdrawal of manufacturing priorities.

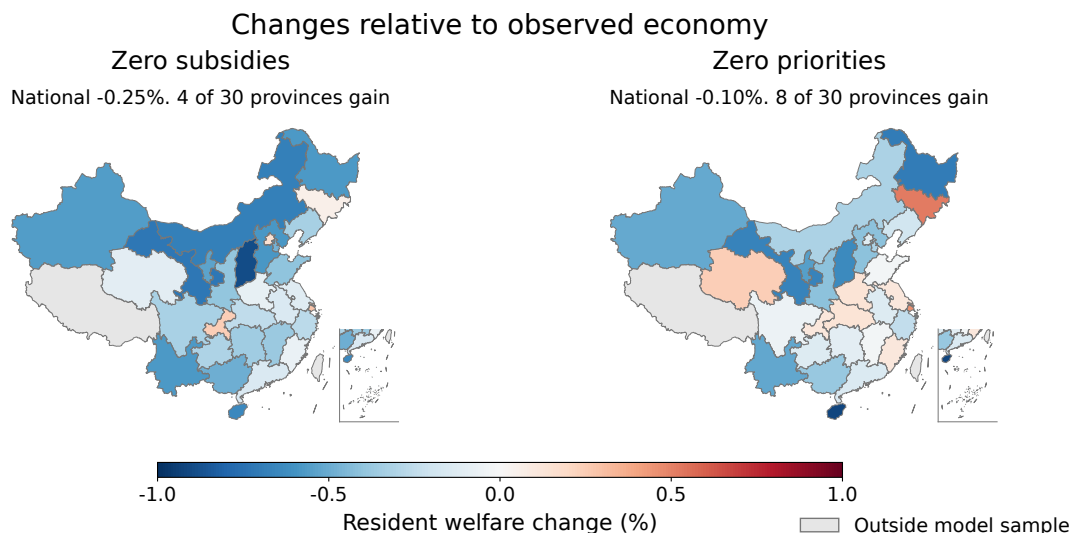


Figure 6: Provincial welfare effects of removing subsidies and priorities, 2012

Notes: Percent changes in resident welfare relative to the observed economy. The left panel removes subsidies; the right panel removes sectoral priorities.

5.3 National scale and the welfare consequences of reallocation

The national welfare loss from removing priorities reflects the benefits of industrial production that extend beyond the supporting province. A provincial government accounts for national productivity effects only through their consequences for its own residents. Expanding a manufacturing industry can also benefit producers and buyers elsewhere, while the province finances the subsidy locally. The observed priorities give provincial governments an additional incentive to sustain manufacturing activity. Removing these priorities weakens that incentive even though each government continues to value the productivity gains received by its own residents.

The observed allocation delivers higher national welfare than either eliminating subsidies or removing sectoral priorities. The observed priorities sustain production that raises national welfare relative to welfare-only provincial competition, but this result does not establish

that their current composition is optimal. The next section asks whether a different set of provincial priorities can improve national welfare within existing fiscal resources.

6 Designing Provincial Priorities

Results in the previous section establish that recovered provincial priorities sustain manufacturing activity whose national productivity benefits contribute to welfare. They also leave a central policy question unanswered: could a different set of priorities direct the same fiscal resources toward an allocation with greater national benefits? The value of maintaining industrial support and the value of its current composition are separate questions. To examine the latter, I preserve the instruments, local financing arrangements, and real subsidy budgets available to provincial governments and ask how their objectives can be redesigned to improve national welfare. The exercise proceeds from allocation to incentives. I first select a coordinated subsidy schedule under these constraints, then construct the redesigned priorities that support it as a Nash equilibrium. This connects the national gains from reallocating support to the local government objectives needed to realize them. In what follows, I refer to the priorities inferred from observed policy as “recovered priorities” and those constructed to implement the constrained-efficient allocation as “redesigned priorities.”

6.1 A constrained national policy benchmark

The constrained-efficient allocation provides a benchmark for assessing the composition of observed support. I use the 2012 economy and evaluate the welfare of residents throughout China with the criterion

$$G(\boldsymbol{\tau}) = \sum_o \omega_o \log W_o(\boldsymbol{\tau}), \quad (30)$$

with the same fixed weights as in [equation \(29\)](#). The national planner chooses provincial subsidy rates subject to competitive equilibrium, the nonnegative rate bounds, and a separate real-spending constraint for each province:

$$\max_{\boldsymbol{\tau}} G(\boldsymbol{\tau}) \quad \text{subject to} \quad F_o(\boldsymbol{\tau}) \equiv \frac{\sum_s \tau_{os} B_{os}(\boldsymbol{\tau})}{P_o^c(\boldsymbol{\tau})} \leq F_o(\boldsymbol{\tau}^b), \quad o \in \mathcal{R}. \quad (31)$$

The numerator is total provincial subsidy expenditure, evaluated at the production levels induced by the policy schedule. Deflating by the provincial consumption price index measures the purchasing power of this expenditure. Each right-hand side is its observed value, so an expansion of the economy does not itself relax the budget and fiscal capacity cannot be transferred from one province to another. The planner therefore reallocates support within

each province’s observed real subsidy expenditure, while valuing welfare across all provinces. The resulting subsidy schedule τ^* implements the constrained-efficient allocation of the observed fiscal resources.¹⁸

The computed subsidy schedule satisfies the first-order and constrained second-order sufficient conditions. Optimization from alternative starting schedules, including zero, uniform, and randomized subsidies, converges to the same policies and welfare within numerical tolerance. These checks provide numerical support for global optimality. Appendix E describes the calculations.

Table 6: Priority redesign within observed provincial real budgets, 2012

	Change from observed economy
National resident welfare	+1.121
Aggregate real value added	+1.098
Real spending in every province	0.000
Smallest provincial welfare gain	+0.568
Largest provincial welfare gain	+1.613
Provinces gaining in welfare	30/30

Notes: Changes are in percent, except the number of provinces gaining.

The constrained-efficient equilibrium raises national resident welfare by **1.12 percent** and aggregate real value added by **1.10 percent** (table 6). Every fiscal constraint binds, so real subsidy spending remains at its observed level in each province. The welfare improvement comes from changing the uses of existing support and the equilibrium responses that follow. The benefits extend to all 30 provinces, with improvements ranging from 0.57 to 1.61 percent. National industry scale and trade linkages transmit the effects of the reallocation beyond the provinces and sectors whose own support expands. The result shows that reallocation within observed provincial budgets can improve welfare throughout the country without transferring fiscal resources across provinces.

6.2 Redesigning provincial priorities

A nationally desirable subsidy schedule becomes relevant to decentralized policy only if provincial governments have incentives to choose it. Having selected τ^* , I therefore return policy choice to the provinces and use the same recovery procedure to construct redesigned

¹⁸Appendix E.2 gives a separate decentralization result for the domestic model. If a finite first-best allocation with positive quantities and regular positive supporting prices exists, corrective subsidies and balanced interprovincial lump-sum transfers can implement it when all required subsidies are available and fiscal ceilings are absent.

priorities ϑ_o^* satisfying each province's first-order conditions at τ^* ,

$$a_o(\tau^*) + \mathcal{B}_o(\tau^*)\vartheta_o^* = 0. \quad (32)$$

Here a_o collects the unilateral derivatives of log resident welfare and $\mathcal{B}_o$ collects the derivatives of local sectoral log real value added, as in the recovery exercise. The derivatives are evaluated at τ^* , holding other provinces' policies fixed. The redesigned priorities make the government's additional valuation of changes in local industry offset the resident-welfare incentive to move away from the constrained-efficient subsidy schedule. The inversion thus translates the coordinated allocation into the sectoral objectives that induce each province to choose its part of the policy schedule.

Choosing the subsidy schedule centrally and implementing it through provincial objectives involve different fiscal constraints. The national planner selects a schedule within each province's observed real budget, but a provincial government assessing a deviation can change both its subsidy composition and its total spending under the original local financing rule and rate bounds. The redesigned priorities must therefore induce each province to choose its constrained-efficient subsidies. The first-order and second-order conditions for each province's full subsidy vector establish strict local optimality for all 30 governments. Unilateral optimization from alternative starting schedules and checks of finite deviations find no profitable deviation. Sequential provincial policy adjustment from the observed profile and a perturbed subsidy schedule also returns to a neighborhood of τ^* . Together, these checks provide numerical support for global best responses and implementation as a Nash equilibrium.

To understand the role of the redesigned priorities, we can compare national and provincial incentives. Let

$$h_{ok} = \sum_{r \neq o} \omega_r \frac{\partial \log W_r}{\partial \tau_{ok}}$$

denote the welfare effect of province o 's sector- k policy on residents elsewhere, and let λ_r be the shadow value of province r 's real fiscal capacity. On an interior policy coordinate, national and provincial stationarity imply

$$\omega_o \sum_s (\mathcal{B}_o)_{ks} \vartheta_{os}^* = h_{ok} - \sum_r \lambda_r \frac{\partial F_r}{\partial \tau_{ok}}. \quad (33)$$

The right-hand side identifies the national incentive absent from the province's resident-welfare objective. Supporting local production can improve welfare elsewhere, but securing those benefits can also use scarce fiscal capacity across the country. A policy that expands another province's subsidy base increases its expenditure at unchanged rates, while a change in

consumption prices alters the real value of that expenditure. All provincial fiscal constraints therefore enter the adjustment. The left-hand side shows how the redesigned priorities supply the resulting incentive through the government’s valuation of local activity. Appendix E gives the corresponding expression at policy bounds.

This identity also explains why the reform requires a vector of sectoral objectives. A subsidy to one industry affects other local industries through intermediate demand and competition for workers and fixed factors. Its additional value to the government consequently depends on the priorities attached to all the activities that respond, as summarized by the relevant row of the activity-response matrix. The desired incentive cannot generally be assigned by looking only at the supported industry’s own expansion or scale elasticity. The inversion selects a redesigned priority vector for each province, taking these joint responses into account.

6.3 How priorities and production change

I next compare the redesigned priorities with the recovered priorities and examine the associated changes in production. Figure 7 presents the four largest increases and four largest decreases in mean sectoral priorities. Each point is a province, and the right-hand column reports the sector’s national real-value-added change under the joint reform. The redesign raises priorities for several industries supplying basic manufactured inputs and reduces priorities in a range of manufacturing and nonmanufacturing activities. Comparing provinces within each industry helps distinguish a common national direction from the local strength of the incentive needed to implement it: the changes frequently have the same sign across provinces, while their magnitudes vary with provincial production and trade conditions.

Chemicals, nonferrous metals, paper, and petroleum processing have the largest mean increases. Chemical priorities rise in 29 of 30 provinces, nonferrous-metal priorities in all 30, paper priorities in 28 of 29 active provinces, and petroleum-processing priorities in all 30. Their national real value added increases by 14.14, 22.01, 17.80, and 20.66 percent, respectively. These industries supply manufactured intermediate inputs used elsewhere in production, so their expansion has consequences for the costs and scale of downstream activity. Within the fixed budgets, subsidy expenditure is reallocated toward them. Mean priorities decline in agriculture, transport services, transport equipment, and nonmetallic minerals, among other sectors. The joint reform therefore changes both the industries receiving higher priorities and the activities from which resources are reallocated.

The redesigned priorities remain closely related to the recovered priorities: across the 1,285 active cells, their level correlation is 0.976. That close association coexists with a systematic

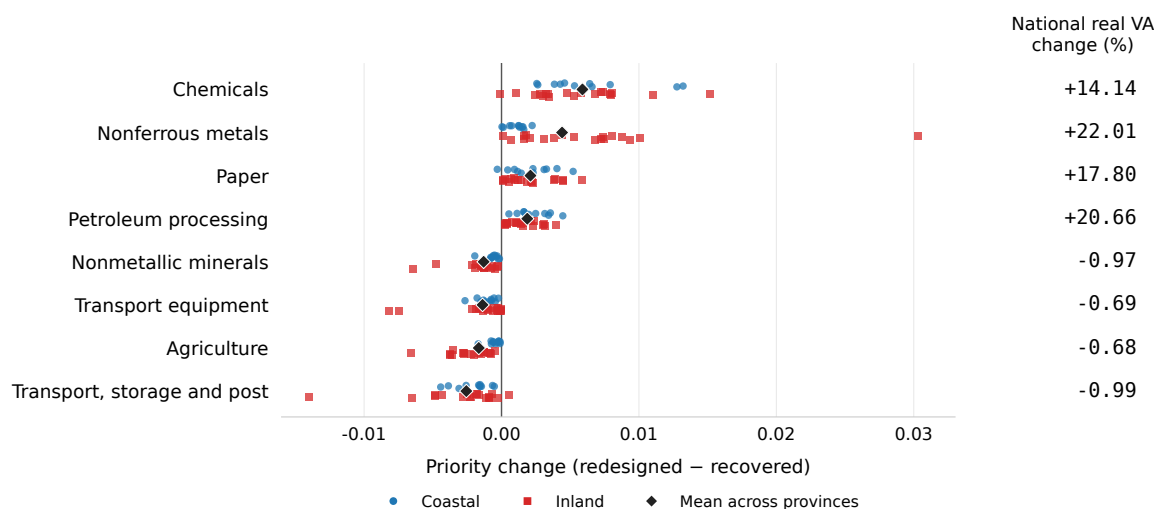


Figure 7: Recovered and redesigned provincial priorities, 2012

Notes: Points represent provinces; diamonds show sector means. The industries shown have the largest positive and negative mean priority changes. Value-added changes are under the full reform.

reorientation, with 948 priorities declining and 337 rising. These changes matter because the government chooses its entire subsidy schedule in response to its objective, and each policy affects the returns to supporting other activities. The correlation describes continuity with the recovered priorities, while the sectoral changes show how the reform redirects support toward the constrained-efficient allocation.

