Building for Promotion: Political Connections and Spatial Structural Change in China

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Preliminary and incomplete. Please do not circulate.

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Abstract

How do political economy frictions shape macroeconomic development? This paper investigates how officials' personal career incentives drive local infrastructure investment and structural transformation in China. Using officials' data, I exploit exogenous provincial leadership turnover as a shock to political connections and find that prefecture leaders who lose ties to their superiors—weakening their promotion prospects—reduce infrastructure spending shares by 2.8%, offsetting approximately 25% of the typical transition away from agriculture. To quantify the aggregate consequences, I develop a dynamic spatial equilibrium model in which career incentives operate as a wedge on local infrastructure investment. Inverting the model to match cross-prefecture data, I recover the career incentive wedge and document its substantial geographic dispersion: the 90th-to-10th percentile ratio of the wedge is approximately 13. Counterfactual analysis reveals that compressing career incentives to the national median reduces infrastructure investment by 19.9% yet *raises* household welfare, implying that the baseline spatial allocation of public capital is inefficient: career incentives channel investment where private political returns are high rather than where social returns are highest.

Keywords: political connection, career incentives, infrastructure investment, spatial equilibrium, structural change

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1 Introduction

The decentralization of public infrastructure provision introduces a fundamental tension: capital allocation is driven by local agents whose political incentives may not align with aggregate economic efficiency. In China, where local governments financed over 94% of public infrastructure investment between 2003 and 2017 (National Bureau of Statistics), prefecture officials exercise substantial discretion over investment decisions. These officials operate within a promotion tournament in which career advancement depends heavily on political connections with provincial superiors (Jia et al., 2015), creating scope for political agency frictions to distort local investment. Yet quantifying the aggregate consequences of such distortions requires a framework that can both measure the unobserved career incentives of local officials and account for the spatial externalities that infrastructure generates across regions.

In this paper, I develop a dynamic spatial general equilibrium model to study how political career incentives shape infrastructure investment and structural transformation in China, and provides reduced-form evidence on the underlying mechanism. I first exploit the loss of political connections induced by provincial leadership turnover and find that prefecture leaders who lose ties to provincial authorities reduce their infrastructure spending share by 2.8%, decelerating local structural transformation. The effect is stronger for younger officials with longer career horizons, consistent with a career incentive mechanism. Motivated by this evidence, I build on Eckert and Peters (2025) to embed local officials into a spatial equilibrium framework. Officials allocate government revenue between infrastructure and other spending to maximize an objective that includes both consumption utility and career returns to public capital. Career incentives enter as an investment wedge, which I recover by inverting the model to match observed data across prefectures. Counterfactual analysis reveals that compressing career incentives to the national median reduces infrastructure investment by 19.9% yet *raises* household welfare by 0.039%, implying that the baseline spatial allocation of public capital is inefficient: career incentives channel investment where private political returns are high rather than where social returns are highest.

China's structural transformation over recent decades has been rapid but spatially uneven. The national agricultural employment share fell from 60% in 1990 to approximately 20% in 2020, yet the pace of this transition varies dramatically across prefectures. Existing studies attribute aggregate structural change to technological progress (Brandt and Zhu, 2010), declining migration costs (Tombe and Zhu, 2019; Hao et al., 2020), and trade liberalization (Erten and Leight, 2021), but

these factors account for only a modest share of the observed reallocation (see Chen and Zha (2025) for a review). Local governments, as the primary investors in public infrastructure, are well positioned to shape local economic trajectories, yet their role in structural transformation has received little attention. The Chinese setting is particularly suitable for studying this question[1]: provincial leadership is assigned by the central government, and the resulting turnover generates plausibly exogenous variation in prefecture-province political connections.

I follow Jiang (2018) in measuring political connections between prefecture and provincial leaders based on past promotion experience, capturing both the existence and strength of ties. My identification strategy differs in an important respect, however. Jiang (2018) estimates the effect of gaining a connection, which raises endogeneity concerns since connection formation may reflect unobserved political or economic factors. I instead estimate the effect of *losing* a connection during provincial leadership turnover, events determined by central personnel decisions largely exogenous to prefecture-level conditions. I find that prefecture leaders who lose connections reduce their infrastructure spending share by 2.8% of total government expenditure. This reduction decelerates local structural transformation: the decline in agricultural employment slows and the growth of manufacturing employment weakens. The effect is stronger for younger officials (3.4% for those aged 52 or below, the sample median), consistent with career incentives driving the investment response.

The model incorporates these mechanisms into a spatial equilibrium framework with three sectors: agriculture, manufacturing, and services. In each region, prefecture officials allocate government revenue between infrastructure investment and other spending. Infrastructure raises productivity in manufacturing and services, reflecting local governments' emphasis on non-agriculture growth (Zeng and Zhou, 2024), while agriculture is unaffected. A key feature is that career incentives operate as an investment wedge: because infrastructure generates positive spillovers both within and across regions that individual jurisdictions do not fully internalize, local governments underinvest relative to the social optimum in the absence of career motivation. Career incentives partially correct this inefficiency by acting as a subsidy for this investment, though sufficiently strong incentives may also lead to overinvestment, implying the existence of an interior optimal level.

I recover the career incentive wedge by inverting the model to match observed

[1]China has five administrative tiers: the central government, 34 province-level divisions, 333 prefecture-level divisions, 2,844 county-level divisions, and approximately 39,000 township-level divisions. This paper focuses on the prefecture level.

data on infrastructure spending shares, GDP per capita, and sectoral employment shares across prefectures. Song and Xiong (2024) recover a similar object at the national and provincial level, but under a non-spatial model that cannot capture spatial competition across jurisdictions. The recovered wedge exhibits substantial geographic dispersion. As an external consistency check, I examine its correlation with observable proxies for career motivation not used in the inversion. The wedge displays a hump-shaped relationship with prefecture party secretary age, peaking in the early-to-mid 50s and declining for officials approaching retirement, which is consistent with the promotion incentive literature.

I conduct three counterfactual exercises to quantify the aggregate consequences of career incentive distortions. In the first, I compress career incentives to the national median across all prefectures. This reduces aggregate infrastructure investment by 19.9%, yet *raises* household welfare by 0.039%, implying that the baseline spatial allocation of public capital is inefficient: career incentives channel investment toward locations where private political returns are high rather than where social returns are highest. In the second, I uniformly increase career incentives by 10% to reflect political cycle change and find that the national infrastructure spending share rises by 5.7%, with labor reallocating primarily into manufacturing due to its higher infrastructure elasticity.

In the third exercise, I examine whether career incentives can serve as a place-based policy instrument. I focus on Guangdong province, which exhibits substantial within-province inequality in income and infrastructure. I increase career incentives only in the province's poorest prefectures, analogous to a provincial leader strategically appointing a connected official to a lagging jurisdiction. This exercise captures spatial spillovers of targeted incentive policies: stronger career incentives in targeted prefectures attract labor and economic activity, generating direct gains for those regions but potentially drawing resources from neighboring prefectures. I equalize career incentive within Guangdong province, this will cause spatial spillover and reduce overall households' welfare by 0.024%.

Related Literature. This paper contributes to three strands of literature: the role of political connections in economic development, spatial structural change, and the use of quantitative spatial equilibrium models to evaluate the aggregate effects of local government behavior.

First, this paper extends the literature on political connections and their economic consequences in China. Local officials are the primary agents responsible for economic

development in their jurisdictions, and career incentives are a central motivation for their intervention in the local economy (Li and Zhou, 2005; Xu, 2011; Yao and Zhang, 2015). Connections with higher-level authorities are a key determinant of promotion prospects (Jia et al., 2015), which in turn shape officials' policy choices. Jiang (2018) exploit connections between city- and provincial-level leaders and show that connected officials achieve higher local GDP growth, partly through greater emphasis on development in policy documents.

I follow Jiang (2018) in measuring connections between city- and provincial-level leaders, but my identification strategy differs in an important respect. Jiang (2018) estimate the effect of gaining a connection, which raises endogeneity concerns since connection formation may itself reflect unobserved political or economic factors. I instead exploit the loss of connections driven by provincial leadership turnover, events largely exogenous to city-level conditions, to identify the causal effect of political connections on local investment and structural change. Connected regions also receive larger fiscal transfers from higher-level governments (Jiang and Zhang, 2020), though this finding is contested: Sun (2023), using a different measure based on shared work experience, find no transfer effect but instead show that connected officials shift spending toward infrastructure and away from innovation, consistent with infrastructure offering more visible short-run returns. This paper goes further by examining how political connections shape local structural transformation and by quantifying the aggregate implications through a spatial equilibrium framework. [2]

Second, this paper contributes to an emerging literature on spatial structural transformation. A large body of work studies structural change across countries, emphasizing market-driven mechanisms such as differential productivity growth, income effects, and relative price changes (Herrendorf et al., 2014; Gollin and Kaboski, 2023), but political determinants have received far less attention (see Martinez-Bravo and Wantchekon (2023) for a review). Cheremukhin et al. (2024); Song and Xiong (2024) show that political economy frictions have been quantitatively important for China's economic development, but neither study incorporates a spatial equilibrium framework. Brandt et al. (2026) document regional convergence in manufacturing productivity and trace it to the decline of state-sector entry barriers, though their focus is on firm dynamics rather than structural transformation across sectors.

A recent strand of this literature employs quantitative spatial models to analyze

[2]For a comprehensive survey of research on China's growth and macro-development, see Chen and Zha (2025).

within-country structural change (Desmet and Rossi-Hansberg, 2014; Tombe and Zhu, 2019; Trew, 2020; Nagy, 2023; Eckert and Peters, 2025; Fan et al., 2023). The most closely related papers are Eckert and Peters (2025), who study the structural transformation of the U.S. economy from agriculture to manufacturing in a spatial framework, and Fan et al. (2023), who analyze service-led growth and its spatial implications in India. I study China, where the institutional environment differs markedly: local officials exercise substantial discretion over public investment, and political connections shape how that discretion is used. Relative to existing spatial models of structural change, my key innovation is to endogenize infrastructure investment as a decision of career-motivated local officials, where infrastructure raises productivity in manufacturing and services and thereby affects the pace of local structural transformation.

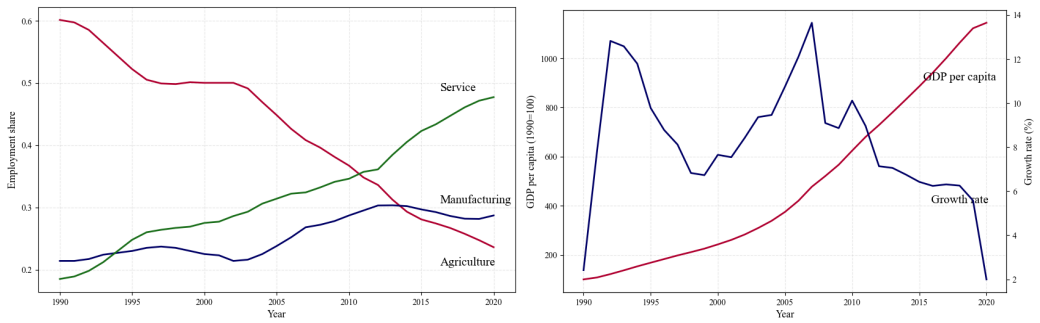
Third, this paper relates to a small but growing literature that incorporates local government decision-making into spatial equilibrium models. Lu et al. (2024) study how Chinese local governments allocate land across residential, manufacturing, and commercial uses, and quantify the aggregate costs of pro-manufacturing land policies. Bordeu (2023) model decentralized infrastructure provision across municipalities within a city and show that it generates underinvestment near jurisdictional boundaries and overinvestment near core areas. At the national level, Jiang (2025) embed strategic state governments in a spatial model of the U.S. highway network and find that states underinvest in interstate connections, producing welfare losses. A common theme in this literature is that political jurisdictions distort infrastructure provision relative to a planner's benchmark. My contribution is to introduce a distinct source of distortion, i.e. career incentives tied to political connections, which operates as an investment wedge. A novel implication is that stronger career incentives can act as a Pigouvian subsidy, partially offsetting the underinvestment problem that arises from jurisdictional fragmentation.