The expansion of basic manufactured inputs suggests that an industry's position in the production network helps organize the redesign. An upstream supplier reaches final users through several stages of intermediate production, giving changes in its costs a route through the domestic network. Figure 8 examines this pattern by relating priority changes and national real-value-added growth to domestic upstreamness, measured as the expected number of production stages before final use following Antràs, Chor, Fally, and Hillberry (2012). The measure uses all 47 industries and their domestic input-output sales, with exports entering terminal demand. The figure displays the 29 manufacturing industries, giving each industry equal weight and averaging its priority change equally across active provinces.

Both priority adjustments and real-value-added growth are positively associated with upstreamness. The correlation between mean priority changes and upstreamness is 0.61 and remains positive when chemicals and nonferrous metals are omitted, showing that the association extends beyond the two most prominent increases. The reform increases the importance of industries that supply inputs through longer domestic production chains. Their expansion changes intermediate demand and transmits productivity gains through domestic supply relationships. Upstreamness describes this common feature of the jointly

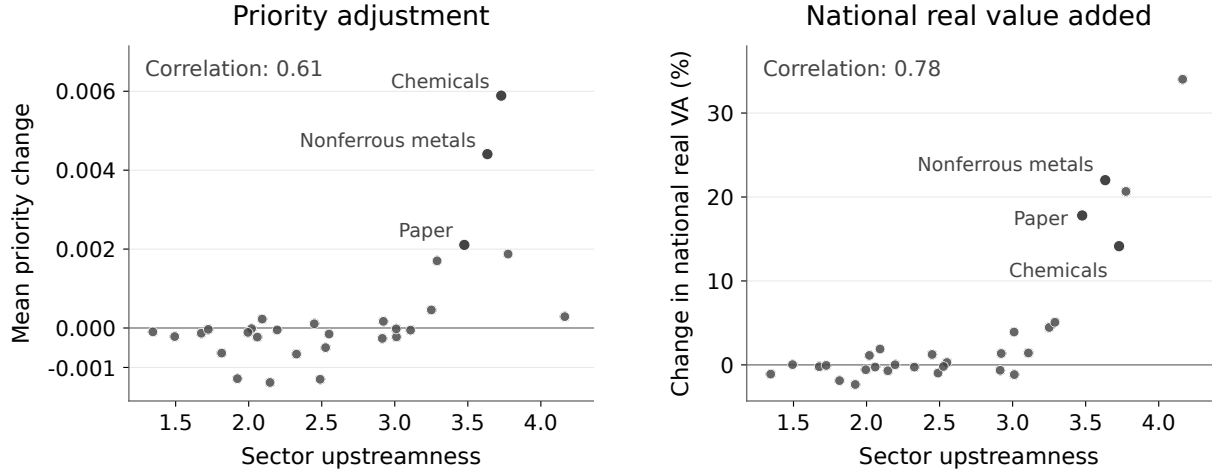


Figure 8: Priority redesign and the position of manufacturing industries in production
Notes: Each point represents a manufacturing industry. Changes compare the constrained-efficient equilibrium with the observed 2012 economy.

chosen sectoral adjustments. The redesigned priorities also reflect scale elasticities, provincial conditions, fiscal costs, and the equilibrium responses summarized in the incentive identity.

The welfare gains coexist with little change in the average similarity of provincial industrial composition. In the constrained-efficient equilibrium, the inland-coastal manufacturing cosine increases only slightly, from 0.5780 to 0.5800, even though sectoral activity changes substantially. Several expanding upstream industries increase their composite inputs in every province with active production, and the resulting growth in their national input pools raises productivity. Provincial factor scarcity, market access, and bilateral trade conditions determine the size of each province's response. The reform therefore changes production levels and national industry scale while leaving the average similarity of provincial industry mixes almost unchanged. Its welfare gains come from which industries expand, the productivity benefits they generate, and the resources used to support them.

6.4 The value of fiscal capacity

The fiscal comparison shows how additional public resources can increase the gains from reallocating existing support. Allowing each provincial real budget to rise by 25 percent increases the welfare gain to 1.385 percent, with all provinces again benefiting. The fixed-budget reform therefore delivers most of this improvement using existing resources. Removing the fiscal ceilings raises welfare by 4.205 percent, but real subsidy spending then exceeds nine times its observed level (Appendix E). These larger gains require a much greater commitment of household resources to industrial support.

7 Conclusion

This paper provides a framework to recover provincial governments' industrial priorities from observed subsidies and production. Subsidy rates alone do not measure these priorities because they also reflect differences in economic fundamentals and the returns to industrial support. A spatial political economy model accounting for trade, production networks and national external economies of scale allows me to recover the additional value governments attach to local sectoral development through a revealed-preference approach.

I find that the recovered priorities become more aligned between inland and coastal provinces, indicating that their governments have become more similar in the industries they want to develop. Higher priorities in industries identified for development in national Five-Year Plans connect provincial objectives to a common development agenda. Comparing these priorities with provincial Five-Year Plans, I find that a one-standard-deviation higher priority is associated with a 3.66 percentage point higher probability that an industry is designated for support, even after controlling for observed subsidy rates. Because neither national nor provincial plans enter the recovery, these relationships support interpreting the recovered priorities as government development objectives. Priorities are also higher in industries with stronger preceding growth, consistent with governments placing greater weight on activities that have expanded faster locally in the past few years.

In the model, provinces finance subsidies locally, while national external economies of scale, trade and production networks allow local industrial expansion to benefit residents in other provinces. I find that the recovered priorities partly offset provincial governments' limited incentives to support industries whose benefits extend beyond their borders. Giving additional weight to local industrial development helps sustain manufacturing activity that receives less support when governments maximize their residents' welfare alone. These results suggest that increasing similarity in industrial composition need not imply wasteful duplication. Assessing provincial industrial policies requires accounting for the national benefits and costs of the activities they support.

The composition of provincial priorities can nevertheless be improved. I show that redesigned priorities implement a constrained-efficient allocation that raises national welfare by 1.12 percent in 2012, benefits all 30 provinces, and keeps each province's real subsidy spending at its observed level. Support shifts toward several upstream manufacturing industries, whose productivity gains reach other industries through intermediate inputs. This reallocation improves welfare with little change in average industrial similarity. The exercise shows how changing provincial objectives can give local governments incentives to choose policies with greater national benefits while retaining local policy choice and financing.

The analysis leaves several questions for future research. The model is static, so the recovery does not distinguish governments' valuation of current industrial activity from their expectations about its future benefits. A dynamic extension with investment, learning, and adjustment costs could examine how provincial policies shape comparative advantage over time. The model also takes provincial objectives as given. Studying how central authorities influence these objectives through development plans, personnel decisions, and fiscal transfers would help explain how redesigned priorities could be implemented in practice.

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A Data Construction and Empirical Specifications

A.1 Province and sector coverage

The production panel and quantitative model cover 30 provincial-level regions, excluding Tibet. The coastal group consists of Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan. The remaining nineteen provinces form the inland group. There are 55 unordered coastal–coastal pairs, 171 inland–inland pairs, and 209 inland–coastal pairs, for a total of 435 distinct pairs. Regional and pairwise averages give equal weight to each province or pair, respectively.

Annual industrial data are harmonized to a broad classification based on the 2002 industries. Removing mining yields the 29-sector manufacturing sample used in the descriptive production and growth comparisons. The quantitative classification contains 47 sectors. Four public-service sectors are excluded from provincial sectoral objectives: water, environment and public facilities, education, health and social work, and public administration and social security. All 47 sectors enter the economy’s production, expenditure, and market-clearing accounts. The recovered-priority and provincial-plan comparisons cover the remaining 43 policy sectors, including manufacturing and nonmanufacturing activities. The active set contains industries with positive baseline production and is held fixed within each experiment. There are 1,288, 1,285, and 1,286 active policy cells in 2007, 2012, and 2017, respectively.

A.2 Constructed real value added

The annual production series uses operating revenue from the China Industry Statistical Yearbook, with industrial sales used when operating revenue is unavailable. Publication year $t + 1$ is assigned to economic year t . After harmonizing industry names and classification changes, constructed real value added is

$$\widetilde{VA}_{ost} = \frac{\text{Revenue}_{ost}}{PPI_{st}} \nu_s^{2007}, \quad \nu_s^{2007} = \left(\frac{VA_s}{Y_s} \right)_{\text{national IO, 2007}}. \quad (\text{A.1})$$

The national sectoral producer-price index is expressed as a price ratio. The first economic year, 2000, uses the 2001 index, the first year of the chained series. When several detailed input-output industries map to one empirical sector, ν_s^{2007} is their summed value added divided by summed gross output. The common coefficient converts sectoral revenue to value added while preserving relative revenue across provinces within the same industry. It holds the sectoral value-added/output ratio fixed across provinces and dates.

Some industries appear separately only in later yearbooks. The harmonization retains

reported detailed revenues and allocates the difference between reported provincial total revenue and the sum of reported detailed industries across the unreported categories. Allocation weights are proportional to predicted revenue from a pooled regression of log revenue on $\log(\text{Employment} + 1)$ and industry fixed effects, estimated where the relevant industries are observed. Unavailable employment entries take the value zero in this predictor. The published total determines the amount allocated. Fitted revenue determines its distribution. Any remaining discrepancy when all candidate industries are reported remains an unallocated residual. Deflation and the input-output conversion follow this step.

The descriptive periods are 2000–02, 2003–05, 2006–08, 2009–11, 2012–14, and 2015–18. Provincial sectoral shares are computed after averaging real value added within each period. The final period contains 2015, 2016, and 2018. 2017 is not interpolated. The activity series extends beyond 2018 for the subsequent-growth regressions. Empirical constructed real value added uses producer-price deflation, whereas model real value added is factor income deflated by the provincial consumption price index.

A.3 Similarity measures

Let $\widetilde{V}A_{os,p}$ denote constructed real value added in province o and sector s , averaged over period p . The manufacturing-share vector is

$$x_{os,p} = \frac{\widetilde{V}A_{os,p}}{\sum_{j \in \mathcal{M}} \widetilde{V}A_{oj,p}}, \quad \mathbf{x}_{o,p} = (x_{os,p})_{s \in \mathcal{M}}, \quad (\text{A.2})$$

where $\mathcal{M}$ contains the 29 manufacturing industries. Similarity between two vectors is measured by the cosine in equation (1).

The fixed coastal benchmark is constructed in three steps. First, real value added is averaged over 2006–08 separately for each province and manufacturing sector. Second, these averages are converted to provincial manufacturing shares. Third, the eleven coastal share vectors are averaged with equal province weights. Every subsequent provincial vector is compared with this same benchmark. The regional lines in Figure 3 average the resulting provincial cosines equally. Pairwise production cosines instead compare two provincial vectors in the same period. Both measures use the 29 manufacturing sectors and equation (1).

For priority similarity, the vectors contain signed recovered priorities. The sector set for each pair is the intersection of sectors active in both provinces at all three benchmark dates. Holding this intersection fixed prevents changes in estimated sector coverage from changing the comparison across years. The main figure uses the 43 policy sectors, and Appendix Table F.2 also reports manufacturing. Signed priorities permit negative cosines in principle.

A cosine measures alignment and is invariant to a common positive scaling of either priority vector.

The scale-elasticity comparison in Figure F.6 divides manufacturing at the median calibrated elasticity, 0.14. Fourteen industries have $\phi_s > 0.14$ and fifteen have $\phi_s \leq 0.14$. Both the provincial vector and the fixed coastal benchmark are restricted to the same group before calculating its cosine. The all-manufacturing series is identical to the inland series in Figure 3.

A.4 Fiscal support in the China Tax Survey

The China Tax Survey reports subsidy income, domestic VAT refunds, VAT reductions, business-tax relief, corporate-income-tax relief, and corporate-income-tax credits. The questionnaire fields are harmonized separately by year. Subsidy income includes VAT refunds, while a separate field also records those refunds. Let C_{it} denote reported subsidy income and V_{it} separately reported domestic VAT refunds. For nonnegative reports I use $\max\{C_{it}, V_{it}\}$ to avoid adding overlapping amounts. Other separately reported relief and credit components are then added. Ordinary export VAT refunds and the separate VAT loan-repayment rebate are excluded.

For the quantitative analysis, the signed construction retains reported reversals and adjustments. Its subsidy-income/VAT term is

$$\max\{C_{it}, V_{it}, 0\} + \min\{C_{it}, V_{it}, 0\}. \quad (\text{A.3})$$

The remaining relief components enter with their reported signs, and missing component fields enter as zero. For nonnegative observations, equation (A.3) reduces to the maximum rule. This rule treats the two reports as overlapping to the greatest extent consistent with their recorded amounts. It is a measurement convention for reconciling overlapping reports. Ordinary tax payments are not deducted from support.

One report is retained per normalized taxpayer identifier by selecting the record with the most complete relevant fields, then the largest output, then the earliest source row. Firms must have mapped province and sector codes and positive finite output. When revenue is positive and the output/revenue ratio is finite, that ratio must lie between 0.001 and 1,000. Other records are retained only if output is no more than 10,000 times the sector median among records with positive revenue and a finite output/revenue ratio. The national median supplies the fallback when necessary.

The upper-tail screen excludes firms above the annual-sector ninety-ninth percentile of positive nonnegative-support/output ratios. A national cutoff is used when a sector has fewer

than fifty positive observations. Annual province-sector cells must also have a nonnegative support/output ratio no larger than 20 percent. These screens determine the retained sample. Signed support is then calculated on the same observations, without a separate negative-tail deletion.

For each model policy window, support and output are summed across retained firms and years before constructing their ratio. The model’s effective subsidy expresses this payment relative to the gross input bill, as specified in Section 4. The observed signed policy wedges range from -0.003876 to 0.159007 . Twelve active policy cells without retained pooled observations receive zero rates in the structural inputs and remain explicitly flagged as imputed. Four occur in 2007: Shanxi tobacco, Inner Mongolia cultural and sporting goods, Gansu tobacco, and Qinghai cultural and sporting goods. Eight occur in 2017: chemical fibers in Beijing and Shanxi, cultural and sporting goods and chemical fibers in Inner Mongolia, tobacco in Jiangxi, measuring instruments in Hainan, and cultural and sporting goods and chemical fibers in Ningxia. These cells are excluded from the observed-rate sample used in the provincial-plan regressions. This preserves the distinction between an observed zero subsidy and an unavailable policy observation.

Figure 2 uses the nonnegative support measure and positive survey revenue. Its right panel divides regional support by revenue times the fixed national 2007 ICT value-added/output coefficient, using the retained province-sector eligibility and original support/output screens. Its left panel uses the separate industry-yearbook measure of the regional ICT share in manufacturing. Both panels aggregate amounts before taking ratios.

A.5 Benchmark timing

Table A.1 records the input windows behind the three benchmark labels. Manufacturing activity is averaged around the input-output benchmark, while nonmanufacturing activity comes from the benchmark accounts. The 2017 policy vector uses the latest available survey window, 2015–16. These assignments also determine the interpretation of the surrounding growth windows.

Table A.1: Input windows for the benchmark economies

Benchmark	Manufacturing activity	Input-output table	Policy window
2007	Mean, 2006–08	2007	Pooled, 2007–08
2012	Mean, 2011–13	2012	Pooled, 2011–13
2017	Mean, 2015, 2016, 2018	2017	Pooled, 2015–16

A.6 National-plan designations

The national-plan indicator maps industries, products, and technologies identified for development in the Eleventh, Twelfth, and Thirteenth Five-Year Plans to the empirical sector classification. The concordance retains the plan category, source document, passage locator, mapping weight, and mapping explanation. Within a sector and benchmark year, the support indicator equals one when the sum of recorded mapping weights is positive. Repeated references to an activity therefore leave its binary support status unchanged. The industry mapping is constructed independently of recovered priorities.

The manufacturing concordance designates 13, 15, and 14 of the 29 sectors in 2007, 2012, and 2017, respectively. The broader concordance designates 27, 28, and 28 of the 43 policy sectors. Table A.2 reports the assignments used in the current national-plan regressions. These are the classifications underlying the binary-support estimates in Table 1.

In each national regression, priorities are standardized using the population standard deviation across eligible finite priority observations in that year and set of industries. The national indicator remains in its raw zero–one units. Regressions are unweighted, include province fixed effects, and use sector-clustered HC1 standard errors with the finite-cluster adjustment. The reported stars use two-sided normal-reference p -values. Thus each coefficient is the conditional priority gap between supported and unsupported sectors, rather than the response to a one-standard-deviation change in support.

Table A.2: National Five-Year Plan support by policy sector

Sector	2007	2012	2017
<i>Manufacturing</i>			
Apparel	0	0	0
Beverages	0	0	0
Chemicals	1	1	1
Computers, communications, and electronics	1	1	1
Cultural, educational, and sporting goods	0	0	0
Electrical equipment	1	1	1
Ferrous metals	1	1	1
Chemical fibers	1	1	1
Food processing	0	0	0
Food products	0	0	0
Furniture	0	0	0
General-purpose machinery	1	1	1

Continued on next page

Table A.2 continued

Sector	2007	2012	2017
Leather and related products	0	0	0
Measuring instruments	1	1	1
Metal products	0	0	0
Nonferrous metals	1	1	1
Nonmetallic mineral products	1	1	1
Other	0	0	0
Paper and paper products	0	0	0
Petroleum processing	0	1	0
Pharmaceuticals	1	1	1
Printing	0	0	0
Rubber and plastics	1	1	1
Special-purpose machinery	1	1	1
Textiles	0	0	0
Timber and wood products	0	0	0
Tobacco	0	0	0
Transport equipment	1	1	1
Waste recycling	0	1	1
<i>Nonmanufacturing</i>			
Accommodation & Catering	1	1	1
Agriculture	1	1	1
Construction	1	1	1
Culture, Sports & Entertainment	1	1	1
Finance	1	1	1
Information Services	1	1	1
Leasing & Business Services	1	1	1
Mining	1	1	1
Real Estate	1	0	1
Resident & Other Services	1	1	1
Scientific & Technical Services	1	1	1
Transport, Storage & Post	1	1	1
Utilities	1	1	1
Wholesale & Retail	1	1	1

A.7 Provincial-plan designations

The CNRDS Industrial Policy Research Database supplies the province, plan, named activity, quoted passage, historical industry codes, and separate local and national key-support flags. The analysis uses the local key-support flag. Activities are matched to the 43 policy sectors before aggregation. Identical province–plan–passage–sector links are deduplicated, and a sector receives local support when at least one retained link carries an affirmative local key-support flag. Repetition of a passage does not increase its regression weight.

Industry matching uses both the supplied codes and named activities. It distinguishes equipment manufacturing from network services, pharmaceutical production from health services, and material recovery from waste disposal. Corrections to sector assignments preserve the provider’s support labels. The completed mapping contains 5,155 record–sector links and 5,029 distinct passage–sector links drawn from 3,065 source activity records. A zero indicates that no retained matched passage records local key support.

The pooled observed-rate sample contains 3,847 cells: 1,284 in 2007, 1,285 in 2012, and 1,278 in 2017. The twelve zero-imputed policy observations are excluded, while observed zero and negative rates remain. The subsidy-only, priority-only, and joint specifications use this same sample. Both predictors are standardized within year over these observations. Province-year and sector-year fixed effects are included, and standard errors are clustered by province and sector with $t(29)$ inference.

A.8 Manufacturing growth specifications

The outcome for a growth window $[a, b]$ is $100[\log \widetilde{V}A_{osb} - \log \widetilde{V}A_{osa}]/(b - a)$. The current prior-growth windows are 2002–05, 2007–10, and 2012–15. Subsequent-growth windows are 2008–11, 2013–16, and 2018–21. Priorities are standardized within benchmark year over finite manufacturing priorities before outcomes are matched. Eligible manufacturing cells with available outcomes and required controls enter each regression.

Both specifications include province and sector fixed effects and the log of the sector’s initial share in provincial manufacturing. The subsequent-growth specification also includes prior growth and the observed subsidy rate in percentage points. Regressions are unweighted, with standard errors clustered by province. The current samples contain 866, 861, and 853 observations for prior growth and 850, 854, and 844 for subsequent growth. Table 3 reports the coefficients, standard errors, and significance levels for these windows.

B Competitive Equilibrium and Calibration

This appendix derives the competitive equilibrium of the domestic model in Section 3, then introduces the foreign-trade extension used in the quantitative analysis and its exact-change representation. All production and occupational sums are over the fixed active set. Fundamental productivities, input shares, preferences, endowments, bilateral trade costs, and the coefficients converting provincial inputs into national units are fixed within an experiment.

B.1 Firm optimization and Armington demand

Write $k_s = \alpha_s(1 - \gamma_s)$ and $\ell_s = (1 - \alpha_s)(1 - \gamma_s)$. A producer minimizes $r_o K + w_{os} L + \sum_j P_{oj} M_j$ subject to producing one unit of its Cobb–Douglas input composite. The first-order conditions equate expenditure shares to exponents:

$$r_o K_{os} = k_s B_{os}, \quad w_{os} L_{os} = \ell_s B_{os}, \quad P_{oj} M_{os,j} = \gamma_{sj} B_{os}.$$

Substitution into the input requirement gives

$$u_{os} = \left(\frac{r_o}{k_s}\right)^{k_s} \left(\frac{w_{os}}{\ell_s}\right)^{\ell_s} \prod_{j:\gamma_{sj}>0} \left(\frac{P_{oj}}{\gamma_{sj}}\right)^{\gamma_{sj}}. \quad (\text{B.1})$$

The cost-share constant in [equation \(5\)](#) is therefore $C_s = k_s^{-k_s} \ell_s^{-\ell_s} \prod_{j:\gamma_{sj}>0} \gamma_{sj}^{-\gamma_{sj}}$. The subsidy multiplies every privately paid input cost by the same factor $1 - \tau_{os}$ and leaves these conditional shares unchanged. Profit maximization at a positive output level gives [equation \(7\)](#). Multiplying by output gives the producer accounts in [equation \(6\)](#).

For delivered origin prices $p_{ro,s} = \kappa_{ro}^s p_{os}$, a composite buyer minimizes $\sum_o p_{ro,s} x_{ro,s}$ subject to the CES quantity requirement. The first-order conditions and homogeneity imply

$$x_{ro,s} = Q_{rs} \left(\frac{p_{ro,s}}{P_{rs}}\right)^{-\sigma_s}, \quad P_{rs} = \left(\sum_o p_{ro,s}^{1-\sigma_s}\right)^{1/(1-\sigma_s)}. \quad (\text{B.2})$$

Thus expenditure shares are $p_{ro,s}^{1-\sigma_s} / \sum_m p_{rm,s}^{1-\sigma_s}$, yielding [equation \(15\)](#) when origin sums run over the provinces in $\mathcal{R}$. This is the standard unweighted Armington composite. Final consumers and intermediate users face the same sectoral price index.

B.2 Factor clearing and household accounts

For a worker in province o , the distribution of maximum earnings is

$$\Pr\left(\max_s w_{os} \epsilon_{hs} \leq y\right) = \exp\left(-y^{-\zeta} \sum_s w_{os}^\zeta\right).$$

Its mean is $\bar{y}_o$ in [equation \(10\)](#). Integrating over the event that occupation s offers the highest earnings gives the choice share λ_{os} and effective labor supply in that equation. Mean realized earnings conditional on the chosen occupation equal $\bar{y}_o$. Accordingly, a sector's share of provincial labor income equals its employment share.

Let $I_o^L = \sum_s \ell_s B_{os}$ and $I_o^K = \sum_s k_s B_{os}$. Factor clearing implies $\bar{y}_o = I_o^L / \bar{L}_o$ and $r_o = I_o^K / \bar{K}_o$. With $\Gamma_\zeta = \Gamma(1 - 1/\zeta)$, efficiency wages are recovered from bills as

$$w_{os} = \frac{\bar{y}_o}{\Gamma_\zeta} \left(\frac{\ell_s B_{os}}{I_o^L} \right)^{1/\zeta}. \quad (\text{B.3})$$

Together with [equation \(B.1\)](#), these expressions eliminate factor prices from the nonlinear equilibrium problem.

Household optimization gives $P_{os} C_{os} = \beta_s Y_o$ for positive final-demand shares. Zero-share sectors can still supply intermediates. Household disposable income is $Y_o = I_o^L + I_o^K - \sum_s \tau_{os} B_{os} + D_o$. Combining final and intermediate expenditures gives

$$\sum_s E_{os} = \sum_s (1 - \tau_{os}) B_{os} + D_o = \sum_s R_{os} + D_o \quad \text{for each } o \in \mathcal{R}.$$

Thus D_o equals provincial expenditure less provincial receipts, with a positive value financing a trade deficit. In the domestic model, $\sum_{o \in \mathcal{R}} D_o = 0$. I express all nominal values, including D_o , in the same numeraire and replace one redundant goods-market equation with the normalization $P_{o^*}^c = 1$ for a reference province o^* .

B.3 Foreign trade in the quantitative model

The quantitative extension described in [Section 4.2](#) adds a foreign region, indexed by 0, that supplies imports and purchases Chinese goods. Let $\mathcal{N} = \mathcal{R} \cup \{0\}$. For Chinese destinations, the origin sums in [equations \(12\)](#) and [\(15\)](#) run over $\mathcal{N}$. Delivered import prices $\kappa_{r0}^s p_{0s}$ are fixed, so foreign supply is perfectly elastic. Foreign purchasers allocate fixed sectoral

expenditure $\bar{E}_{0s}$ across Chinese origins according to

$$P_{0s} = \left[\sum_{o \in \mathcal{R}} (\kappa_{0o}^s p_{os})^{-\theta_s} \right]^{-1/\theta_s}, \quad \pi_{0o,s} = \frac{(\kappa_{0o}^s p_{os})^{-\theta_s}}{\sum_{m \in \mathcal{R}} (\kappa_{0m}^s p_{ms})^{-\theta_s}}. \quad (\text{B.4})$$

The foreign expenditure share sums to one over Chinese suppliers. With $Q_{0s} = \bar{E}_{0s}/P_{0s}$, demand for the aggregate Chinese sectoral composite has unit price elasticity, while expenditure shifts across Chinese origins according to the sectoral Armington elasticity. Origin receipts include export sales, extending [equation \(17\)](#) to

$$R_{os} = \sum_{r \in \mathcal{R}} \pi_{ro,s} E_{rs} + \pi_{0o,s} \bar{E}_{0s}. \quad (\text{B.5})$$

Domestic production, household accounts, and government objectives retain their definitions in [Section 3](#). National input pools sum only over Chinese provinces, so foreign production does not enter the productivity externality. Provincial expenditure less receipts equals D_o , now accounting for both interprovincial and foreign trade. Summing goods clearing across Chinese provinces gives

$$\sum_{r \in \mathcal{R}, s} \pi_{r0,s} E_{rs} - \sum_s \bar{E}_{0s} = \sum_{o \in \mathcal{R}} D_o.$$

National import payments can therefore differ from export receipts. The foreign counterpart is $D_0 = -\sum_{o \in \mathcal{R}} D_o$, so $\sum_{o \in \mathcal{N}} D_o = 0$. Fixed foreign prices anchor the nominal price level, replacing the domestic model's numeraire condition.