Road Map. The structure of the paper is as follows. Section 2 provides context on China's structural transformation and its spatial heterogeneity. Section 3 presents the motivating facts on the relationship between political connections, infrastructure investment, and spatial structural change in China. Section 4 develops a dynamic spatial general equilibrium model of structural change with career-motivated local officials. Section 5 describes the estimation strategy to bring the model to the data. Section 6 presents the quantitative results, including the recovered career incentives and counterfactual analyses. Section **??** discusses the robustness of the results. Section 7 concludes.

2 Context

Rapid structural change and economic growth at the national level during 1990-2020.

I follow China's national standard industrial classification (GB/T 4754—2011), which groups industries into primary (agriculture), secondary (mining, manufacturing, utilities, construction), and tertiary (services) sectors. Figure 1 depicts China's occupational structure and real GDP per capita in China from 1990 to 2020. During this period, China underwent substantial structural transformation. The agriculture employment share fell from 60% in 1990 to about 20% in 2020. While workers shifted to both manufacturing and services, the secondary sector employment share only grows slightly between 20% and 30%. The service sector exhibited consistent employment growth, expanding from approximately 10% in 1990 to 50% in 2020.



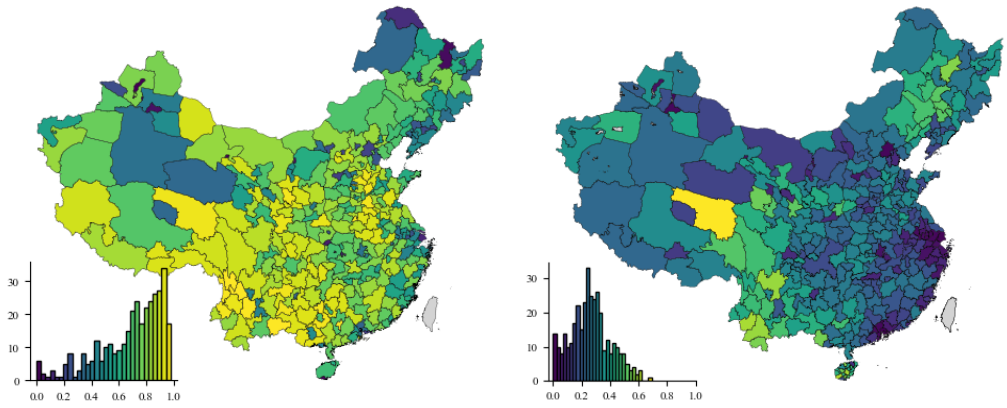
(a) Occupational structure **(b)** GDP per capita and growth rate

Figure 1. Occupational structure and GDP per capita of China during 1990-2020. *Notes:* Panel (a) shows the employment share in the three broader sectors: agriculture (or primary), manufacturing (or secondary), and service (or tertiary) sector across China from 1990 to 2020. In the following part, I use agriculture, manufacturing, and service to denote the three sectors. Panel (b) shows the real GDP per capita and growth rate of real GDP per capita in China from 1990 to 2020. Data source: the National Bureau of Statistics of China.

Structural change is uneven across space.

The occupational structure in China during 1990-2020 exhibited substantial regional heterogeneity. Figure 2 displays the agricultural employment share across prefectures in 1990 and 2020. In 1990, agricultural employment predominated nationwide, though share were lower in northeast and coastal regions compared to the

hinterland. This spatial pattern persisted through 2020, despite the substantial overall decline in agricultural employment. By 2020, the distribution shifted leftward, with most regions falling below 40% agricultural employment. In particular, the Yangtze River Delta region–encompassing Shanghai, Suzhou, Hangzhou, and surrounding prefectures–maintained consistently lower agricultural employment shares than western regions.



(a) 1990 **(b)** 2020

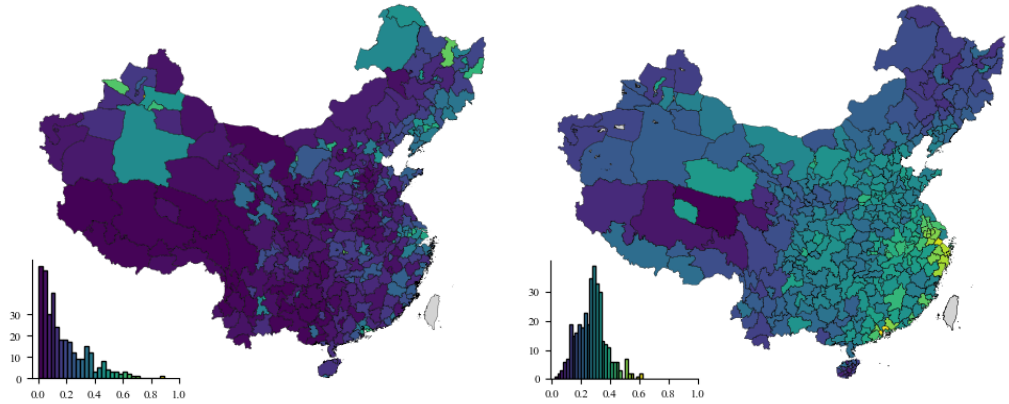
Figure 2. Employment share in the agriculture sector in 1990 and 2020.
Notes: The histograms at the south-west of each sub-figure are the count of regions (y-axis) against the employment share in the agricultural sector (x-axis). Data source: Census in 1990 and 2020.

Manufacturing employment shares also exhibited significant spatial variation. As Figure 3 illustrates, the average manufacturing employment share increased from approximately 17% in 1990 to 27% in 2020. In 1990, China's industrial activity concentrated in the Northeast region, including Shenyang, Dalian, and surrounding regions. However, this region declined in relative manufacturing prominence during the transformation period. By 2020, manufacturing activity had shifted substantially, with the Yangtze River Delta and the Pearl River Delta regions–including Guangzhou, Shenzhen, and neighboring cities–emerging as China's dominant manufacturing hubs.

For the service sector (Figure 4), the entire distribution shifted rightward. In 1990, most prefectures had service employment share below 20%, whereas by 2020, even the lowest recorded share exceed 20%. At the prefecture level, provincial capitals consistently maintained higher service employment shares than surrounding prefectures.

In summary, structural transformation in China exhibits pronounced spatial heterogeneity, necessitating the incorporation of geographic factors and local economic

and political characteristics into any comprehensive analysis.



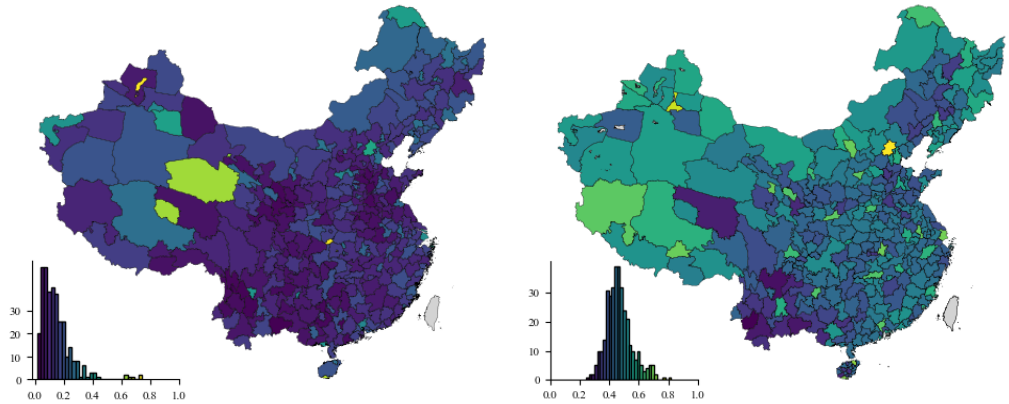
(a) 1990 **(b)** 2020

Figure 3. Employment share in the manufacturing sector in 1990 and 2020. *Notes:* The histograms at the south-west of each sub-figure are the count of regions (y-axis) against the employment share in the manufacturing sector (x-axis). Data source: Census in 1990 and 2020.

3 Motivating Facts: Political Connection and Spatial Structural Change

3.1 Data Description

Economic data I obtain economic data from the City Statistical Yearbook (CSY) for 1990 to 2020. Sectoral value added share in GDP is the key outcome variable to evaluate the structural change. In addition, I get data on local government tax income, public expenditures, and local public goods, such as schools and hospitals, from the CSY for each region. In addition, I use the 1% sample from Census data for 1990, 2000, 2010, and 2020 to obtain the occupational structure by prefecture. The employment shares in the agriculture, manufacturing, and services, serve as key variables to invert wages. The infrastructure spending data is from the China Urban-Rural Development Statistical Yearbook during 2002-2017. I use the indicator *Fixed Asset Investment in Municipal Public Facilities* to denote infrastructure spending. This indicator includes investment in transportation networks, water supply systems, heating facilities, and other municipal public facilities. The fiscal transfer data is from the *Public Finance Statistical Materials of Prefectures, Cities, and Counties (quanguo*



(a) 1990 **(b)** 2020

Figure 4. Employment share in the service sector in 1990 and 2020.
Notes: The histograms at the south-west of each sub-figure are the count of regions (y-axis) against the employment share in the service sector (x-axis). Data source: Census in 1990 and 2020.

dishixian caizheng tongji ziliao) from 2001 to 2009. After 2009, the statistics is not available.

Local officials' data To construct patronage networks or political connection, I use the China Center for Economic Research (CCER) Officials Dataset (Yao et al., 2020), which provides the most comprehensive and reliable data on Chinese officials currently available. Due to data limitations, the dataset includes only chief officials at the prefecture level–mayors and party secretaries–from 1994 to 2017. These officials serve as local leaders responsible for local economic development. I use these data to identify the political connection between local officials and upper level authorities, and to calculate promotion probabilities for local officials across prefectures.

3.2 Political Connection and Structural Change

Here we examine whether city leaders' political connection affect local structural transformation via distorting local public investment. Specifically, we focus on the patronage network between city leaders and provincial leaders, since this patronage-client relationship could affect the promotion of city leaders and this is complementary with local economic performance (Jia et al., 2015). I use the political connection in Jiang (2018) to capture the patronage network between city leaders and provincial

leaders.[3]

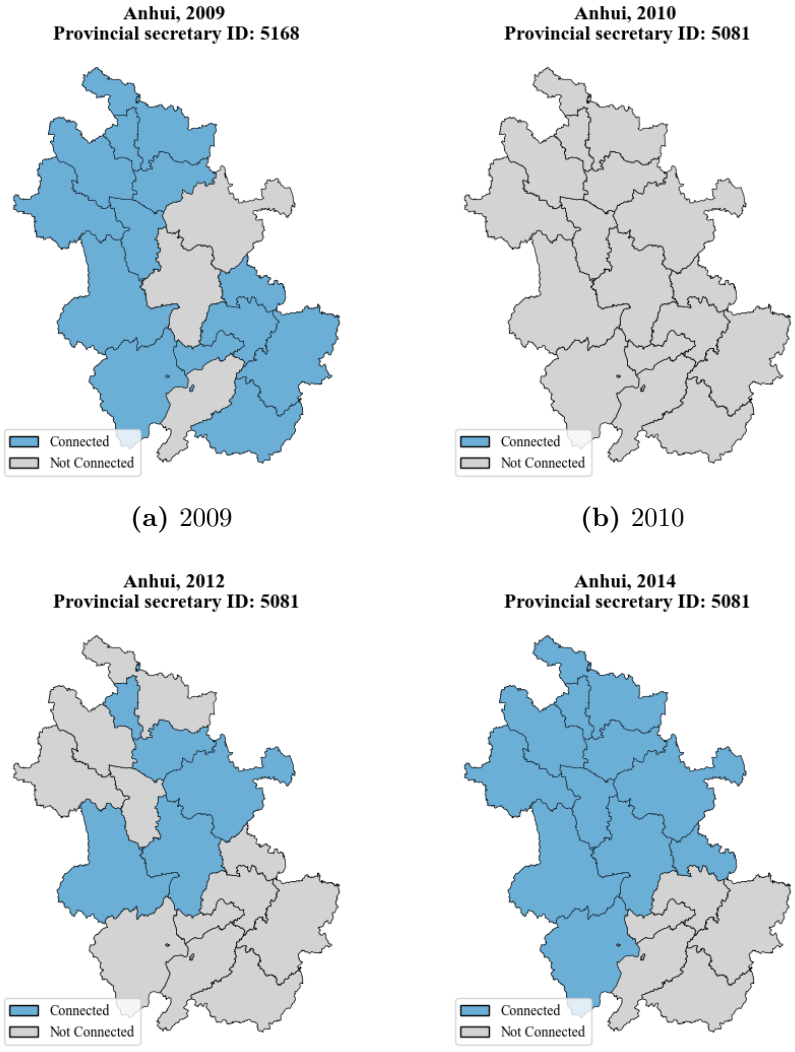
There are of course some other political connections across officials, such as hometown, colleague, university alumni. However, these definitions can only capture the acquaintance but not *quality* of connection. There are both cooperation and competition among these groups, which could have positive (Jia et al., 2015) or negative (Fisman et al., 2020) effects on officials' career. Since here we focus on city leaders' career incentive and promotion probability, we use the previous promotion relationship between city leaders and provincial leaders. This can capture the patronage-client relationship well. Some studies also use this definition both in political science (Jiang, 2018) and economics (Jiang and Zhang, 2020; Chu et al., 2025; Xu et al., 2025)

However, gaining connection could be endogenous due to strategic appointment. Therefore, I, unlike previous studies, use a new variation to estimate the effects of *losing connection*. The identification logic is that the loss of political connection is mainly due to the turnover of provincial secretaries, which is quite exogenous to city leaders and city-level economic conditions. In addition, I restrict the sample to the turnover window to identify the effect of losing political connection on local structural change. Specifically, to exclude the potential endogenous selection within the provincial leaders' term, I keep the last year and the first year of provincial secretary's tenure for each province. Then the regions connected in the last year is treatment group, and it loses the connection in the first year of new provincial leader, which is plausibly exogenous.

Figure 6 shows the number of prefectures in the treatment and control groups that lose political connection due to provincial leader turnover from 2000 to 2017. Since I restrict the sample to the turnover window of provincial party secretaries, the sample size in each year varies. In the years of the National Congress of the CCP, the turnover of provincial party secretaries is more likely to happen. Hence, there are more prefectures in treatment in these years.

Table 1 reports summary statistics for the key variables used in the analysis. The sample covers Chinese prefectures from 2000 to 2017, restricted to the last year and first year of each provincial party secretary's term — that is, the turnover window that generates variation in political connections. The average prefecture in the sample derives approximately 16% of its value added from agriculture, 48% from manufacturing, and 37% from services, reflecting an economy still in the midst of structural

[3]The defition is: A city leader is politically connected with provincial leader if and only if the city leader was first promoted to a city leadership position (as city party secretary or mayor) from within province when the provincial leader was serving as the provincial secretary of that province.



(a) 2009 **(b)** 2010

(c) 2012 **(d)** 2014

Figure 5. Variation in the Connection Status: Anhui Province (2009-2014)
Notes: This figure shows the evolution of the connection status variable in Anhui province. Cities governed by leaders connected to the incumbent provincial secretary are marked in blue.

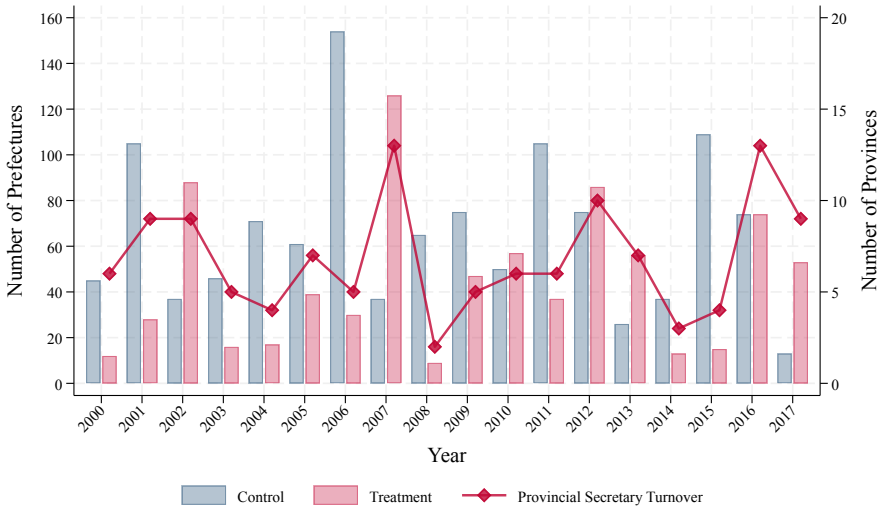


Figure 6. Treatment and control groups losing political connection due to provincial leader turnover.
Notes: I restrict sample to the turnover window of provincial party secretaries, this is why the sample size in each year is various. The treatment group includes prefectures whose leaders were politically connected to the provincial party secretary in the party secretary's term last year.

transformation over this period. Log infrastructure spending has a mean of 11.4 with substantial cross-prefecture variation (s.d. = 1.5), and infrastructure accounts for roughly 14% of total spending on average.

Turning to official characteristics, the average provincial party secretary is about 52 years old, and mayors are slightly younger at around 50. Both positions are overwhelmingly held by men, with only 3% of secretaries and 6% of mayors being female. College education rates are higher among mayors (41%) than secretaries (46%), and very few officials share a hometown with the provincial secretary (about 1% of both secretaries and mayors). The political connection indicator has a mean of 0.82, indicating that in most prefecture-year observations within the turnover window, the city leader had an existing connection to the provincial secretary — consistent with connections being common and their *loss* providing the identifying variation.

3.2.1 Effects on infrastructure spending and fiscal transfer

Local governments decide most part of local infrastructural investment. When local officials make this decision, one key factor is their own career prospects. Figure 7 shows the effects of losing connection on infrastructure spending. Prefectures that

Table 1. Summary statistics of key variables

	mean	sd	min	max	count
Agriculture Value-Added Share	0.156	0.098	0.000	0.773	2022
Manufacturing Value-Added Share	0.477	0.109	0.149	0.859	2022
Service Value-Added Share	0.368	0.086	0.000	0.773	2022
Infrastructure Spending (ln)	11.364	1.549	5.247	16.094	1759
Infrastructure Spending per Capita (ln)	5.503	1.465	-1.306	9.516	1756
Infrastructure Spending Share	0.136	0.143	0.000	0.890	1744
GDP (ln)	6.541	1.089	2.887	9.741	2022
Population (ln)	5.859	0.677	2.770	7.096	2007
GDP per Capita (ln)	9.917	0.861	7.776	12.281	2021
Secretary Age	51.854	3.759	32.000	60.000	2015
Secretary Female (0/1)	0.032	0.177	0.000	1.000	2020
Secretary College Education (0/1)	0.459	0.498	0.000	1.000	2022
Secretary Same Hometown as PSec (0/1)	0.009	0.094	0.000	1.000	2022
Mayor Age	49.815	4.022	33.000	67.000	1928
Mayor Female (0/1)	0.058	0.235	0.000	1.000	1935
Mayor College Education (0/1)	0.405	0.491	0.000	1.000	2022
Mayor Same Hometown as PSec (0/1)	0.012	0.111	0.000	1.000	2022
Had Political Connection	0.822	0.383	0.000	1.000	1988

Notes: This table reports the summary statistics of key variables in the regression analysis. The sample size is from 2000 to 2017. I restrict samples to the last year and first year of provincial party secretaries' term, i.e. the turnover window of the party secretary. The classification of sectors is based on the Industrial Classification for National Economic Activities (GB/T 4754—2011). The three sectors are defined as follows: The primary sector comprises agriculture, forestry, animal husbandry, and fisheries, excluding service activities related to these industries. The secondary sector comprises mining (excluding mining support activities), manufacturing (excluding repair of metal products, machinery, and equipment), the production and supply of electricity, heat, gas, and water, and construction. The tertiary sector, i.e., the service sector, comprises all industries not included in the primary or secondary sectors. Specifically, it includes: wholesale and retail trade; transportation, warehousing, and postal services; accommodation and food services; information transmission, software, and information technology services; finance; real estate; leasing and business services; scientific research and technical services; water conservancy, environmental management, and public infrastructure management; household services, repair services, and other services; education; health care and social work; culture, sports, and entertainment; public administration, social security, and social organizations; international organizations; as well as agricultural, forestry, animal husbandry, and fishery service activities reclassified from the primary sector, mining support activities reclassified from mining, and the repair of metal products, machinery, and equipment reclassified from manufacturing. The total infrastructure spending in the prefecture is measured by *Fixed Asset Investment in Municipal Public Facilities* from the China Urban-Rural Development Statistical Yearbook. Other economic data come from China City Statistics Yearbook. Prefecture party secretary and mayor' data come from China Center for Economic Research (CCER) Officials Dataset.

lose political connections subsequently experience a decline in infrastructure spending across all measures—aggregate levels, per capita expenditure, and the infrastructure share of the local budget. Notably, these effects materialize immediately in the first post-turnover period, consistent with infrastructure investment being a particularly flexible margin of local fiscal adjustment.

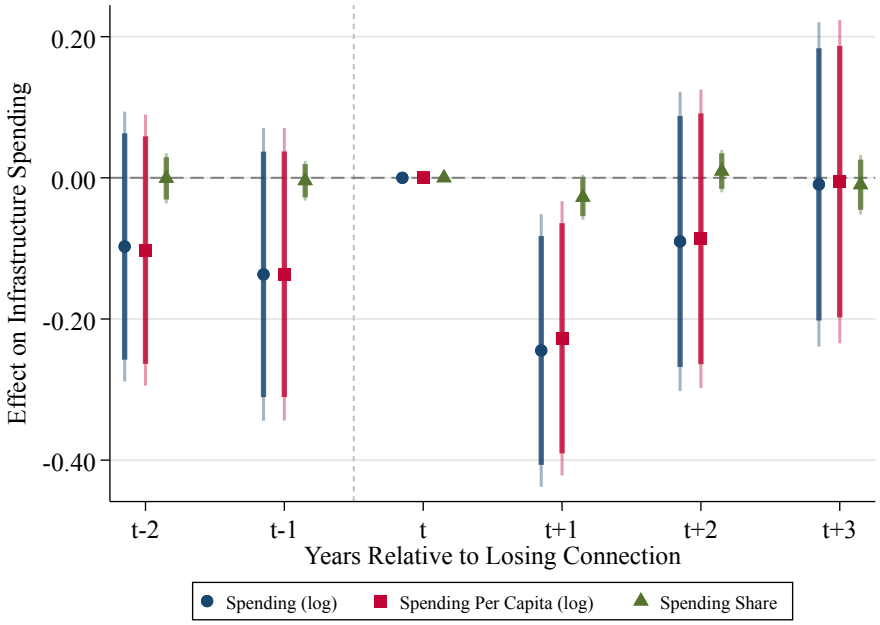


Figure 7. The effects of losing connection on infrastructure spending

Notes: The figure shows the estimated results of regression: $y_{i,p,t+k} = \beta_0 + \beta_1\, had_connection_i \times psec_change_t + \Gamma \mathbb{X}_{i,t} + \gamma_i + \eta_{p,t} + \epsilon_{i,t}$ for total infrastructure spending, infrastructure spending per capita, and infrastructure spending share of all local government expenditure. The infrastructure spending data is from the China Urban-Rural Development Statistical Yearbook during 2002-2017. I use the indicator *Fixed Asset Investment in Municipal Public Facilities* to denote infrastructure spending. This indicator includes investment in transportation networks, water supply systems, heating facilities, and other municipal public facilities. The thick bars denote 90% CIs and thin bars denote 95% CIs.

I also examine the effect on total government spending and revenues. While the total expenditure declines, the total government revenues and expenditure and revenues per capita are not affected. This supports that the main mechanism is the allocation of local government revenues across governments' expenditure and infrastructure investment.