B.4 Exact changes

The equations below include the foreign-trade extension. Let b denote the baseline and $\hat{z} = z'/z^b$. Trade imbalances remain fixed in nominal terms in the external numeraire, so $D'_o = D_o^b$. These amounts can be positive, negative, or zero and enter the system in levels.

To express national input pools in common units, set $a_{os} = u_{os}^b/u_s^{\text{ref}}$, where u_s^{ref} is a fixed sectoral reference unit. [Equation \(3\)](#) then gives

$$\hat{Z}_s = \sum_o \chi_{os}^b \frac{\hat{B}_{os}}{\hat{u}_{os}}, \quad \chi_{os}^b = \frac{B_{os}^b}{\sum_r B_{rs}^b}, \quad (\text{B.6})$$

$$\hat{\Psi}_s = \hat{Z}_s^{\phi_s}. \quad (\text{B.7})$$

Baseline bills therefore weight changes in physical input use. The conversion coefficients stay fixed, while current pool shares adjust with real inputs. Deflating the bill change by the input-cost change matters because a rise in expenditure need not represent a larger physical

input pool. National productivity consistency is imposed within every equilibrium evaluation, including government deviations, so the government anticipates the productivity response when assessing a marginal subsidy. Baseline matching preserves observed productivity levels while allowing policies to change productivity through national scale.

Baseline labor-income and fixed-factor-income shares are

$$\lambda_{os}^b = \frac{\ell_s B_{os}^b}{I_o^{L,b}}, \quad \eta_{os}^b = \frac{k_s B_{os}^b}{I_o^{K,b}}.$$

Fixed endowments and factor clearing give

$$\hat{y}_o = \sum_s \lambda_{os}^b \hat{B}_{os}, \quad \hat{r}_o = \sum_s \eta_{os}^b \hat{B}_{os}, \quad \hat{w}_{os} = \hat{B}_{os}^{1/\zeta} \hat{y}_o^{1-1/\zeta}. \quad (\text{B.8})$$

The wage expression follows directly by taking ratios in [equation \(B.3\)](#). Input costs and physical inputs satisfy

$$\hat{u}_{os} = \hat{r}_o^{k_s} \hat{w}_{os}^{\ell_s} \prod_j \hat{P}_{oj}^{\gamma_{sj}}, \quad \hat{X}_{os} = \frac{\hat{B}_{os}}{\hat{u}_{os}}. \quad (\text{B.9})$$

With fixed fundamental productivity and bilateral trade costs, changes in delivered domestic prices and destination price indices satisfy

$$\hat{c}_{os} = \frac{1 - \tau'_{os}}{1 - \tau_{os}^b} \frac{\hat{u}_{os}}{\hat{\Psi}_s}, \quad \hat{P}_{rs} = \left(\pi_{r0,s}^b + \sum_{o \in \mathcal{R}} \pi_{ro,s}^b \hat{c}_{os}^{-\theta_s} \right)^{-1/\theta_s}. \quad (\text{B.10})$$

Here $\hat{c}_{os}$ is also the factory-price change because $\bar{A}_{os}$ is fixed, and the foreign import price has unit hat. The first expression separates the direct policy wedge from changes in input costs and national productivity. The second gives their effect on destination prices through baseline trade shares.

For a Chinese destination, define

$$\mathcal{D}_{rs} = \pi_{r0,s}^b + \sum_{o \in \mathcal{R}} \pi_{ro,s}^b \hat{c}_{os}^{-\theta_s}.$$

Then

$$\hat{P}_{rs} = \mathcal{D}_{rs}^{-1/\theta_s}, \quad \pi'_{ro,s} = \frac{\pi_{ro,s}^b \hat{c}_{os}^{-\theta_s}}{\mathcal{D}_{rs}}, \quad \pi'_{r0,s} = \frac{\pi_{r0,s}^b}{\mathcal{D}_{rs}}. \quad (\text{B.11})$$

For foreign buyers, the denominator is $\mathcal{D}_{0s} = \sum_{o \in \mathcal{R}} \pi_{0o,s}^b \hat{c}_{os}^{-\theta_s}$, and $\pi'_{0o,s} = \pi_{0o,s}^b \hat{c}_{os}^{-\theta_s} / \mathcal{D}_{0s}$.

At a candidate bill vector, disposable resources and expenditures are

$$Y'_o = \sum_s (1 - \gamma_s - \tau'_{os}) B_{os}^b \hat{B}_{os} + D_o^b, \quad E'_{rs} = \beta_s Y'_r + \sum_j \gamma_{js} B_{rj}^b \hat{B}_{rj}.$$

The remaining goods-market equations are

$$(1 - \tau'_{os})B_{os}^b \hat{B}_{os} = \sum_{r \in \mathcal{R}} \pi'_{ro,s} E'_{rs} + \pi'_{0o,s} \bar{E}_{0s}. \quad (\text{B.12})$$

Solving bill and price consistency jointly determines the equilibrium, with national productivity imposed through [equation \(B.7\)](#). The state can be written as log bill hats and log domestic sectoral price hats. Welfare and activity changes are

$$\hat{P}_o^c = \prod_s \hat{P}_{os}^{\beta_s}, \quad \hat{W}_o = \frac{Y'_o/Y_o^b}{\hat{P}_o^c}, \quad \hat{V}_{os} = \frac{\hat{B}_{os}}{\hat{P}_o^c}. \quad (\text{B.13})$$

The equations reproduce the calibrated accounts at unit hats and the baseline policy schedule.

For an exact-change calculation around a baseline equilibrium of the domestic model, omit the foreign-origin and export terms from the trade and goods-market equations and impose $\sum_o D_o^b = 0$. Replace one redundant goods-market equation with $\hat{P}_{o*}^c = 1$, holding D_o fixed in this numeraire. The production, factor-market, national-productivity, and welfare equations otherwise retain the same form.

B.5 Input-output parameters and occupational responsiveness

Table [B.1](#) reports the production, demand, trade, and scale parameters. The labor, fixed-factor, and input columns are shares of total production costs and sum to one. The 2007 national input-output table supplies common industry cost shares and final-expenditure shares. Employee compensation determines labor payments. Depreciation and operating surplus determine fixed-factor payments. Net production taxes are excluded from factor-cost shares. Final-demand shares use domestic final expenditure, including consumption, government demand, capital formation, and inventory change, which the model represents as static final absorption. Common shares are held fixed across the three benchmark years, while provincial production and trade patterns vary. The comparison across years therefore incorporates the changing location and scale of activity within a common specification of industry input requirements and final expenditure.

The trade-elasticity assignments follow the Giri–Yi–Yilmazkuday estimates as mapped by [Bartelme, Costinot, Donaldson, and Rodríguez-Clare \(2025\)](#). The unmatched industries are furniture, cultural and arts manufacturing, other manufacturing, waste and recycling, and the 18 nonmanufacturing industries. Their trade elasticity is 4.32, the median of the adopted 15-industry vector, and their EES coefficient is zero. The median pertains to that mapped vector rather than the complete original Giri–Yi–Yilmazkuday sample. Assigned

trade elasticities range from 2.97 to 8.94, and Armington substitution elasticities are $1 + \theta_s$. Positive EES elasticities apply to 25 manufacturing industries and range up to 0.22. Separate detailed industries retain distinct national productivity pools.

Table B.1: Sectoral technology and demand parameters

Sector	β_s	Labor	Fixed factor	Inputs	θ_s	ϕ_s
1 Agriculture	0.0558	0.5565	0.0293	0.4142	4.32	0.00
2 Mining	0.0016	0.1824	0.2408	0.5768	4.32	0.00
3 Food Processing	0.0335	0.0742	0.0780	0.8478	3.57	0.17
4 Food Products	0.0226	0.0642	0.1090	0.8267	3.57	0.17
5 Beverage	0.0084	0.0856	0.1477	0.7666	3.57	0.17
6 Tobacco	0.0082	0.1810	0.1854	0.6336	3.57	0.17
7 Textile	0.0024	0.0765	0.0826	0.8409	4.43	0.14
8 Apparel	0.0162	0.1241	0.0750	0.8009	4.43	0.14
9 Leather	0.0076	0.0887	0.0770	0.8343	4.43	0.14
10 Timber	0.0006	0.0854	0.1021	0.8125	4.32	0.12
11 Furniture	0.0066	0.1195	0.0945	0.7860	4.32	0.00
12 Paper	0.0006	0.0689	0.1035	0.8276	2.97	0.22
13 Printing	0.0002	0.1294	0.1331	0.7375	2.97	0.22
14 Culture Arts	0.0013	0.0897	0.0877	0.8226	4.32	0.00
15 Petro Processing	0.0028	0.0547	0.0799	0.8654	8.94	0.07
16 Chemical Processing	0.0044	0.0604	0.1009	0.8388	3.75	0.16
17 Pharmaceuticals	0.0046	0.0892	0.1641	0.7468	3.75	0.16
18 Fiber	0.0003	0.0401	0.0969	0.8631	3.75	0.16
19 Rubber Plastic	0.0024	0.0649	0.0993	0.8358	4.13	0.13
20 Non Metal Mineral	0.0014	0.1023	0.1267	0.7710	5.14	0.12
21 Ferrous Metals	0.0019	0.0540	0.1021	0.8439	8.94	0.06
22 Non Ferrous Metals	0.0007	0.0536	0.0896	0.8569	8.94	0.06
23 Metal products	0.0062	0.0737	0.0999	0.8264	5.07	0.12
24 General Machinery	0.0208	0.0856	0.1066	0.8078	3.27	0.19
25 Special Machinery	0.0462	0.0927	0.1011	0.8062	3.27	0.19
26 Transport Equip	0.0524	0.0806	0.0726	0.8468	4.47	0.14
27 Electrical Equip	0.0280	0.0520	0.0880	0.8600	3.27	0.21
28 Communication Equip	0.0263	0.0589	0.0795	0.8616	3.27	0.21
29 Measuring Instruments	0.0054	0.0857	0.0920	0.8223	3.27	0.21
30 Other	0.0093	0.1168	0.0904	0.7928	4.32	0.00
31 Waste Recycling	0.0000	0.0121	0.7956	0.1923	4.32	0.00
32 Utilities	0.0124	0.0748	0.1816	0.7435	4.32	0.00
33 Construction	0.2463	0.1216	0.0871	0.7913	4.32	0.00
34 Wholesale & Retail	0.0401	0.1701	0.3630	0.4670	4.32	0.00
35 Transport, Storage & Post	0.0178	0.1309	0.3065	0.5626	4.32	0.00
36 Accommodation & Catering	0.0237	0.1083	0.2404	0.6513	4.32	0.00

Table B.1 continued

Sector	β_s	Labor	Fixed factor	Inputs	θ_s	ϕ_s
37 Information Services	0.0174	0.1177	0.4683	0.4141	4.32	0.00
38 Finance	0.0182	0.1942	0.4690	0.3368	4.32	0.00
39 Real Estate	0.0452	0.1039	0.7055	0.1906	4.32	0.00
40 Leasing & Business Services	0.0074	0.1157	0.1839	0.7004	4.32	0.00
41 Scientific & Technical Services	0.0073	0.2871	0.2064	0.5065	4.32	0.00
42 Water, Environment & Public Facilities	0.0059	0.2603	0.2442	0.4955	4.32	0.00
43 Resident & Other Services	0.0165	0.1343	0.3077	0.5580	4.32	0.00
44 Education	0.0484	0.4453	0.1078	0.4469	4.32	0.00
45 Health & Social Work	0.0430	0.2327	0.1026	0.6648	4.32	0.00
46 Culture, Sports & Entertainment	0.0069	0.2055	0.1958	0.5988	4.32	0.00
47 Public Administration & Social Security	0.0645	0.4775	0.0703	0.4522	4.32	0.00

Occupational parameter. The auxiliary calibration maps 2008 employment and wage bills to broader input-output industries. A source category split across destination industries is allocated equally among them. With observed employment share $\tilde{\lambda}_{os}$ and average earnings $\bar{e}_{os}$, the employment-weighted regression is

$$\log \tilde{\lambda}_{os} = \delta_o + b \log \bar{e}_{os} + \varepsilon_{os}.$$

It yields $b = 1.391151$ across 909 cells in 31 provinces, including Tibet, and the model sets $\zeta = b$. This auxiliary sample differs from the 30-province quantitative sample. Since the maintained Roy model equalizes conditional mean realized earnings across occupations, the regression slope is an auxiliary responsiveness benchmark rather than a structurally identified estimate of the efficiency-wage elasticity. The same value is held fixed in each model year.