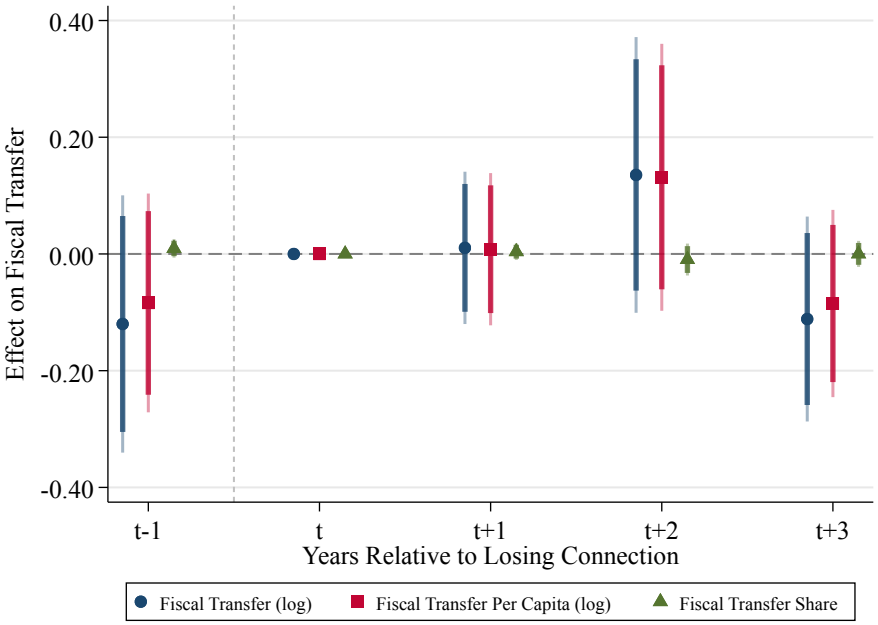


Figure 8. The effects of losing connection on fiscal transfer

Notes: The figure shows the estimated results of regression: $y_{i,p,t+k} = \beta_0 + \beta_1\, had_connection_i \times psec_change_t + \Gamma \mathbb{X}_{i,t} + \gamma_i + \eta_{p,t} + \epsilon_{i,t}$ for total fiscal transfer, fiscal transfer per capita, and fiscal transfer share of all local government expenditure. The fiscal transfer data is from the *Public Finance Statistical Materials of Prefectures, Cities, and Counties (quanguo dishixian caizheng tongji ziliao)* from 2001 to 2009. After 2009, the statistics is not available. The thick bars denote 90% CIs and thin bars denote 95% CIs.

Table 2. Political Connection and Total Government Spending and Revenue

	(1) Total Exp.	(2) Exp. per capita	(3) Total Rev.	(4) Rev. per capita
Treat × Post	-0.064**	-0.043	-0.041	0.006
	(0.029)	(0.031)	(0.034)	(0.027)
R^2	0.945	0.925	0.981	0.978
Prefectures	278	278	278	278
Observations	1684	1684	1682	1684
Mean of Dep. Var.	4.769	8.106	4.377	7.277

Notes:: Sample size is from 2000-2017. Dependent variable is 1-year forward total government spending and revenue (log). All regressions include prefecture and province×year FE. Controlled city leaders' characteristics, including age, gender, education, and hometown network. Controlled pre-appointed economic conditions, including GDP, population size, and secondary GDP ratio. Standard errors clustered at prefecture level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

3.2.2 Heterogeneous Effects by Age

Age is a critical determinant of promotion prospects for Chinese officials (Li and Zhou, 2005), which in turn shapes their economic decisions, including infrastructure investment. Figure 9(a) presents the age distribution and promotion probabilities for municipal party secretaries. Both the median and mean ages are approximately 52 years. I use this threshold to classify officials as "young" (≤ 52) or "old" (> 52) and examine heterogeneous responses to the loss of political connections across these groups.

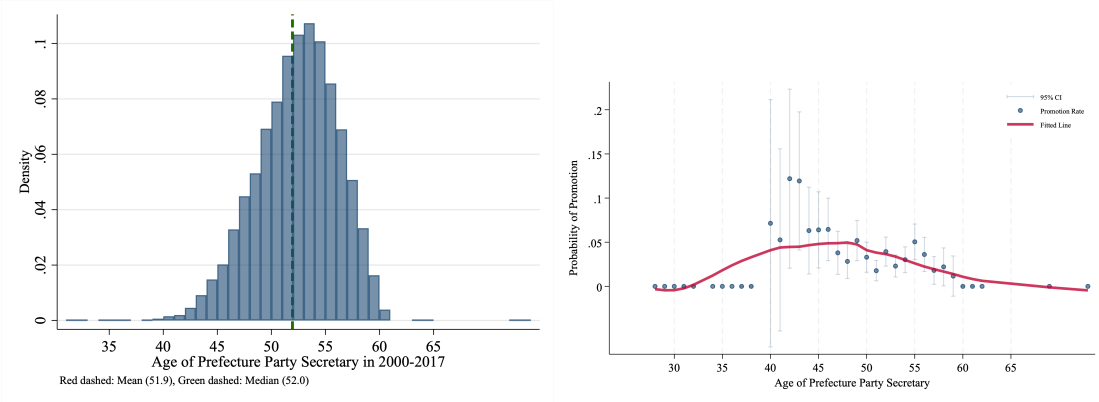
The underlying mechanism is straightforward. Younger officials face stronger career incentives: with longer time horizons and higher promotion probabilities, they have greater motivation to signal competence through visible infrastructure projects that stimulate local economic growth. Consequently, when these officials lose their political connections, the reduction in their infrastructure spending should be more pronounced. In contrast, older officials—facing diminished promotion prospects regardless of their connections—have weaker baseline incentives to invest in growth-enhancing infrastructure, implying a more muted response to connection loss.

Table 3 presents the heterogeneous effects by official age. The variable *Young* is an indicator equal to one if the municipal party secretary is aged 52 or below (the sample median). Column (1) reports results for log infrastructure spending, Column (2) for per capita infrastructure spending, and Column (3) for infrastructure's share of total fiscal expenditure.

The coefficient on the interaction term (*Lose Connection* $\times$ *Young*) is negative across all specifications, reaching statistical significance in Column (3). This pattern suggests that younger officials exhibit a stronger response to connection loss than their older counterparts. More importantly, the total effect for young officials—computed as $\beta_1 + \beta_2$—is negative and statistically significant at the 5% level across all three outcome measures. In terms of magnitude, young officials who lose their political connections reduce infrastructure spending by approximately 20 percent, and decrease the infrastructure share of fiscal expenditure by 3.4 percentage points. Given that the sample mean of infrastructure share is 13.6%, this represents a reduction of roughly 25% relative to the mean.

By contrast, the coefficient on *Lose Connection* alone—which captures the effect for older officials—is negative but statistically indistinguishable from zero. This asymmetry is consistent with the career incentives mechanism: younger officials, facing stronger promotion incentives, respond more sharply to the loss of patronage

ties.



(a) Age distribution **(b)** Promotion probability by age

Figure 9. Age distribution and promotion probability of municipal secretaries

Notes: Panel (a) shows the age distribution of municipal secretaries in 2000-2017. Panel (b) plots the promotion probability by age group and period. Promotion is defined as being promoted to a higher-level position (e.g., from municipal secretary to provincial official). I calculate the promotion probability for each age year and plot the average promotion probability for each age year.

3.2.3 Effects on local structural transformation

Since structural transformation is a slow process, I estimate the difference between forward 1-3 years to the year losing connection. The regression is

$$y_{i,p,t+k} - y_{i,p,t} = \beta_0 + \beta_1 \, had_connection_i \times psec_change_t + \Gamma \mathbb{X}_{i,t} + \gamma_i + \eta_{p,t} + \epsilon_{i,t} \quad (1)$$

where $y_{i,p,t}$ is the value added share in various sectors in prefecture i located in province p at year t. $k = 1, 2, 3$ denotes the forward years after losing connection. The key independent variable is $had_connection_i \times psec_change_t$, $had_connection_i$ equals 1 if the prefecture is connected to the provincial leader in the last year of the provincial leader's tenure, 0 otherwise; $psec_change_t$ equals 1 if this is the first year of new provincial party secretary's tenure, 0 otherwise. β_1 captures the effects of losing connection on local structural change. γ_i is the prefecture fixed effects and $\eta_{p,t}$ is the province-year fixed effects to capture time-varying province-level confounders, such as changes in provincial leadership priorities, provincial industrial policies. $\mathbf{X}_{i,t}$ includes city leaders' individual characteristics: age, gender, college education, and whether the city leaders have the same hometown (city) with the provincial party secretary; and pre-appointment economic conditions: GDP, population size, and secondary industry share.

Table 3. Political Connection and Infrastructure Spending by Party Secretary Age

	(1) Infras Spending	(2) Infras Spending PC	(3) Infras Spending Share
Lose Connection	-0.156	-0.138	-0.008
	(0.105)	(0.106)	(0.016)
Lose Connection × Young	-0.091	-0.091	-0.026***
	(0.069)	(0.069)	(0.009)
Young (Age ≤ 52)	0.168***	0.172***	0.028***
	(0.058)	(0.058)	(0.008)
Total Effect of losing connection for Young Officials	-0.246**	-0.229**	-0.034*
	(0.103)	(0.104)	(0.017)
R-squared	0.871	0.857	0.787
Prefectures	268	268	268
Observations	1550	1550	1542
Mean of Dep. Var.	11.453	5.563	0.136

Notes: The results are from regressions: $y_{i,p,t+1} = \beta_0 + \beta_1 lose_connection_{i,t} \times young_{i,t} + \beta_2 lose_connection_{i,t} + \beta_3 young_{i,t} + \Gamma \mathbb{X}_{i,t} + \gamma_i + \eta_{p,t} + \epsilon_{i,t}$. Dependent variable is 1-year forward infrastructure spending (log) and infrastructure share. Young = 1 if municipal secretary age ≤ 52 (Median). Total effect for young = $\beta_1 + \beta_2$ All regressions include prefecture and province×year FE. Standard errors clustered at prefecture level in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 10 presents estimates for sectoral value-added shares. Prefectures experiencing a loss of political connections exhibit a significant decline in manufacturing share, accompanied by a modest increase in agricultural share.

To gauge the economic magnitude, consider the agricultural sector: the average decline in agricultural share over two years is 1.29 percentage points, reflecting ongoing structural transformation. Prefectures losing political connections experience a 0.30 percentage point smaller decline, offsetting approximately one-quarter of the typical transition away from agriculture. The pattern is more pronounced for manufacturing: while the sample mean change in manufacturing share is positive (0.39 percentage points), consistent with ongoing industrialization, the estimated coefficient of -0.52 percentage points implies that prefectures losing connections experience a net decline in manufacturing share—running counter to the prevailing trend. The loss of connections thus not only slows but reverses the trajectory of industrial upgrading in affected prefectures.

Taken together, these results indicate that political connections facilitate structural transformation, and their dissolution impedes the transition from agriculture to manufacturing.

These estimates likely represent a lower bound of the true effect. In the years

following a leadership transition, some prefectures may establish new connections with the incoming provincial leader, attenuating the estimated impact of losing prior connections.