B.6 Reconciliation of bilateral flows

The 42-sector interregional input-output tables provide priors for the model’s 47-sector flows. A detailed model industry inherits its parent industry’s provincial routing profile. Combined source industries contribute their summed flows. National export-to-output and import-to-use ratios determine initial foreign-trade totals, which are allocated across provinces using those profiles.

I measure provincial trade imbalances from the raw interregional input-output accounts before mapping industries. Let D_o^{IRIO} be purchases from other provinces and abroad, including final and intermediate goods, less sales to those destinations, and let GO_o^{IRIO} be provincial gross output in the same accounts. I preserve the ratio of net imports to gross output when

expressing the imbalance in benchmark units:

$$D_o^b = \frac{D_o^{\text{IRIO}}}{GO_o^{\text{IRIO}}} \sum_s R_{os}^b. \quad (\text{B.14})$$

This scaling accommodates the difference between nominal input-output accounts and the constructed benchmark output series. Positive values finance deficits and negative values correspond to surpluses. The construction permits a national trade imbalance, with the external counterpart equal to $-\sum_o D_o^b$.¹⁹

Given these imbalances, benchmark household resources are $Y_o^b = \sum_s (1 - \gamma_s - \tau_{os}^b) B_{os}^b + D_o^b$, and sectoral expenditure follows [equation \(16\)](#). I hold observed producer receipts and input bills fixed and adjust bilateral flows to match these expenditure and receipt margins. The resulting flows preserve each province's calibrated net imports while satisfying the model's accounts.

For each industry and year, let $Q_{ro,s}$ denote a prior flow from origin o to destination r . I choose calibrated flows by

$$\begin{aligned} \min_{f_{ro,s} \geq 0} \quad & \sum_{r,o: Q_{ro,s} > 0} [f_{ro,s} \log(f_{ro,s}/Q_{ro,s}) - f_{ro,s} + Q_{ro,s}] \\ \text{subject to} \quad & \sum_{o \in \mathcal{N}} f_{ro,s} = E_{rs} \quad (r \in \mathcal{R}), \\ & \sum_{r \in \mathcal{N}} f_{ro,s} = R_{os} \quad (o \in \mathcal{R}). \end{aligned} \quad (\text{B.15})$$

The rest-of-world margins adjust, and foreign trade with itself is zero. Structural zeros remain zero. Economically available links with zero source flows receive a small positive prior. On supported positive flows the solution has the form $f_{ro,s} = a_r Q_{ro,s} b_o$, with multipliers chosen by iterative proportional fitting to satisfy both margins. These calibration multipliers are unrelated to the national-input conversion coefficients.

Domestic trade shares are $\pi_{ro,s} = f_{ro,s}/E_{rs}$. Foreign spending and its origin shares are $\bar{E}_{0s} = \sum_o f_{0o,s}$ and $\pi_{0o,s} = f_{0o,s}/\bar{E}_{0s}$. The reconciliation supplies expenditure shares and accounts consistent with the specified trade imbalances for the exact-change system. It does not separately identify the levels of bilateral trade costs and fundamental productivities. The quantitative comparisons retain these baseline shares and fixed bilateral trade costs.

¹⁹The 2012 and 2017 source tables include Tibet, which is outside the model's 30-province sample. Its bilateral flows are included in the external counterpart when measuring the retained provinces' net imports.

C Priority Recovery and Provincial Optimality

The inverse problem uses the response of the complete competitive equilibrium to unilateral policy changes. Rival policy rates and trade imbalances are fixed, while goods prices, factor allocation, fiscal resources, and national productivity adjust. This appendix derives the response system and separates recovery of first-order incentives from verification of provincial optimality. The response equations include the quantitative extension in Appendix B.3. The domestic model follows by omitting the foreign-trade terms and imposing its price normalization; the local recovery argument applies to both specifications.

C.1 Differentiating the competitive equilibrium

Write the equilibrium in Appendix B as $\mathcal{E}(z, \tau) = 0$, where z collects log input bills and sectoral prices. For the domestic model, the system includes the numeraire condition in place of one redundant goods-market equation. The national productivity equations are included by substitution. On a branch with nonsingular $\mathcal{E}_z$, the response to a policy direction d is

$$z_d = -\mathcal{E}_z^{-1} \mathcal{E}_\tau d. \quad (\text{C.1})$$

The factorization of $\mathcal{E}_z$ can be reused across policy directions. The following equations describe its economic components explicitly.

Consider $\tau(t) = \tau + td$. Denote derivatives of log bills, input costs, factory prices, and composite prices by b_{os} , $u_{os}^{(1)}$, $c_{os}^{(1)}$, and $p_{os}^{(1)}$. These are response variables rather than levels. Let λ_{os} and η_{os} be current labor-income and fixed-factor-income shares. Factor clearing and input costs give

$$\begin{aligned} (\log \bar{y}_o)' &= \sum_s \lambda_{os} b_{os}, & (\log r_o)' &= \sum_s \eta_{os} b_{os}, \\ (\log w_{os})' &= \zeta^{-1} b_{os} + (1 - \zeta^{-1}) \sum_j \lambda_{oj} b_{oj}, \\ u_{os}^{(1)} &= k_s (\log r_o)' + \ell_s (\log w_{os})' + \sum_j \gamma_{sj} p_{oj}^{(1)}. \end{aligned} \quad (\text{C.2})$$

With current physical-pool shares $\chi_{os} = a_{os}X_{os}/Z_s$,

$$\begin{aligned} (\log \Psi_s)' &= \phi_s \sum_o \chi_{os} (b_{os} - u_{os}^{(1)}), \\ c_{os}^{(1)} &= u_{os}^{(1)} - (\log \Psi_s)' - \frac{d_{os}}{1 - \tau_{os}}, \\ p_{rs}^{(1)} &= \sum_{o \in \mathcal{R}} \pi_{ro,s} c_{os}^{(1)}, \quad (\log \pi_{ro,s})' = -\theta_s (c_{os}^{(1)} - p_{rs}^{(1)}). \end{aligned} \quad (\text{C.3})$$

Foreign import prices have zero response. For foreign demand, replace the destination index by 0 and form $p_{0s}^{(1)}$ using export shares across Chinese origins.

Disposable income is $Y_o = \sum_s (1 - \gamma_s - \tau_{os}) B_{os} + D_o$. Holding D_o fixed in the relevant numeraire, income and expenditure responses satisfy

$$\begin{aligned} Y_o' &= \sum_s (1 - \gamma_s - \tau_{os}) B_{os} b_{os} - \sum_s B_{os} d_{os}, \\ E_{rs}' &= \beta_s Y_r' + \sum_j \gamma_{js} B_{rj} b_{rj}. \end{aligned} \quad (\text{C.4})$$

Differentiating goods clearing gives

$$(1 - \tau_{os}) B_{os} b_{os} - B_{os} d_{os} = \sum_r \pi_{ro,s} E_{rs}' \left[(\log \pi_{ro,s})' + \frac{E_{rs}'}{E_{rs}} \right] + \pi_{0o,s} \bar{E}_{0s} (\log \pi_{0o,s})'. \quad (\text{C.5})$$

Equations (C.2)–(C.5) form a linear system for equilibrium responses. They incorporate the direct fiscal cost of policy, changes in subsidy bases, and national productivity feedback. Welfare and activity derivatives follow from

$$(\log W_o)' = Y_o'/Y_o - \sum_s \beta_s p_{os}^{(1)}, \quad (\log V_{os})' = b_{os} - \sum_j \beta_j p_{oj}^{(1)}.$$

Applying these equations to the individual own-policy directions constructs a_o and $\mathcal{B}_o$ in [equation \(23\)](#).

C.2 Recovery and local implementation

Proposition 1 (Recovery and local support). *Fix an interior subsidy profile and a twice continuously differentiable competitive-equilibrium branch. Suppose province o has the same number of controlled rates and valued activities, and its activity-response matrix $\mathcal{B}_o$ is non-singular. The unique priorities satisfying its first-order conditions are $\vartheta_o = -\mathcal{B}_o^{-1} a_o$. If the resulting own-policy Hessian H_o in [equation \(27\)](#) is negative definite, the provincial policy is a strict local best response. If these conditions hold for every province, the profile has strict*

local Nash support.

Proof. Differentiating the government objective yields $a_o + \mathcal{B}_o \boldsymbol{\vartheta}_o$. Nonsingularity gives the unique zero of this expression in priorities. With those priorities fixed, a unilateral policy perturbation d_o changes the objective by

$$g_o(\tau_o + td_o, \tau_{-o}) - g_o(\tau) = \frac{t^2}{2} d_o^\top H_o d_o + o(t^2).$$

Negative definiteness and continuity yield strict local optimality in all own-policy directions. Applying the argument to each province establishes the local Nash property. $\square$

The activity-coordinate representation makes the result particularly transparent. Let v_o collect the log sectoral activities corresponding to the columns of $\mathcal{B}_o$, and let $J_o = D_{\tau_o} v_o = \mathcal{B}_o^\top$. A local inverse expresses welfare as $f_o(v_o) = \log W_o(\tau_o(v_o), \tau_{-o})$. The government objective becomes $f_o(v_o) + \boldsymbol{\vartheta}_o^\top v_o$. At the recovered first-order conditions,

$$\boldsymbol{\vartheta}_o = -\nabla_v f_o, \quad H_o = J_o^\top D_v^2 f_o J_o. \quad (\text{C.6})$$

The terms involving second derivatives of the coordinate map vanish because the gradient of the objective is zero. Thus identification uses the rank of the activity response, whereas local optimality uses the curvature of resident welfare in those activity coordinates.

At bounds $\underline{\tau}_{ok} \leq \tau_{ok} \leq \bar{\tau}_{ok}$, write $q_o = a_o + \mathcal{B}_o \boldsymbol{\vartheta}_o$. The necessary signs for a maximizer are

$$(q_o)_k \leq 0 \text{ at a lower bound,} \quad (q_o)_k = 0 \text{ in the interior,} \quad (q_o)_k \geq 0 \text{ at an upper bound.} \quad (\text{C.7})$$

Second-order sufficiency requires negative curvature on feasible directions with zero first-order gain. Bound inequalities can admit multiple priority vectors. Solving all gradients to zero selects one assignment when the response matrix is invertible. Historical recovery treats observed signed rates, including zero rates, as interior choices. The nonnegative counterfactual domain instead treats zero as a lower bound.

C.3 Second derivatives and economic curvature

For two policy directions d, e , implicit differentiation gives

$$\mathcal{E}_z z_{de} = -\{\mathcal{E}_{zz}[z_d, z_e] + \mathcal{E}_{z\tau}[z_d, e] + \mathcal{E}_{\tau z}[d, z_e] + \mathcal{E}_{\tau\tau}[d, e]\}. \quad (\text{C.8})$$

Second responses therefore use the same equilibrium Jacobian as first responses. For a scalar objective $g(z, \tau)$, a transpose solve $\mathcal{E}_z^\top \lambda = g_z$ projects the second-order forcing directly into

objective curvature. This adjoint calculation avoids a separate state solve for every outcome.

The nonlinear forcing terms have explicit economic forms. For a weighted log sum, the second derivative equals the weighted mean of component second derivatives plus the variance of component first derivatives. In particular,

$$(\log Z_s)'' = \sum_o \chi_{os} (\log X_{os})'' + \text{Var}_{\chi_s} \left((\log X_{os})' \right), \quad (\text{C.9})$$

$$(\log P_{rs})'' = \sum_o \pi_{ro,s} (\log p_{os})'' - \theta_s \text{Var}_{\pi_{r\cdot,s}} \left((\log p_{os})' \right). \quad (\text{C.10})$$

The foreign import component has zero derivatives. Factor-income aggregates contribute analogous positive variance terms. Along a straight path in level subsidy rates, $(\log(1-\tau_{os}))'' = -d_{os}^2/(1-\tau_{os})^2$. The fiscal second derivative retains both bill curvature and the interaction between the policy change and its changing base. These terms are included before assembling the complete own-policy Hessian.

The economic sources of curvature can also be seen from the provincial resource identity. Define real sales revenue $\mathcal{R}_o = \sum_s R_{os}/P_o^c$ and real intermediate expenditure $\mathcal{M}_o = \sum_s \gamma_s B_{os}/P_o^c$. Then $W_o = \mathcal{R}_o - \mathcal{M}_o + D_o/P_o^c$. Let $r = \log \mathcal{R}_o$, $h = \log \mathcal{M}_o$, and $p = \log P_o^c$. Holding nominal D_o fixed, the Hessian in activity coordinates is

$$\begin{aligned} D_v^2 \log W_o &= \frac{\mathcal{R}_o}{W_o} \left[D_v^2 r + (D_v r)(D_v r)^\top \right] - \frac{\mathcal{M}_o}{W_o} \left[D_v^2 h + (D_v h)(D_v h)^\top \right] \\ &\quad + \frac{D_o}{P_o^c W_o} \left[(D_v p)(D_v p)^\top - D_v^2 p \right] - (D_v \log W_o)(D_v \log W_o)^\top. \end{aligned} \quad (\text{C.11})$$

This expression permits positive, negative, or zero D_o , provided $W_o > 0$. When $D_o = 0$, it reduces to

$$D_v^2 \log W_o = \frac{D_v^2 r - m D_v^2 h}{1 - m} - \frac{m}{(1 - m)^2} (D_v r - D_v h)(D_v r - D_v h)^\top, \quad m = \frac{\mathcal{M}_o}{\mathcal{R}_o}.$$

When all activities are coordinates, intermediate expenditure is a sum of exponentials of those activities and its log Hessian is a positive semidefinite expenditure-share covariance. In the balanced-trade case, its negative contribution and the final outer-product term provide stabilizing curvature. With nonzero D_o , changes in the consumption price index also change the real value of the inflow; the general expression retains this additional source of curvature. In the application, four background industries also respond endogenously, and their second derivatives enter $D_v^2 h$. The calculation retains these responses. Receipt curvature can have either sign, so private constant returns alone does not establish government concavity.

The finite-elasticity sufficient condition uses the same variance terms to separate destabi-

lizing and stabilizing channels. At a recovered stationary policy profile, write the own-policy second variation in activity coordinates as $v^\top(P_o - N_o)v$, where P_o, N_o sum positive semidefinite channel contributions according to the sign of their adjoint coefficients. Each channel consists of a weighted square of a first-order response or a difference of responses. If N_o is positive definite, choose A_o with $A_o N_o A_o^\top = I$. A sufficient comparison is

$$|A_o P_o A_o^\top|_{w_o} < w_o \quad \text{for some } w_o > 0, \quad (\text{C.12})$$

where absolute values and inequalities are entrywise. The inequality bounds the destabilizing quadratic form strictly below the stabilizing one. It accommodates the full trade, fiscal, background-industry, and national-EES responses through the first-order equilibrium system. It is a condition at the specified policy profile. Domain-wide bounds are needed to establish global best responses.

C.4 Recorded recovery diagnostics

Table C.1 reports the diagnostics for observed policies. Maxima are taken across the 30 provincial systems in each year. First-order residuals are derivatives of the log government objective with respect to subsidy rates. All provincial response matrices are full rank, with maximum condition numbers below 8.2. First-order residuals are at numerical precision. The largest eigenvalue of every full own-policy Hessian is strictly negative. These checks evaluate the recovered priorities held fixed while the province changes its policies, and they include all cross-sector own-policy terms.

Table C.1: Priority recovery and joint own-policy curvature

Year	Controls	Full rank	Max. condition	Max. FOC	Largest eigenvalue
2007	1,288	30	8.1	3.89×10^{-16}	-8.56×10^{-6}
2012	1,285	30	7.7	2.78×10^{-16}	-2.90×10^{-5}
2017	1,286	30	7.3	3.33×10^{-16}	-4.41×10^{-5}

The exact fit of the inverse first-order system is conditional on the model: with one unrestricted priority per policy condition, it provides no overidentifying restriction. Joint curvature imposes an additional behavioral restriction. The plan and growth comparisons in Section 4.4 provide external evidence about the recovered objectives.

The sufficient condition in equation (C.12) also holds at all 90 observed provincial policy vectors and the 60 provincial policy vectors in the two fiscal-design exercises. This provides an additional check of local optimality using first-order equilibrium responses. The fiscal-design checks are reported in Appendix E.

C.5 Responses to changes in priorities

To distinguish historical recovery from forward policy changes, stack governments' first-order conditions as $K(\tau, \vartheta) = 0$. On a regular interior policy-equilibrium branch,

$$\frac{d\tau}{dt} = -K_\tau^{-1} K_\vartheta \frac{d\vartheta}{dt}. \quad (\text{C.13})$$

The diagonal blocks of K_τ are own-policy Hessians. The off-diagonal blocks describe how rival policies affect marginal incentives. A change in one province's priorities can therefore induce adjustments throughout the policy profile. At bounds, the corresponding system applies to free coordinates with the relevant active constraints. Finite policy experiments solve these conditions jointly with competitive equilibrium and check provincial optimality at the resulting policies.

D Counterfactual Construction and Welfare Accounting

The policy experiments and welfare accounting in this appendix use the quantitative model with foreign trade described in Appendix B.3.

D.1 Policy experiments and outcome measures

The all-zero-policy experiment sets every effective rate in the 47-sector economy to zero and solves competitive equilibrium jointly with national productivity. The priority-removal experiment instead replaces each provincial objective by $\log W_o$ and optimizes rates in the active strategic sectors over $[0, 0.95]$. Public-service and absent-production policy cells remain at observed values. The first experiment removes subsidies directly; the second changes government objectives and solves for the resulting subsidies. Zero priorities do not impose zero support.

National welfare is the fixed-weight geometric index in [equation \(29\)](#). For a sector group $\mathcal{A}$, aggregate real-value-added changes are

$$100 \left[\frac{\sum_o \sum_{s \in \mathcal{A}} (1 - \gamma_s) B_{os}^b \hat{B}_{os} / \hat{P}_o^c}{\sum_o \sum_{s \in \mathcal{A}} (1 - \gamma_s) B_{os}^b} - 1 \right]. \quad (\text{D.1})$$

Amounts are summed before calculating the percentage change. The manufacturing group contains 29 sectors. The nonmanufacturing activity group contains the other 18, including the

four public services. Rate averages instead use the 14 strategic nonmanufacturing categories and fixed observed input-bill weights. Spending shares use the policy rates and input bills of the allocation being described.

Let $v_o = (V_{os})_{s \in \mathcal{M}}$ be province o 's vector over the manufacturing sectors. Manufacturing similarity is

$$C = \frac{1}{209} \sum_{(o,r) \in \mathcal{P}_{IC}} \frac{v_o^\top v_r}{\|v_o\| \|v_r\|}, \quad (\text{D.2})$$

where $\mathcal{P}_{IC}$ contains the 209 pairs formed from 19 inland and 11 coastal provinces. A province-common consumption deflator cancels from each cosine. The main zero-policy table reports a percentage change in C . [Table D.1](#) reports changes in cosine points. The five-year magnitude comparison divides $C_t^{\text{cf}} - C_t^b$ by $(C_{t+5}^b - C_t^b)/5$, using the same quantitative data at both dates.

Rates within 10^{-7} of zero are counted as zero in [table D.1](#).

Table D.1: Welfare-only provincial policy across calibrated years

Change from observed economy	2007	2012	2017
National welfare (percent)	−0.3500	−0.0952	−0.1667
Aggregate real value added (percent)	−0.6659	+0.3151	−0.2765
Manufacturing cosine change (points)	+0.003111	+0.004135	−0.000626
Provinces gaining in welfare	3/30	8/30	7/30
Strategic rates at zero	905/1,288	936/1,285	999/1,286

The 2012 observed strategic profile is feasible under nonnegative policies. For 2007 and 2017, I first solve the nonnegative game with the original historical priorities to distinguish the domain restriction from the change in objectives. Relative to observed allocations, national welfare changes by -0.000076 and -0.000359 percent. Starting from these feasible historical-priority profiles, removing priorities changes welfare by -0.349948 and -0.166350 percent, respectively. The small domain adjustment therefore leaves the economic conclusions unchanged. These comparisons use ratios of welfare indices rather than subtracting percentage changes.

D.2 The equilibrium welfare differential

Write $I_o = \sum_s (1 - \gamma_s) B_{os}$ for gross factor income, $S_{os} = \tau_{os} B_{os}$ for policy expenditure, and $Y_o = I_o - \sum_s S_{os} + D_o$ for disposable resources. Trade imbalances are held fixed in nominal terms in the external numeraire, so $dD_o = 0$. The factor-allocation envelope and the

Cobb–Douglas cost function imply

$$dI_o = \sum_s B_{os} d \log u_{os} - \sum_j \left(\sum_s \gamma_{sj} B_{os} \right) d \log P_{oj}. \quad (\text{D.3})$$

Subtracting the change in policy expenditure and the cost of final absorption gives

$$Y_o d \log W_o = \sum_s [B_{os} d \log u_{os} - E_{os} d \log P_{os} - dS_{os}]. \quad (\text{D.4})$$

All coefficients are evaluated at the current allocation. Since $R_{os} = (1 - \tau_{os})B_{os}$, $X_{os} = B_{os}/u_{os}$, and the Chinese factory-gate price is proportional to $(1 - \tau_{os})u_{os}/\Psi_s$, the product rule yields

$$B_{os} d \log u_{os} - dS_{os} = R_{os} (d \log p_{os} + \phi_s d \log Z_s) - S_{os} d \log X_{os}. \quad (\text{D.5})$$

Fundamental productivity is fixed along the policy change, so only the input-cost, policy, and national-productivity terms enter the producer-price differential. Substitution into [equation \(D.4\)](#) separates the direct national productivity effect, the policy wedge on real input use, and price incidence.

Define $m_o = \omega_o/Y_o$, domestic origin–destination sales $D_{ro,s} = \pi_{ro,s}E_{rs}$, and export receipts R_{os}^X . The Armington expenditure-share envelope gives $d \log P_{rs} = \sum_{o \in \mathcal{R}} \pi_{ro,s} d \log p_{os}$ because foreign offer prices are fixed. Finally, $\chi_{os} = a_{os}X_{os}/Z_s$ implies $d \log X_{os} = d \log Z_s + d \log \chi_{os}$. Combining these identities yields

$$\begin{aligned} dG = & \underbrace{- \sum_s \left(\sum_o m_o S_{os} \right) d \log Z_s}_{\text{national scale at policy wedges}} + \underbrace{\sum_s \phi_s \left(\sum_o m_o R_{os} \right) d \log Z_s}_{\text{direct national EES}} \\ & \underbrace{- \sum_{o,s} m_o S_{os} d \log \chi_{os}}_{\text{geographic allocation}} + \underbrace{\sum_{o,r,s} (m_o - m_r) D_{ro,s} d \log p_{os}}_{\text{domestic price incidence}} \\ & + \underbrace{\sum_{o,s} m_o R_{os}^X d \log p_{os}}_{\text{foreign price incidence}}. \end{aligned} \quad (\text{D.6})$$

The foreign term remains because the national criterion values Chinese residents. Foreign demand has unit quantity elasticity at the sectoral Chinese export-composite level. Nominal sectoral export expenditure is fixed. Domestic price incidence compares the welfare value of income to a seller’s residents with its value to a buyer’s residents. It can redistribute welfare across provinces while having a small national sum.

The geographic term measures the contribution of changing provincial shares of a national

input pool at existing policy wedges. It has no predetermined sign. The direct EES term is a productivity contribution within the accounting identity, not the entire equilibrium effect of changing the EES technology: prices and the location of activity also respond to productivity. The five terms describe the joint reform, so sectoral contributions should not be read as isolated effects of individual policies.

D.3 Finite changes and numerical verification

For each endpoint τ^1 , the main accounting path is $\tau(t) = (1 - t)\tau^b + t\tau^1$, $t \in [0, 1]$. Competitive equilibrium and national EES are solved at every integration node. Write $q_k(t)$ for the derivative of component k in [equation \(D.6\)](#) along this path. The ordinary percentage-point contribution is

$$C_k = 100 \int_0^1 \exp\{G(t) - G(0)\} q_k(t) dt, \quad \sum_k C_k = 100 [\exp\{G(1) - G(0)\} - 1]. \quad (\text{D.7})$$

The integrands are not separately exponentiated or rescaled to match the endpoint. The intermediate policy profiles serve the accounting exercise and need not solve a government optimization problem.

Table D.2: Welfare accounting for the 2012 policy experiments

	Remove subsidies	Remove priorities	Fixed-budget redesign
National scale at policy wedges	+0.0246	−0.0316	−0.1452
Direct national EES	−0.6910	−0.6350	+0.7566
Geographic allocation	+0.0125	−0.0537	−0.0393
Domestic price incidence	+0.0002	+0.0001	+0.0001
Foreign price incidence	+0.4042	+0.6249	+0.5489
Total welfare change	−0.2495	−0.0952	+1.1211

The saved removal calculations reproduce national endpoint welfare within 4×10^{-13} percentage point and provincial endpoints within 4×10^{-12} point. Analytical path derivatives are checked with two central-difference steps, and Gaussian quadrature is refined for individual components as well as their sum. A path linear in log net-of-subsidy wedges provides an additional sensitivity check. The fiscal-design accounting separately reproduces the total within 2.4×10^{-13} percentage point, with maximum component refinement below 1.2×10^{-11} point. These checks assess the welfare identity and its numerical integration. The endpoint policy-optimality checks are distinct.

E Priority Design and Fiscal Capacity

E.1 Computing constrained-efficient subsidies

The 2012 national policy problem uses the observed factor-income weights, the same subsidy instruments as in the main text, and nonnegative rate bounds. Let $F_o(\boldsymbol{\tau})$ be real provincial expenditure as defined in [equation \(31\)](#). For a multiplier k , the fiscal constraint is $F_o(\boldsymbol{\tau}) \leq kF_o(\boldsymbol{\tau}^b)$. The main specification sets $k = 1$. A second sets $k = 1.25$. The no-additional-ceiling comparison drops these inequalities while retaining local financing and all other model restrictions.

The constraint is on real net expenditure across all sectors. With nonnegative subsidies and the retained 2012 background policies, net and gross support coincide. For reporting, national real expenditure sums provincial amounts in baseline consumption units, with each baseline consumption-price hat normalized to one. The ceilings remain tied to observed spending throughout the calculation. At both finite-cap solutions, all 30 fiscal constraints bind. The computed schedules satisfy feasibility, positive household resources, equilibrium consistency, and the national first-order conditions, including the conditions at subsidy bounds.

I also verify the constrained second-order sufficient conditions at both allocations. The Hessian of the national Lagrangian in [equation \(E.3\)](#) includes the welfare effects of joint policy changes across provinces and the curvature of every real-spending constraint. It is negative definite at both computed allocations, satisfying the curvature requirement on feasible critical directions. These checks establish strict local optimality to numerical precision.