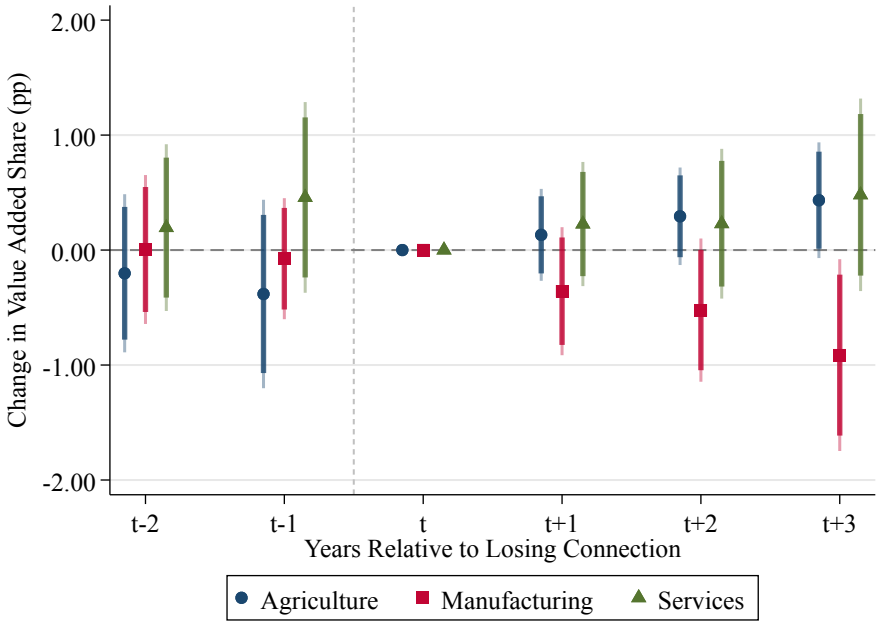


Figure 10. The effects of losing connection on sectoral value added share
Notes: The figure shows the estimated results of Equation 1. The thick bars denote 90% CIs and thin bars denote 95% CIs.

4 A Dynamic Spatial Model of Structural Change

Motivated by these stylized facts in Section 3, I develop a dynamic spatial general equilibrium model to analyze the effects of local governments' public investment distortions on spatial development, especially regional structural change, in China. In particular, I extend Eckert and Peters (2025)'s model to three sectors and incorporate political determinants of economic development, building on the contributions by Song and Xiong (2024).

The economy comprises R regions, indexed by $i, j \in 1, ..., R$. Regions differ in amenities, productivity, and local investment distortions. Each region contains three broad sectors: agriculture (A), manufacture (M), and services (S), with heterogeneous productivity growth rates across sectors. The growth rate of productivity in three sectors is different. Time, t, is discrete. The economy has an exogenous, constant total labor force, $\bar{L}_t$, with workers selecting their sector of employment each period [4].

In each region, local governments levy taxes at rate τ_{it} and provide public investment, G_{it}, which enhance sectoral productivity and accumulate over time. To characterize local government distortions, I introduce an investment wedge, κ_{it} to reflect distortions in public investment allocation. Local officials maximize an objective function that includes consumption utility and career promotion, allocating resources between government expenditure and public goods investment. I will explain details about this government mechanism in Section 4.3.

4.1 Household

Households face three sequential decisions. First, they choose a region in which to reside, subject to migration costs. Second, upon arrival, individuals learn their sector-specific labor productivity and select the sector offering the highest wages. Third, they allocate income across consumption goods to maximize their utility. Households are hand-to-mouth consumers who exhaust their earnings each period. Below, I first specify household preferences and consumption decisions before addressing spatial mobility and sectoral choice.

[4] Meng (2023) demonstrates that China's labor supply growth between 1985 and 2015 was negligible, as increases in working-age population were offset by declining labor force participation rates. Consequently, labor supply expansion contributed minimally to economic growth during this period, justifying its omission from my model.

Preferences

Since the change of expenditure share across sectors is a key feature of structural change, I use non-homothetic preferences to model the consumption choice. In particular, I use the Price Independent Generalized Linear (PIGL) preferences, refer to Boppart (2014); Eckert and Peters (2025); Fan et al. (2023). Individuals value agricultural, manufacturing, and service goods. Since agriculture and manufacturing goods can trade across regions, we assume a CES function to aggregate varieties across regions.

$$c_{iA} = \left(\sum_{j=1}^{R} (c_{ijA})^{\frac{\sigma_A - 1}{\sigma_A}} \right)^{\frac{\sigma_A}{\sigma_A - 1}} \quad \text{and,} \quad c_{iM} = \left(\sum_{j=1}^{R} \int_0^{N_j} c_{ijM}(\omega)^{\frac{\sigma_M - 1}{\sigma_M}} d\omega \right)^{\frac{\sigma_M}{\sigma_M - 1}} \tag{2}$$

where c_{ijA} is the consumption of agricultural goods produced in region j by an individual living in region i. $c_{ijM}(\omega)$ is the consumption of manufacturing variety ω produced in region j by an individual living in region i. σ_A and σ_M are the elasticities of substitution across regions for agricultural and manufacturing goods, respectively. Service goods are non-tradable, so individuals can only consume local service goods, c_{iS}.

There is no explicit utility function for PIGL preference. The indirect utility function follows:

$$V(e, \mathbb{P}_{ist}) = \frac{1}{\eta} \left(\frac{e}{P_{iAt}^{\phi_A} P_{iMt}^{\phi_M} P_{iSt}^{\phi_S}} \right)^{\eta} - \sum_{s \in A,M,S} \nu_s ln P_{ist} \tag{3}$$

where e is expenditure, $\mathbb{P}_{ist}$ is the price vector. $P_{iAt}, P_{iMt}, P_{iSt}$ are the price of agricultural, manufacturing, and service goods, respectively. η is the Engel elasticity, which governs the shape of consumers' Engel curves. $\eta, \phi_s \in (0, 1)$.

We can get the individual expenditure share on sector s via the Roy's identity.

$$\vartheta_s(e, \mathbb{P}_{ist}) = -\frac{\partial V(e, P_{iAt}, P_{iMt}, P_{iSt})/\partial P_{rs}}{\partial V(e, P_{iAt}, P_{iMt}, P_{iSt})/\partial e} \cdot \frac{P_{is}}{e} \tag{4}$$

$$= \phi_s + \nu_s \left(\frac{e}{P_{iAt}^{\phi_A} P_{iMt}^{\phi_M} P_{iSt}^{\phi_S}} \right)^{-\eta} \tag{5}$$

where ϕ_s is the asymptotic expenditure share of sector s. Since $\eta > 0$, when $\nu_s > 0$, individuals reduce their expenditure share on sector s as their income increases. If $\eta = 1$ and $\nu_s = 0$, the PIGL preferences reduce to the standard homothetic Cobb-

Douglas preferences.

Labor supply choice

Spatial Mobility Individuals can migrate across regions. At the beginning of each period, workers can move to another region but face migration costs. I denote the distribution of workers across regions at the beginning and end of a period by $\{L_{it}\}_i$ and $\{L'_{it}\}_i$, respectively.

I assume that workers only know their labor productivity in each sector after they arrive in a location. The expected utility of a worker i from region r to region j at time t is given by:

$$\mathcal{U}^i_{rjt} \equiv \frac{\mathcal{V}_{jt}\mathcal{B}_{jt}}{\mu_{rjt}}\mu^i_{jt} \quad s.t. \quad \mathcal{V}_{jt} = \int V(e, p_{jt})dF_{jt}(e) \tag{6}$$

$\mathcal{V}_{jt}$ denotes the expected utility of a worker in region j at time t, which reflect the uncertainty of labor productivity after arrival region j. $\mathcal{B}_{jt}$ is amenities in location j at time t, which is exogenous [5]. μ_{rjt} is migration costs between region r and j at time t. μ^i_{jt} is the idiosyncratic location preference shock, which is independent across individuals and locations. It follows the Fréchet distribution, with shape parameter ϵ.

Workers migrate to region where they can maximize their expected utility. Using properties of the Fréchet distribution, we can show that the migration decision is given by:

$$m_{rjt} = \frac{(\mathcal{V}_{jt}\mathcal{B}_{jt}/\mu_{rjt})^\epsilon}{\sum_{j'}(\mathcal{V}_{j't}\mathcal{B}_{j't}/\mu_{rj't})^\epsilon} \tag{7}$$

where $\mathcal{V}_{jt} = \int V(e, \mathbb{P})dF_{jt}(e) = \frac{1}{\eta}\Gamma_{\frac{\zeta}{\eta}}(\bar{w}_{jt}/(P^{\phi_A}_{jAt}P^{\phi_M}_{jMt}P^{\phi_S}_{jSt}))^\eta + \sum_{s=A,M,S}\nu_s ln(P_{jst})$ is the expected utility.

Thus, the total workers in location j at the end of period t is given by:

$$L'_{jt} = \sum_r m_{rjt}L_{rt} \tag{8}$$

Sectoral labor supply One feature of structural transformation is labor reallocation across sectors. In other words, labor moves from agriculture sector to manufacturing and service sectors. To incorporate this, I assume workers are het-

[5] We can set that amenities are affect population density, such as $\mathcal{B}_{jt} = \mathcal{B}_j L^{-\rho}_{jt}$, which creates a congestion force. In the baseline model, I abstract away from this force.

erogeneous in their labor productivity across sectors. In particular, I use the typical Roy-type machinery. Workers are specialized in various sectors. An individual worker i in region r can supply z_s^i efficiency units labor to sector s that are drawn from a sector specific Fréchet distribution, $P(z_s^i \leq z) = F_s(z) = e^{-z^{-\zeta}}$. The parameter ζ captures the dispersion of efficiency units across workers in sector s. Thus, the income of each worker i who works in sector s is $z_s^i w_{rs}$, where w_{rs} denotes the payment for per efficiency unit of labor in sector s in region r.

Workers choose sector to maximize their income, y_r^i. In other words, $y_r^i = max_s\{z_s^i w_{rs}\}$. Since z follows the Fréchet distribution, the income also follows the Fréchet distribution, that is,

$$F_r(y) = e^{-(y/\bar{w}_r)^{-\zeta}} \quad where \quad \bar{w}_r = (w_{rA}^{\zeta} + w_{rM}^{\zeta} + w_{rS}^{\zeta})^{1/\zeta} \tag{9}$$

where $\bar{w}_r$ is the average earning in region r. Based on this, we can get the sectoral employment share and aggregate efficient labor supply:

$$s_{rs} = P(y_{rs}^i > y_{rs'}^i) = \frac{w_{rs}^{\zeta}}{\sum_s w_{rs}^{\zeta}} = \frac{w_{rs}^{\zeta}}{\bar{w}_{rs}^{\zeta}} \tag{10}$$

$$H_{rs} = s_{rs} L_r E(z_s^i | sector\ s\ chosen) \tag{11}$$

$$= (w_{rs}/\bar{w}_{rs})^{\zeta} L_r \Gamma_{\zeta} (w_{rs}/\bar{w}_{rs})^{-1} = \Gamma_{\zeta} L_r (w_{rs}/\bar{w}_{rs})^{\zeta - 1} \tag{12}$$

where $\Gamma_{\zeta} \equiv \Gamma(1 - 1/\zeta)$ and $\Gamma(\cdot)$ is the gamma function [6]. As shown in Eckert and Peters (2025), the parameter ζ captures the sectoral labor supply elasticity. The higher ζ is, the more elastic the labor supply is.

4.2 Production side

There are three sectors, agriculture, manufacturing, and service.

Agriculture Sector

The agriculture sector is a standard Cobb-Douglas production function.

$$Y_{iAt} = Z_{iAt} H_{iAt}^{1-\alpha} T_{iA}^{\alpha} \tag{13}$$

[6]The property of the Fréchet distribution: If the CDF is $F(x) = e^{-x^{-\alpha}}$, where α is a shape parameter. The expectation of x is $E(x) = \Gamma(1 - \frac{1}{\alpha})$ for $\alpha > 1$

where Z_{iAt} is the total factor productivity (TFP) in agriculture sector, which grows at an exogenous rate, H_{iAt} is the efficient labor, and T_{iA} is agricultural land, which is fixed. Thus, the agriculture sector is decrease return to scale.

The firm chooses labor demand to maximize its profit, we can get the labor demand function:

$$\pi_{iAt} = p_{iAt}Y_{iAt} - \tilde{w}_{iAt}H_{iAt} - r_{iAt}T_{iA} \tag{14}$$

where p_{iAt} is the price of agriculture goods, $\tilde{w}_{iAt}$ is the wage for per efficient labor in agriculture sector, r_{iAt} is the land rent.