For the observed-budget problem, I additionally repeat the optimization from alternative initial subsidy schedules, including zero subsidies, province-uniform rates, and randomized sectoral rates. All searches converge to the same policy schedule and welfare within numerical tolerance and satisfy the first-order and fiscal conditions. These results provide numerical support for global optimality.

Changes in [Table E.1](#) are relative to the observed 2012 economy.

The first two columns of [table E.1](#) isolate the scope for changing the composition of support within given provincial fiscal resources. The no-ceiling solution illustrates the importance of this restriction. Its real spending reaches 19.45 percent of baseline factor income, compared with 2.10 percent observed, and its largest provincial spending ratio exceeds twenty times the observed amount. Its larger welfare gain is consequently not a fixed-budget reform.

Table E.1: Priority design and provincial fiscal capacity, 2012

	Observed real budgets	Real budgets plus 25 percent	No additional fiscal ceiling
National welfare (percent)	+1.121	+1.385	+4.205
Aggregate real value added (percent)	+1.098	+1.882	+21.496
Real spending (percent change)	0.0	+25.0	+824.3
Real spending / baseline factor VA (percent)	2.104	2.630	19.450
Provinces gaining in welfare	30/30	30/30	29/30
Smallest provincial welfare change (percent)	+0.568	+0.827	−0.003
Manufacturing cosine	0.5800	0.5817	0.5991

E.2 The corrective-support benchmark

A physical resource benchmark clarifies the distortion corrected by the subsidy instrument. Start from the domestic economy in Section 3, permit balanced lump-sum transfers across provinces, and make all required active-sector input subsidies available without fiscal ceilings. Retain the model’s technologies, occupational choices, factor immobility, and iceberg requirements. Suppose the resource problem has a finite global optimum with positive quantities and regular positive supporting prices. The following conditions characterize a subsidy representation supporting that allocation.

Let $R_s = \sum_o R_{os}$ and evaluate all variables at the allocation to be supported. Increasing province o ’s composite input raises its own output and the productivity of every producer in industry s . The resource planner’s marginal condition is

$$u_{os} = p_{os}\bar{A}_{os}\Psi_s + \phi_s \frac{a_{os}}{Z_s} R_s. \quad (\text{E.1})$$

The first term is the private output value of the input. The second is the output value of its national productivity spillover. A competitive atomistic firm instead faces $p_{os}\bar{A}_{os}\Psi_s = (1 - \tau_{os})u_{os}$. Multiplying the difference by X_{os} yields the corrective payment and reimbursement rate:

$$S_{os}^{\text{corr}} = \phi_s \chi_{os} R_s, \quad e_{os} = \phi_s \chi_{os} \frac{R_s}{R_{os}}, \quad \tau_{os}^{\text{corr}} = \frac{e_{os}}{1 + e_{os}}. \quad (\text{E.2})$$

The subsidy-to-receipts ratio e_{os} differs from the reimbursement rate because $S_{os}/R_{os} = \tau_{os}/(1 - \tau_{os})$. Since the instrument reimburses every component of the input bundle, it supplies the missing incentive on labor, fixed-factor, and intermediate-input use simultaneously. Intermediate inputs already enter the supporting resource prices. Their presence does not add a separate Leontief multiplier to [equation \(E.2\)](#).

For this supporting representation, national sectoral support satisfies $\sum_o S_{os}^{\text{corr}}/R_s = \phi_s$,

and its provincial distribution follows χ_{os} . A common sectoral rate $\phi_s/(1 + \phi_s)$ follows only when physical-pool shares equal revenue shares. Appropriate balanced transfers support the efficient consumption allocation. The constrained numerical exercise instead uses the foreign-trade extension in Appendix B.3, local financing, a restricted instrument set, and provincial budgets, so its constrained-efficient subsidy schedule need not satisfy this corrective formula. The benchmark instead explains why national industry scale and its geographic allocation are separate objects in the policy problem.

E.3 Fiscal shadow values and redesigned priorities

The national Lagrangian is

$$\mathcal{L}^N = \sum_r \omega_r \log W_r - \sum_r \lambda_r (F_r - \bar{F}_r), \quad \lambda_r \geq 0, \quad (\text{E.3})$$

with the rate bounds imposed separately. Write $\eta_o^N, \xi_o^N \geq 0$ for the national lower- and upper-rate-bound multipliers and $\eta_o^P, \xi_o^P \geq 0$ for their provincial counterparts. National stationarity with respect to province o 's rates is

$$\omega_o a_o + h_o - \sum_r \lambda_r \nabla_{\tau_o} F_r + \eta_o^N - \xi_o^N = 0, \quad (\text{E.4})$$

where $h_o = \sum_{r \neq o} \omega_r \nabla_{\tau_o} \log W_r$. Provincial stationarity is

$$a_o + \mathcal{B}_o \boldsymbol{\vartheta}_o + \eta_o^P - \xi_o^P = 0. \quad (\text{E.5})$$

Subtracting the weighted provincial equation from the national condition gives

$$\omega_o \mathcal{B}_o \boldsymbol{\vartheta}_o = h_o - \sum_r \lambda_r \nabla_{\tau_o} F_r + \eta_o^N - \xi_o^N - \omega_o \eta_o^P + \omega_o \xi_o^P. \quad (\text{E.6})$$

The bound multipliers are complementary to their respective slacks. On coordinates interior to both domains, their terms vanish and this reduces to [equation \(33\)](#). At a lower rate bound, a maximizer's derivative can be negative. The nonnegative lower-bound multiplier offsets it in the displayed stationarity convention.

Real expenditure responds through its rate, spending base, and deflator:

$$dF_r = \frac{1}{P_r^c} \sum_s (B_{rs} d\tau_{rs} + \tau_{rs} dB_{rs}) - F_r d \log P_r^c. \quad (\text{E.7})$$

The direct rate term is zero for a change in another province's policy, but the base and

price responses generally remain. Thus the fiscal adjustment in [equation \(E.6\)](#) includes every provincial constraint. The term h_o includes all welfare spillovers through national productivity, trade, prices, and financing, rather than only the technological externality.

For a smooth local solution with a stable active set, the envelope theorem gives $dG^* = \sum_r \lambda_r d\bar{F}_r$. If the constraints are normalized as $F_r/F_r(\tau^b) \leq k$ with multipliers μ_r , then $\lambda_r = \mu_r/F_r(\tau^b)$ and $dG^*/dk = \sum_r \mu_r$. The finite comparison between $k = 1$ and $k = 1.25$ allows all policies and equilibrium quantities to adjust. It is not a linear extrapolation using a single set of shadow values.

E.4 Implementation checks

For each constrained-efficient equilibrium, I solve the inverse derivative system for one redesigned priority vector per province. The selected assignment sets the provincial objective gradient to zero, including at boundary rates. All 30 provinces use this assignment without a constrained fallback. Priorities remain unrestricted in sign and retain a unit coefficient on log resident welfare. Bounds can admit other priority vectors that satisfy provincial stationarity, so the reported changes characterize the selected assignment.

The provincial implementation game uses the original nonnegative rate domain and local financing rule. The national real-spending constraints are not imposed on unilateral deviations. Full own-policy second-order checks establish strict local optimality for all 30 provinces at both constrained-efficient allocations. The same priority arrays are then used for finite searches and forward policy adjustment.

For each province, I search for profitable unilateral deviations starting from the constrained-efficient rates, the observed historical rates, and zero subsidies. I also evaluate feasible finite deviations along leading curvature directions. All searches complete, and none finds a gain above the 10^{-8} objective tolerance. The largest recorded gains are below 10^{-14} . These results provide numerical support for global best responses under both redesigned priority assignments.

Forward sequential provincial adjustment is also run from the observed policy profile and from a perturbed constrained-efficient subsidy schedule. Both return to the constrained-efficient schedule within numerical tolerance: maximum policy distances are below 2.2×10^{-7} and maximum provincial welfare differences are below 6.6×10^{-7} percentage point. Final response checks use the common resulting profile. Independent saved-result audits verify matching priority arrays across the second-order, finite-deviation, and forward checks. Together, these calculations provide numerical support for Nash implementation and convergence to the reported equilibrium from alternative initial policies.

E.5 Production-network summaries

The upstreamness comparison uses the full domestic production network. Let Z_{sj}^D be domestic intermediate sales by supplier sector s to user sector j , and let R_s denote national sectoral receipts. Define $Q_{sj} = Z_{sj}^D/R_s$. Domestic upstreamness solves

$$U_s = 1 + \sum_j Q_{sj} U_j, \quad U = (I - Q)^{-1} \mathbf{1}. \quad (\text{E.8})$$

Domestic final sales and exports are terminal demand. The underlying calculation uses 2012 flows and the common production coefficients, and reconciles receipts with domestic intermediate sales, domestic final sales, and exports. It measures distance to final use in the domestic network, rather than global upstreamness. The main figure compares 29 manufacturing industries, using equal-sector descriptive associations.

The Pearson correlation of mean priority changes with upstreamness is 0.609. The Spearman correlation is 0.579. Omitting chemicals and nonferrous metals together leaves the Pearson correlation at 0.567. The positive association therefore extends beyond the two largest mean increases. These comparisons organize the sectoral pattern of the jointly designed allocation, without identifying separate causal effects of network position.

F Additional Evidence on Industrial Composition and Priorities

F.1 Vehicle production in the United States

Figures [F.1](#) and [F.2](#) provide the U.S. comparison for the vehicle-production example in Section [2.1](#), using reported car and truck production from *Ward's Automotive Yearbook*. The time series records observations at five-year intervals. Missing state reports do not establish zero production, and the national “Other” category is not allocated across states.

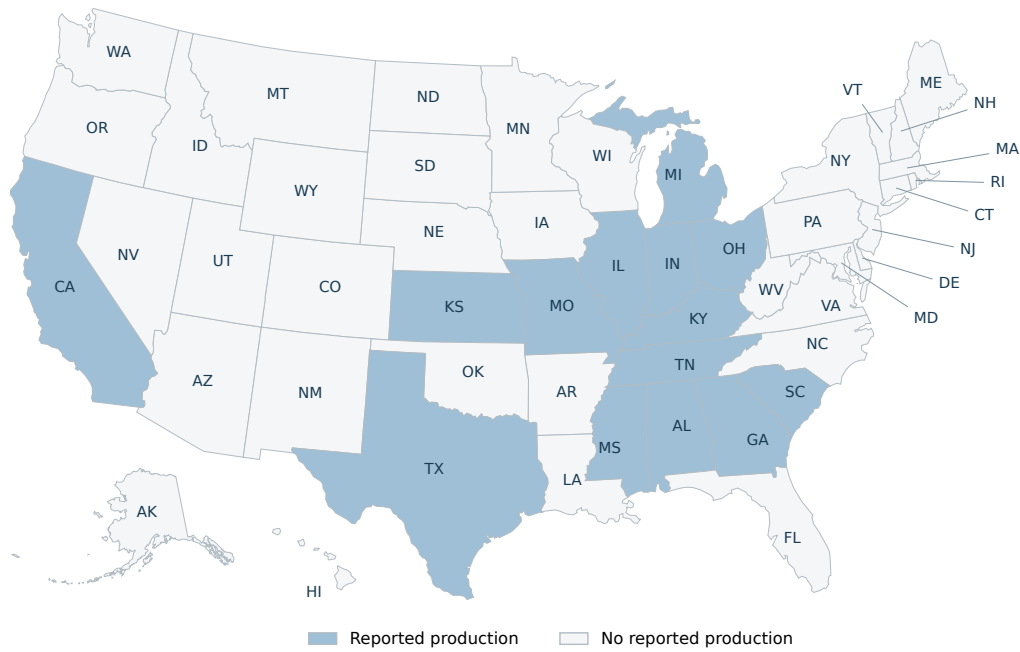


Figure F.1: U.S. states with reported vehicle production, 2015

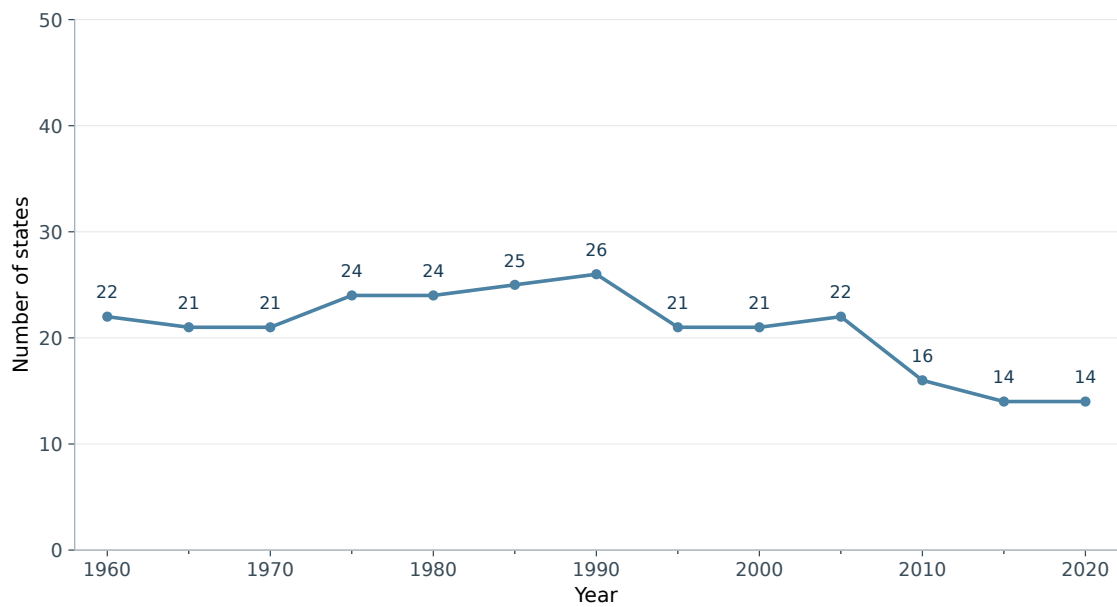


Figure F.2: Number of U.S. states with reported vehicle production, 1960–2020

F.2 Additional measures of industrial composition

The Krugman specialization index compares each province’s industrial composition with that of the rest of China. Using the manufacturing shares defined in equation (A.2), the index for province o in period p is

$$K_{o,p} = \frac{1}{2} \sum_{s \in \mathcal{M}} |x_{os,p} - x_{-o,s,p}|, \quad (\text{F.1})$$

where $x_{-o,s,p}$ is sector s ’s share in pooled constructed real value added across all provinces other than o . The index lies between zero and one. Lower values indicate a manufacturing composition closer to that of the rest of the country.