Take the first order condition, we can get:

$$(1-\alpha)p_{iAt}Z_{iAt}H_{iAt}^{-\alpha}T_{iA}^{\alpha} = \tilde{w}_{iAt} \tag{15}$$

$$\alpha p_{iAt}Z_{iAt}H_{iAt}^{1-\alpha}T_{iA}^{\alpha-1} = r_{iAt} \tag{16}$$

We assume that the land rents also goes to workers in agricultural sector. Thus, the total payment in agricultural sector is $w_{iAt} \equiv \tilde{w}_{iAt} + \frac{\alpha}{1-\alpha}\tilde{w}_{iAt} = \frac{1}{1-\alpha}\tilde{w}_{iAt}$. Thus, the labor demand function of agricultural firms is:

$$H_{iAt} = p_{iAt}^{\frac{1}{\alpha}} w_{iAt}^{-\frac{1}{\alpha}} Z_{iAt}^{\frac{1}{\alpha}} T_{iA} \tag{17}$$

Manufacturing Sector

The manufacturing sector is the standard monopolistic competition but face a lump-sum tax. There is representative final goods firm to assemble the intermediate varieties to final manufacturing consumption goods.

$$Y_{iMt} = \left(\int_0^N y(\omega)^{\frac{\sigma_m-1}{\sigma_m}} d\omega\right)^{\frac{\sigma_m}{\sigma_m-1}} = \left(\sum_{j=1}^{R}\int_0^{N_{jt}} y_{jt}(\omega)^{\frac{\sigma_m-1}{\sigma_m}} d\omega\right)^{\frac{\sigma_m}{\sigma_m-1}} \tag{18}$$

where N is the total number of varieties available and N_{jt} is the number of varieties produced in location j, which is endogenous, σ_m is the elasticity of substitution across varieties.

Intermediate firms face entry costs, f_{iEt}. After firms entry local market, each firm produce a variety ω. The intermediate firm's technology follows:

$$y_{it}(\omega) = \tilde{Z}_{iMt}h_{ipt}(\omega) \tag{19}$$

$$\tilde{Z}_{iMt} = Z_{iMt}G_{it}^{\gamma_M} \tag{20}$$

where $\tilde{Z}_{iMt}$ and Z_{iMt} is the TFP in manufacturing sector, Z_{iMt} follows an exogenous process. G_{it} is the local public investment, such as infrastructure, and h_{ipt} is the efficient labor for production. I assume that the local infrastructure increases the manufacturing sector productivity of the city (as in Song and Xiong (2024); Chambru et al. (2024)). γ_M capture the intensity of the effect [7].

In addition, to provide local public goods, the local governments collect a lump-sum tax, τ_{it}, from the intermediate firm firms. Thus, for the intermediate firm, the profit function is:

$$\pi_{it} = p_{it}(\omega)y_{it}(\omega) - w_{iMt}h_{iMt} - \tau_{it} \tag{21}$$

subject to the demand function of the intermediate good:

$$y_{it}(\omega) = \left(\frac{p_{it}(\omega)}{P_{iMt}}\right)^{-\sigma} Y_{iMt} \tag{22}$$

where P_{iMt} is the price index of manufacturing goods in region i at time t,

$$P_{iMt} = \left(\sum_{i=1}^{R}\int_{0}^{N_{it}} p(\omega)_{ijt}^{1-\sigma_m}\lambda_{ijt}^{1-\sigma_m}\, d\omega\right)^{\frac{1}{1-\sigma_m}} \tag{23}$$

Since intermediate firms can freely enter regions, the profits should equal to the entry costs. This pins down the mass of firms in each region.

$$p_{it}(\omega)y_{it}(\omega) - w_{iMt}h_{ipt} - \tau_{it} - w_{iMt}f_{iEt} = 0 \tag{24}$$

Since the tax is lump-sum, it does not affect firms' decision. The optimal price of the intermediate goods is still a constant markup of the cost, $p_{it} = \frac{\sigma}{\sigma-1}MC$, where MC is the marginal cost of the intermediate goods. The profit for each firm is $\frac{1}{\sigma}p_{it}(\omega)y_{it}(\omega)$, which should equal to the entry cost.

$$\frac{1}{\sigma}p_{it}(\omega)y_{it}(\omega) = w_{iMt}f_{iEt} + \tau_{it} \tag{25}$$

To get the mass of firms in region i, we can use the free entry condition (I drop ω for

[7] Infrastructure, of course, could also affect the productivity in agriculture. However, in the baseline model, I assume the governments' interventions only affect the manufacturing and service sector to reflect local governments' incentives for boosting local economic development via pro-manufacturing and pro-service investment. In addition, Zeng and Zhou (2024) empirically demonstrate that local officials' career incentives only have significant effects on manufacturing and service sectors and no effect on agriculture sector, which support my assumption.

simplicity).

$$p_{it}y_{it} - w_{iMt}h_{ipt} - \tau_{it} - w_{iMt}f_{iEt} = 0 \tag{26}$$

$$\frac{w_{iMt}y_{it}}{\tilde{Z}_{iMt}} = (\sigma - 1)(\tau_{it} + w_{iMt}f_{iEt}) \tag{27}$$

$$w_{iMt}h_{iPt} = (\sigma - 1)(\tau_{it} + w_{iMt}f_{iEt}) \tag{28}$$

$$h_{iPt} = (\sigma - 1)(\tau_{it}/w_{iMt} + f_{iEt}) \tag{29}$$

where h_{iPt} is the labor for production in each intermediate firm. Thus, the total labor demand in manufacturing sector is:

$$H_{iMt} = H_{iPt} + H_{iEt} \tag{30}$$

$$N_{it} = \frac{H_{iMt}}{(\sigma f_{iEt} + (\sigma - 1)\frac{\tau_{it}}{w_{iMt}})} \tag{31}$$

Service Sector

Service goods are non-tradable and are produced by a local representative firm. The technology follows:

$$Y_{iSt} = \tilde{Z}_{iSt}H_{iSt} \tag{32}$$

$$\tilde{Z}_{iSt} = Z_{iSt}G_{it}^{\gamma_S} \tag{33}$$

where $\tilde{Z}_{iSt}$ is the TFP in service sector, Z_{iSt} is the exogenous service TFP, H_{iSt} is the efficient labor, γ_S captures the effect of local public goods on service sector productivity. I assume the service sector is perfectly competitive. The wage in service sector follows:

$$w_{iSt} = P_{iSt}\tilde{Z}_{iSt} \tag{34}$$

where w_{iSt} is the wage in service sector and P_{iSt} is the price of service goods.

4.3 Local government

In each region, local officials maximize their utility from consumption and the probability of career promotion. The local governments collect a lump-sum tax, τ_{it} from each intermediate firm. Thus, the total tax revenues are $N_{it}\tau_{it}$. These tax revenues

are used for local officials' consumption and providing local public investment. [8]

Local governments use tax revenues to provide local public goods and own consumption. Budget constraint of the local government follows:

$$E_{it}^G + I_{it}^G = \tau_{it} N_{it} \tag{35}$$

where E_{it}^G denotes expenditure for officials consumption, and I_{it} is spending on public investment. Public investment can accumulate and it evolves as:

$$G_{it+1} = (1 - \delta_{it}^G) G_{it} + I_{it}^G \tag{36}$$

where G_{it} is public investment, δ_{it}^G is the depreciation rate of the public investment.

Local government's decision problem Local governments face intertemporal consumption and public investment problem and intratemporal consumption problem. I assume that local officials also face PIGL preference within periods. The local officials' objective function of intratemporal problem in each period is:

$$U_{it}^G = V(E_{it}^G, P_{iAt}, P_{iMt}, P_{iSt}) + \kappa_{it} log(G_{it+1}) \tag{37}$$

where $V(E_{it}^G, P_{iAt}, P_{iMt}, P_{iSt}) = \frac{1}{\eta} \left(\frac{E_{it}^G}{P_{iAt}^{\phi_A} P_{iMt}^{\phi_M} P_{iSt}^{\phi_S}} \right)^{\eta} - \sum_{s \in A,M,S} \nu_s ln P_{ist}$ is the indirect utility from the PIGL preference, which is the same as the household's indirect utility function. E_{it}^G is the local officials' consumption. $\kappa_{it} \equiv \hat{\kappa}_{it+1} \frac{\sigma_a^2/\sigma_\xi^2}{\sigma_a^2/\sigma_\xi^2 + 1} \gamma$ denotes the governor's current-period incentive to invest in public goods. If $\kappa_{it} = 0$, there is no career incentives, local officials only care their own consumption. This setting follows Song and Xiong (2024) and the micro-foundation of the career incentives is in B. Here, κ_{it} is an investment wedge, which captures local public investment distortions from career incentives.

Combining equation (35) and (36), we obtain the local government's constraint is:

$$G_{it+1} = N_{it} \tau_{it} + (1 - \delta_{it}^G) G_{it} - E_{it}^G \tag{38}$$

For the intertemporal problem, local officials deal with the optimal spending and

[8] For the baseline model, I assume a lump-sum tax, which is exogenous. In the future, I will include other types of taxes and coercive capacity. For example, tax collection requires coercive capacity, C_{it}, which varies across local governments. Thus, the final taxes revenues are: $T_{it} = C_{it} \tau_{it} P_{iMt} Y_{iMt}$.

investing decision, i.e. choose E_{it}^G and G_{it+1} to maximize their objective.

$$\max_{E_{it}^G, G_{it+1}} U_{i0}^G = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left\{ V(E_{it}^G, P_{iAt}, P_{iMt}, P_{iSt}) + \kappa_{it} log(G_{it+1}) \right\} \tag{39}$$

$$s.t. \quad G_{it+1} = N_{it}\tau_{it} + (1 - \delta_{it}^G)G_{it} - E_{it}^G \tag{40}$$

The Lagrangian function is:

$$\mathcal{L} = \mathbb{E}_0 \left\{ \sum_{t=0}^{\infty} \beta_t \left(V(E_{it}^G, P_{iAt}, P_{iMt}, P_{iSt}) + \kappa_{it} log(G_{it+1}) + \lambda_{it}[N_{it}\tau_{it} + (1 - \delta_{it}^G)G_{it} - E_{it}^G - G_{it+1}] \right) \right\} \tag{41}$$

where λ_{it} is the Lagrange multiplier. Taking the first order condition, we can get:

$$\{E_{it}^G\}: \quad \frac{\partial V_{it}}{\partial E_{it}^G} - \lambda_{it} = 0 \tag{42}$$

$$\{G_{it+1}\}: \quad \kappa_{it} \frac{1}{G_{it+1}} - \lambda_{it} + \beta \lambda_{it+1}(1 - \delta) = 0 \tag{43}$$

where β is the discount factor. After some rearrangements, we can get the Euler equation:

$$\kappa_{it} \frac{1}{G_{it+1}} = \frac{\partial V_{it}}{\partial E_{it}^G} - \beta(1 - \delta) \frac{\partial V_{it+1}}{\partial E_{it+1}^G} \tag{44}$$

where $\partial V_{it} / \partial E_{it}^G$ is the marginal utility of consumption.

The Euler equation for local officials is:

$$\frac{\partial V_{it}}{\partial E_{it}^G} \frac{\partial E_{it+1}^G}{\partial V_{it+1}} - \kappa_{it} \frac{1}{G_{it+1}} \frac{\partial E_{it+1}^G}{\partial V_{it+1}} = \beta(1 - \delta) \tag{45}$$

$$\left(1 - \kappa_{it} \frac{1}{G_{it+1}} \frac{\partial E_{it}^G}{\partial V_{it}} \right) \frac{\partial V_{it}}{\partial E_{it}^G} \frac{\partial E_{it+1}^G}{\partial V_{it+1}} = \beta(1 - \delta) \tag{46}$$

where κ_{it} acts like an investment wedge. If $\kappa_{it} = 0$, the equation reduces to the standard Euler equation. $\frac{\partial V_{it}}{\partial E_{it}^G} = (E_{it}^G)^{(\eta - 1)} \left(\frac{1}{P_{iAt}^{\phi_A} P_{iMt}^{\phi_M} P_{iSt}^{\phi_S}} \right)^{\eta}$

4.4 Markets Clearing

For agricultural goods, market clearing condition is:

$$w_{iAt}H_{iAt} = \sum_j \underbrace{\left(\frac{\lambda_{ijt}p_{iAt}}{P_{jAt}}\right)^{1-\sigma_A}}_{\text{trade share}} \left(\underbrace{\vartheta_{jAt}\Gamma_\zeta L_{jt}\bar{w}_{jt}}_{\text{private demand}} + \underbrace{\vartheta^G_{jAt}E^G_{jt}}_{\text{public demand}} \right) \tag{47}$$

where ϑ_{jAt} and ϑ^G_{jAt} are the expenditure shares on agriculture goods for private and public demand, respectively.

For manufacturing goods, sales of firm ω located in region i are given by:

$$p_{it}(\omega)y_{it}(\omega) = \sum_j \underbrace{\left(\frac{\lambda_{ijt}p_{iMt}(\omega)}{P_{jMt}}\right)^{1-\sigma}}_{\text{trade share}} (\underbrace{\vartheta_{jMt}\Gamma_\zeta L_{jt}\bar{w}_{jt}}_{\text{private demand}} + \underbrace{\vartheta^G_{jMt}E^G_{jt}}_{\text{public demand}}) \tag{48}$$

where λ_{ijt} denotes the iceberg trading costs between region i and j. $\vartheta_{jMt} = \frac{\int \vartheta_{Mt}(y,\mathbb{P})y\,dF_i(y)}{\int y\,dF_i(y)} = \phi_M + \nu_M \frac{\Gamma_{\zeta/(1-\eta)}}{\Gamma_\zeta}\left(\frac{\bar{w}_i}{P_{iA}^{\phi_A}P_{iM}^{\phi_M}P_{iS}^{iS}}\right)^{-\eta}$ is the aggregate expenditure share on manufacturing goods. $\Gamma_\zeta L_{jt}\bar{w}_{jt}$ is the average income of workers in region j. E^G_{jt} denotes public employees' expenditure.

For local service sector, total sales equal to total expenditures on service goods:

$$w_{iSt}H_{iSt} = \underbrace{\vartheta_{iSt}\Gamma_\zeta L_{it}\bar{w}_{it}}_{\text{private demand}} + \underbrace{\vartheta^G_{iSt}E^G_{it}}_{\text{public demand}} \tag{49}$$

Services cannot trade, thus, all service goods are consumed locally.

For the labor market, the total labor supply in region i is given by:

$$L'_{it} = \sum_i^R L_{it}m_{ijt}, \quad \text{and} \quad m_{ijt} = \frac{(\mathcal{V}_{jt}\mathcal{B}_{jt}/\mu_{ijt})^\epsilon}{\sum_{j'}(\mathcal{V}_{j't}\mathcal{B}_{j't}/\mu_{ij't})^\epsilon} \tag{50}$$

m_{ijt} denotes the migration rate from region i to region j.

Local governments Local officials' optimal consumption and saving conditions meet

$$G_{it+1} = N_{it}\tau_{it} + (1-\delta^G_{it})G_{it} - E^G_{it} \tag{51}$$

$$\left(1 - \kappa_{it}\frac{1}{G_{it+1}}\frac{\partial E^G_{it}}{\partial V_{it}}\right)\frac{\partial V_{it}}{\partial E^G_{it}}\frac{\partial E^G_{it+1}}{\partial V_{it+1}} = \beta(1-\delta) \tag{52}$$

where $\frac{\partial V_{it}}{\partial E_{it}^G} = (E_{it}^G)^{(\eta-1)} \left(\frac{1}{P_{iAt}^{\phi_A} P_{iMt}^{\phi_M} P_{iSt}^{\phi_S}} \right)^{\eta}$

And local officials maximize their objectives, workers maximize their utility and firms maximize their profits. In each region, given structural parameters and local state capacity, I need to solve 5 unknowns $\{L_{it}, w_{iAt}, w_{iMt}, w_{iSt}, E_{it}^G, \}$ by solving the system of 5 equations: 47, **??**, 49, 50, 51.

Definition 1. ***Static Equilibrium*** *Given structural parameters and the lump-sum tax, τ_i, and the initial distribution of labor, productivity and public goods, $\{L_{i0}, Z_{iA0}, Z_{iM0}, Z_{iS0}, G_{i0}\}_i$, the static equilibrium is a set of wage $\{w_{iA}, w_{iM}, w_{iS}\}$, prices $\{P_{iA}, P_{iM}, P_{iS}\}$, private workers' consumption $\{C_{iA}, C_{iM}, C_{iS}\}$, local officials' expenditure $\{E_i^G\}$, public investment $\{G_i\}$, and efficient labor supply $\{H_{iA}, H_{iM}, H_{iS}\}$ such that: 1) consumers maximize their local choice utility and consumption; 2) the creation of local varieties is consistent with free entry; 3) firms maximize their profits; 4) local officials maximize their objectives; 5) all markets clear.*

4.5 Social planner's optimal allocation

To compare the decentralized equilibrium with the centralized planner, I assume there is a planner or the central government, who allocate consumption and public goods across regions. This is the benchmark allocation. Its objective is to maximize households' welfare, which denoted by the weighted sum of the utility of all households in all regions. In this case, local governments play no role and local officials' career incentives are not considered. I consider two scenarios: one is there is a local planner whose objective is to maximize local residents' utility; the other is a social planner whose objective is to maximize the welfare of all residents in all regions and the social planner can transfer taxes across regions.

The local planner's problem in each region is:

$$max_{E_{it}, G_{it+1}} (\sum_{i}^{L_i} V_{it} + V_{it}^G) \tag{53}$$

$$s.t. \quad G_{it+1} = N_{it}\tau_{it} + (1 - \delta_{it}^G) G_{it} - E_{it}^G \tag{54}$$

The local planner faces the same budget constraint as the local government.

The social planner's problem is:

$$max \sum_{r}^{R} \{ \sum_{i}^{L_i} V_{it} + V_{it}^{G} \} \tag{55}$$

$$s.t. \quad \sum_{r}^{R} G_{it+1} = \sum_{r}^{R} N_{it}\tau_{it} + \sum_{r}^{R} (1 - \delta_{it}^{G}) G_{it} - \sum_{r}^{R} E_{it}^{G} \tag{56}$$

The social planner faces the whole governments' budget across all regions since the planner can make regional transfer.

Since there is public goods, which caused externality and market failure, the decentralization (i.e. local governments' decision is not optimal.) The social planner's will consider externalities. Here I compare investment allocation under four scenarios: 1) no career incentive, which means local officials only care about expenditure or rent-seeking; 2) the baseline model: utility from expenditure and career promotion; 3) local social planners whose objective is to maximize local residents' welfare and local officicals welfare from expenditure. And local social planners still face the same fiscal budget constraints; 4) the social planner, whose objective is to maximze all residents' welfare and officials' utility from expenditure. The social planner faces the budget constraint across all regions, which means it can do regional transfer.

From this comparison, we can see the career incentives play a role as the Pigouian subsidy to local public investment. When local officials only care about expenditure, they under-invest in public goods since they do not consider the positive externalities from public goods. When local officials care about career promotion, they will invest more in public goods, which is closer to the social optimal allocation. But the impact depends on the *intensity* of career incentives.

> **Proposition (Career incentives and public investment):** Career incentives act as the Pigouvian subsidy for local infrastructure investment. If there is no career incentive, local governments under-invest infrastructure. There exists the optimal career incentives which can fix local infrastructure spillover but not for externalities across regions.

Table 4. Investment Allocation Decisions in Four Scenarios

Scenario	Objective / Incentives	Euler Equation (MC=MB)
1. Baseline	Exp. utility + **Career incentives** ($\kappa > 0$)	$\frac{\partial V_t^G}{\partial E_t^G} = \frac{\kappa_t}{G_{t+1}} + \beta(1-\delta^G)\frac{\partial V_{t+1}^G}{\partial E_{t+1}^G}$
2. No Incentives	Exp. utility only ($\kappa = 0$)	$\frac{\partial V_t^G}{\partial E_t^G} = \beta(1-\delta^G)\frac{\partial V_{t+1}^G}{\partial E_{t+1}^G}$
3. Local Social Planner	Max. local res' and off's welfare	$\frac{\partial V_t^G}{\partial E_t^G} = \beta\sum_{i=1}^{L}\frac{dV_i}{dG} + \beta(1-\delta^G)\frac{\partial V_{t+1}^G}{\partial E_{t+1}^G}$
4. Global Social Planner	Max. agg. welfare	$\cdots + \sum_i \frac{dV_{1i}}{dG_1} = \sum_i \frac{dV_{2i}}{dG_2} = \ldots$

Notes: V_t^G and V_i represent the value functions for government and individual welfare, respectively. The Euler equations illustrate the marginal conditions for optimal public investment under different scenarios, highlighting the role of career incentives and social planning in shaping investment decisions.

4.6 Illustrative example / Comparative statics

Consider two regions, i and j, that are initially identical across all dimensions, including productivity, amenities, land endowment, and local officials' career incentives κ, local tax rate τ. And there are migration costs but no trading costs between regions.

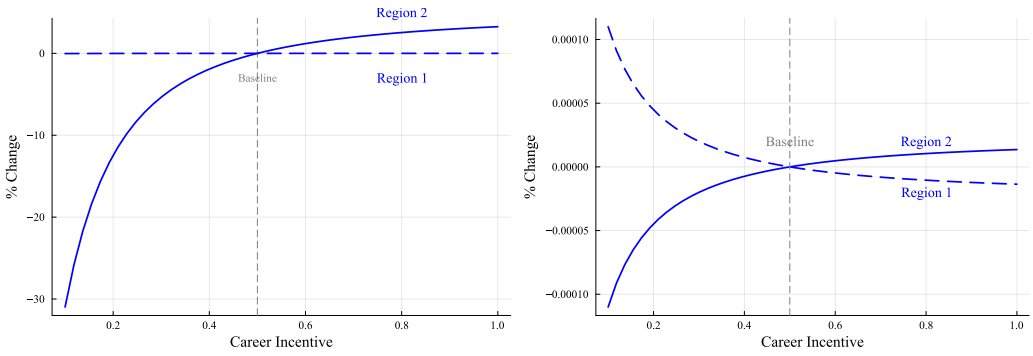
Assume that region i's leader has connection with the leader in the upper level, while region j is not. This means that region i will face a higher incentive career promotion, $\kappa_{it} > \kappa_{jt}$, higher fiscal capacity, i.e. higher tax rate, $\tau_{it} > \tau_{jt}$. I adjust these parameters in region i to show the effects on the economy, given the structural parameters in Table 5.

4.6.1 Adjust career incentive

I examine the effects of varying the career incentive parameter κ in region 2 while holding region 1's parameters constant. Figure 11 shows the resulting changes in local public goods investment and population distribution across both regions. When the career incentive in region 2 increases, local officials increase the investment in public goods and the investment ratio in region 2 rises. Since public investment enhances productivity in both manufacturing and services, region 2 develops a comparative advantage over region 1 in these sectors. This productivity differential generates migration flows from region 1 to region 2, increasing region 2's population share. However, the magnitude of population reallocation remains modest due to high migration costs

The increase in career incentives and corresponding public investment also triggers structural change within each region. Figure 12 presents the evolution of employment share across agriculture, manufacturing, and service sectors. In region 2, enhanced

public investment drives labor reallocation away from agriculture toward both manufacturing and service, reflecting the productivity gains in these sectors. Region 1 experiences a different pattern of structural change: employment share declines in both agriculture and manufacturing sector, while services expend. However, the magnitude of sectoral reallocation in region 1 is smaller than in region 2, consistent with the indirect nature of these adjustments through general equilibrium effects.



(a) Investment ratio in public investment. **(b)** Population share.

Figure 11. Career incentives versus investment in public goods and population share.

Notes: The baseline career incentive is set to 0.5 in both region 1 and region 2. The y-axis denotes the change compared to the baseline. I only adjust the career incentive in region 2, while the career incentive in region 1 is fixed.