Figure F.3 shows that inland specialization falls after 2006–08. The inland mean declines from 0.379 to 0.331 by 2015–18, while the coastal mean rises from 0.286 to 0.299. The gap between the two regional means narrows by 65 percent. The specialization index thus confirms the increasing similarity in industrial composition documented by the cosine measure in Section 2.

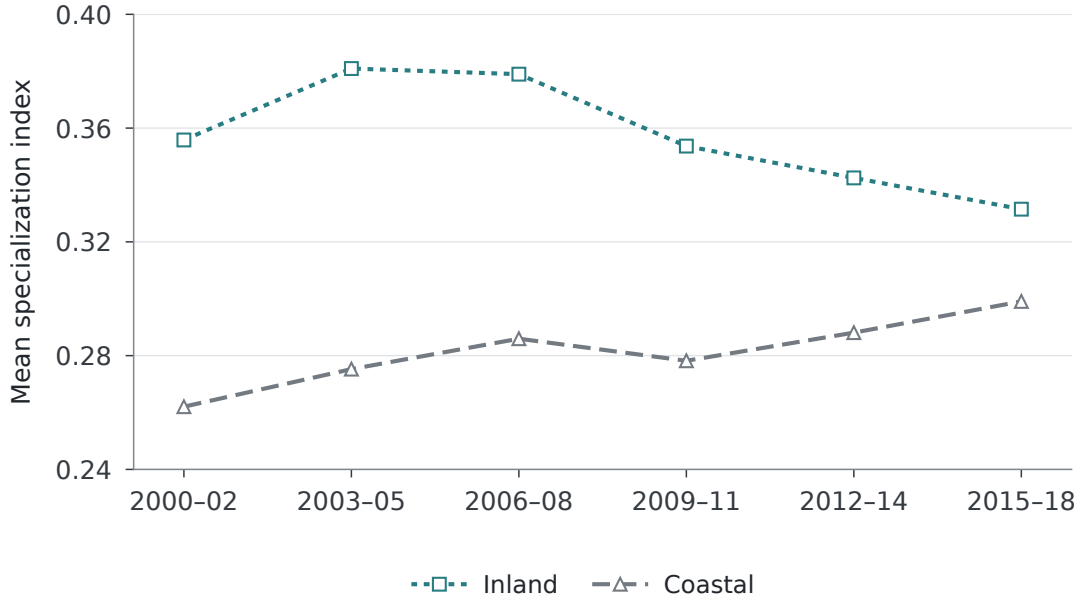


Figure F.3: Manufacturing specialization by region

Figure F.4 shows the mean manufacturing cosine across all 435 distinct province pairs. It rises from 0.575 in 2006–08 to 0.610 in 2015–18. This broader comparison complements the fixed-coastal-benchmark measure by averaging bilateral similarity throughout the country.

Table F.1 separates this change into comparisons within and between regions. The inland–coastal mean rises by 0.073 between 2006–08 and 2015–18, while mean similarity within either region changes little. Thus, the increase in average bilateral similarity mainly

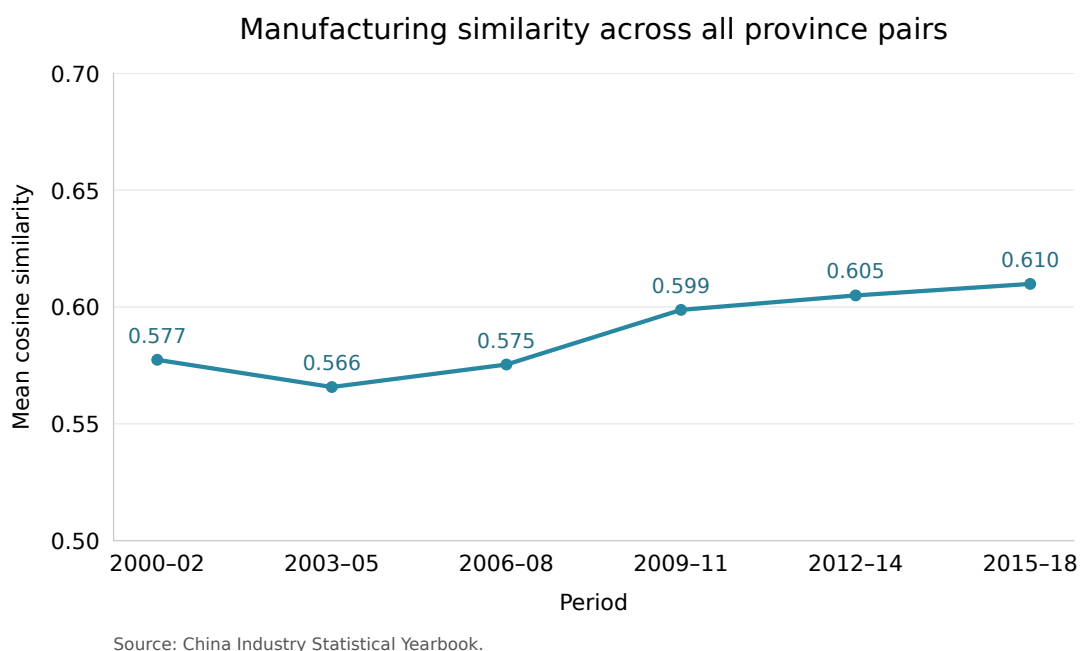


Figure F.4: Manufacturing similarity across all province pairs

reflects the narrowing of differences between inland and coastal provinces.

Table F.1: Manufacturing similarity within and between regions

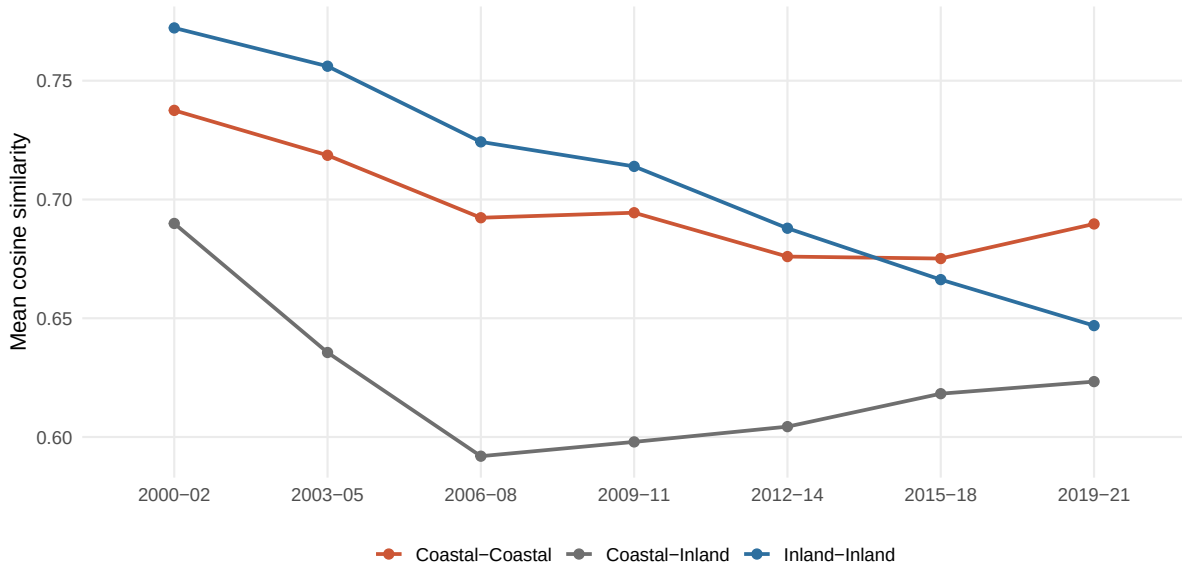
Period	Inland–coastal	Inland–inland	Coastal–coastal
2006–08	0.521	0.615	0.659
2009–11	0.559	0.623	0.674
2012–14	0.579	0.616	0.669
2015–18	0.594	0.615	0.654

Employment shares also become more similar across inland and coastal provinces after 2006–08. Figure F.5 reports pairwise cosines using year-end urban-unit employment from the *China Labour Statistical Yearbook* ([National Bureau of Statistics of China 2001–2023](#)). The comparison covers the same 30 provinces and 29 manufacturing industries, with an extension through 2019–21. The 2015–18 employment period includes all four years, while the constructed-value-added series excludes 2017. The increase in inland–coastal similarity is smaller than for constructed value added, and similarity within the inland group declines. The employment evidence therefore supports the direction of the cross-region change, while showing that its magnitude and within-region pattern depend on the activity measure.

The change in similarity is stronger among industries with larger calibrated external

Pairwise similarity of manufacturing employment structures

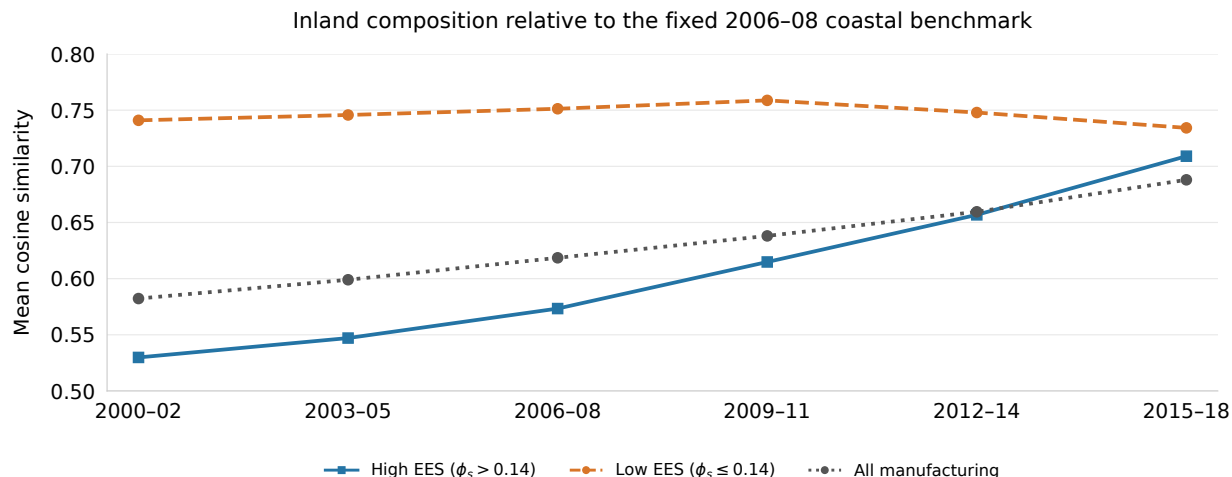
Mean cosine similarity across period-aggregated 29-sector employment shares



Labour Statistical Yearbook year-end urban-unit employment; 30 provinces; Tibet excluded.

Figure F.5: Manufacturing employment similarity within and between regions

economies of scale. Figure F.6 reports cosines computed separately within two groups of manufacturing industries. Among industries above the median scale elasticity, the inland mean cosine to the fixed coastal benchmark rises from 0.573 in 2006-08 to 0.709 in 2015-18. The corresponding low-elasticity mean changes from 0.751 to 0.734. The comparison describes the composition of the observed change using the scale elasticities adopted in the quantitative model.



Source: China Industry Statistical Yearbook.

Figure F.6: Inland similarity by manufacturing scale elasticity

F.3 Priority comparisons by industry coverage

Table F.2 distinguishes the main 43-sector comparison from its manufacturing subset. The broad-sector increase in inland–coastal alignment occurs mainly in 2007–12, while the manufacturing comparison continues to rise through 2017. The set of industries therefore matters for the timing of increasing alignment in provincial priorities. Both calculations use signed priorities with the sector set held fixed within each pair across all three dates. Each pair retains at least 25 manufacturing industries.

Table F.2: Inland–coastal priority similarity by industry coverage

Industry coverage	2007	2012	2017
All 43 policy sectors	0.201	0.342	0.354
Manufacturing sectors	0.285	0.379	0.488

Table F.3 gives an industry illustration of the changing regional composition of priorities. ICT remains a stronger coastal priority, while its mean inland valuation rises and its rank improves. Means weight active provinces equally. Ranks compare means across all 43 policy sectors.

Table F.3: An illustration of changing regional priorities: ICT

Year	Coastal mean priority	Inland mean priority	Inland rank
2007	0.0504	0.0023	14
2012	0.0349	0.0080	5
2017	0.0332	0.0179	3