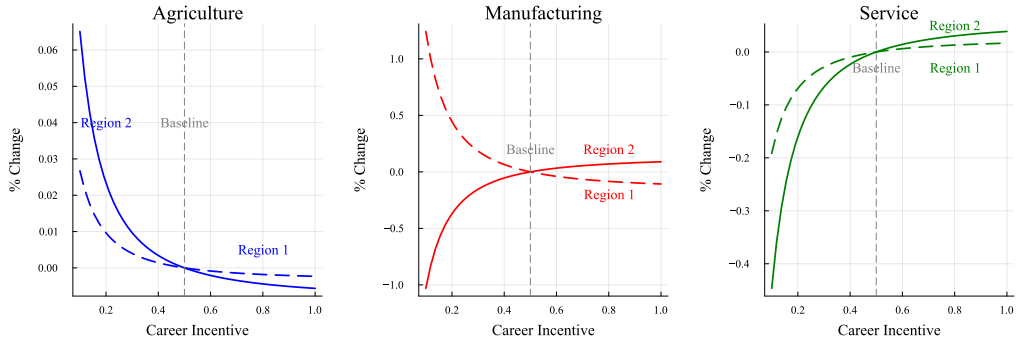


Figure 12. Career incentives versus employment share.

Notes: The baseline career incentive is set to 0.5 in both region 1 and region 2. The y-axis denotes the change compared to the baseline. I only adjust the career incentive in region 2, while the career incentive in region 1 is fixed.

5 Take the model to the data

In this section, I describe how I combine calibration, inversion, and structural estimation to bring the model to the data. I outline the data used to estimate key structural parameters and the estimation strategies employed. The analysis uses prefecture-level data from 1990 to 2020 to invert and estimate the model, with each model period representing 10 years, i.e. 1990, 2000, 2010, and 2020. Due to data limitations, I exclude seven provinces: Tibet, Xinjiang, Gansu, Inner Mongolia, Ningxia, Qinghai and Hainan provinces. The first six provinces have predominantly ethnic minorities populations with economic characteristics that differ substantially from the main Chinese population, while Hainan, as an island province, lacks reliable data on migration and trade costs. This sample restriction yields 23 provinces and about 200 prefectures, covering the majority of China's economically integrated regions.

Structural parameters borrowed from the literature For the household PIGL preference parameters, I directly adopt values from Chen et al. (2023), who estimate these parameters using China's household-level survey data, making them well-suited for my model. For the labor mobility parameter of the Fréchet distribution, I follow Tombe and Zhu (2019) and set $\epsilon = 2.0$.

For the production side, I set the labor share in agriculture to $\alpha = 0.4$, following Eckert and Peters (2025). In the manufacturing and service sectors, public investment can affect productivity. I set the intensity of this effect to $\gamma_M = 0.025$ for manufacturing, following Song and Xiong (2024), and $\gamma_S = 0.01$ for services. To capture local governments' pro-manufacturing infrastrucutre and policies, I set the $\gamma_M = 0.025 > \gamma_S = 0.01$. All parameters are shown in Table 5.

Migration costs and trade costs I construct migration costs and goods trading costs using travel time data for passengers and freight across prefectures from Ma and Tang (2024). Ma and Tang (2024) calculate travel time via roads and railways between prefectures during 1994-2017, accounting for transportation infrastructure quality[9]. Since their data covers 1994-2017, I use linear extrapolation to obtain travel times for 1990 and 2020.

Regional fundamentals in 2000 I use 2000 data to invert regional fundamentals, including productivity in agriculture (Z_{iA2000}), manufacturing (Z_{iM2000}), and services (Z_{iS2000}), and amenity ($\mathcal{B}_{i2000}$). Specifically, assume the average wage is equal to local GDP per capita. Based on the labor sectoral productivity assumption,

[9]For details on the travel time data construction, see Section 2 of Ma and Tang (2024)

Table 5. Structural Parameters

Variable	Value	Meaning	Source
PIGL Preferences			
η	0.375	Engel elasticity	
ν_A	0.48	PIGL preference parameter for agriculture	
ν_M	0.52	PIGL preference parameter for manufacturing	
ν_S	-1.0	PIGL preference parameter for service	Chen et al. (2023)
ϕ_A	0.01	Asymptotic expenditure share on agriculture goods	
ϕ_M	0.37	Asymptotic expenditure share on manufacturing goods	
ϕ_S	0.62	Asymptotic expenditure share on service goods	
Labor supply			
ϵ	2.0	Location taste heterogeneity	Tombe and Zhu (2019)
ζ	3.0	Labor supply elasticity	Fan et al. (2023)
Production			
α	0.4	Land share in agriculture production function	Eckert and Peters (2025)
γ_M	0.025	Share of public goods in manufacturing production function	Song and Xiong (2024)
γ_S	0.01	Share of public goods in service production function	
σ	5.0	Elasticity of substitution between manufacturing goods	Standard
f_E	1.0	Fixed cost of entry	Normalization
Local government			
δ_G	0.13	Depreciation rate of public investment	Song and Xiong (2024)
β	0.9	Discount factor of local officials	
τ		Local lump-sum tax / tax rate	Calibration from data
κ		Career incentive parameter	Recovered from model
Structural residuals			
Z_{iA}		Local agricultural productivity	
Z_{iM}		Local manufacturing productivity	
Z_{iS}		Local service productivity	
$\mathcal{B}_i$		Local amenity	

we can obtain sectoral wages. Upon we know the wages, we can solve sectoral prices from goods markets clearing conditions. Once we know prices, it's easy to get sectoral productivity. Then I use regional population share to invert local amenities (up to scale).

One key variable recovered from the model is career incentive κ_{it}. Based on local officials' Euler equation and optimal investment and consumption we know from the model, we can calculate regional career incentives.

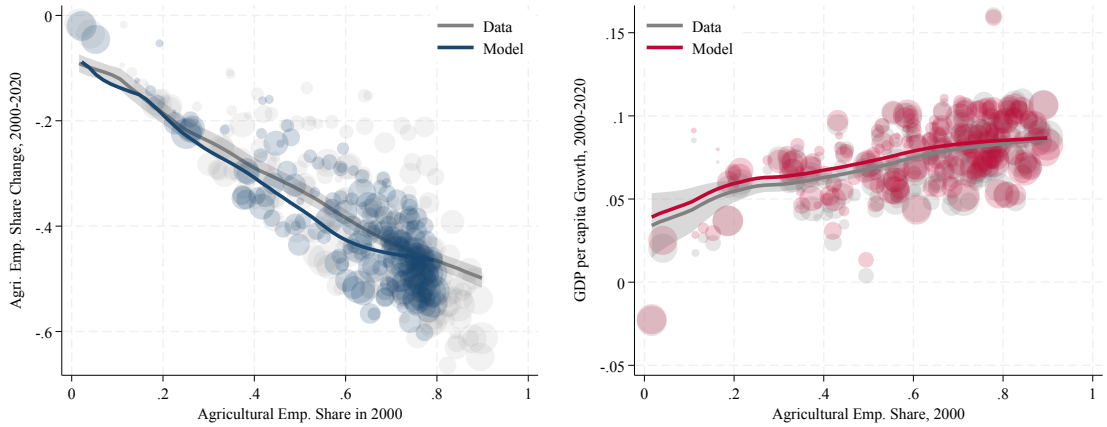
$$\kappa_{it} = (1 - \beta * (1 - \delta^G))G_{it} * eG_{it}^{\eta-1} * (\Psi_{it})^{-\eta} \tag{57}$$

where G_{it} is the optimal public investment and eG_{it} is the expenditure from the model, and $\Psi = P_{iA}^{\phi_A} P_{iM}^{\phi_M} P_{iS}^{\phi_S}$ is the price index, which we get in the equilibrium.

5.1 Model Fit

Figure 13 illustrates the model's ability to match the cross-section of structural transformation and growth across Chinese prefectures. Panel (a) shows a strong negative relationship between initial agricultural employment share and subsequent structural

change: prefectures that were more agricultural in 2000 experienced larger declines in agricultural employment by 2020. Panel (b) shows that more agricultural prefectures grew somewhat faster in per capita terms, consistent with convergence. Since both moments are targeted in the model inversion, the close fit confirms that the procedure successfully recovers fundamentals that rationalize observed outcomes. The figure also highlights two salient features of China's regional development over this period: rapid structural transformation away from agriculture was nearly universal, and growth rates exhibited notable convergence across prefectures with different initial economic structures.

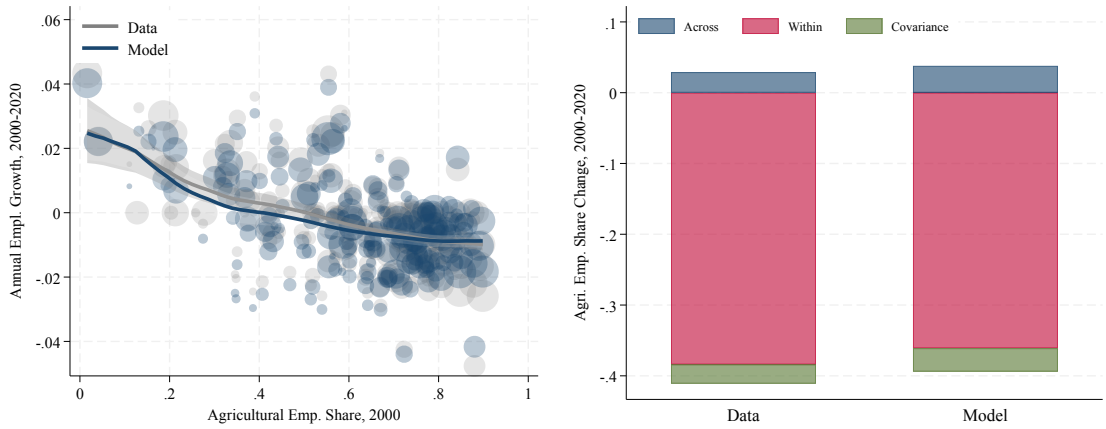


(a) Structural Transformation **(b)** GDP per Capita Growth

Figure 13. Model fit: employment share and GDP per capita growth.
Notes: Panel (a) plots the change in agricultural employment share (2000–2020) against the initial agricultural employment share in 2000. Panel (b) plots annualized GDP per capita growth (2000–2020) against the same initial condition. In both panels, each point represents a prefecture, with marker size proportional to initial employment. The gray line and shaded band show a nonparametric local polynomial smooth and its 95% confidence interval estimated from the data; the colored line shows the corresponding smooth from model outcomes.

Figure 14 evaluates the model against two moments not used in the inversion. Panel (a) shows that more agricultural prefectures experienced slower employment growth over 2000–2020, a pattern consistent with labor reallocation away from agriculture toward urban sectors. The model reproduces both the level and the nonlinear shape of this relationship closely, including the flattening among prefectures with very high initial agricultural shares. Panel (b) provides a more demanding test by decomposing aggregate structural change into within-prefecture, across-prefecture, and covariance components. In the data, the decline in the national agricultural employ-

ment share is driven almost entirely by within-prefecture structural transformation, that is, by workers shifting out of agriculture locally rather than by differential population growth across more and less agricultural regions. The model matches this composition well, with the within component dominating and the across and covariance terms playing quantitatively similar roles in both data and model. The close fit on these non-targeted moments, particularly the decomposition, which disciplines the spatial dimension of the model separately from the sectoral dimension, strengthens confidence that the model captures the relevant forces shaping China's structural transformation.



(a) Local employment growth **(b)** Local structural change

Figure 14. Non-targeted moments: employment growth and structural change.
Notes: This figure assesses model fit using non-targeted moments. Panel (a) plots annualized local employment growth (2000–2020) against the initial agricultural employment share in 2000. Each point represents a prefecture, with marker size proportional to initial population. The gray and blue lines show nonparametric local polynomial smooths for the data and model, respectively, with 95% confidence bands. Panel (b) decomposes the aggregate decline in the agricultural employment share between 2000 and 2020 into three components following Eckert and Peters (2025): $\Delta s_{At} = \sum_i l_{it}\Delta s_{iAt} + \sum_i \Delta l_{it} s_{iAt} + \sum_i \Delta l_{it}\Delta s_{iAt}$, where Δ denotes the 20-year difference, l_{it} is prefecture i's share of national employment, and s_{iAt} is the agricultural employment share in prefecture i. The three terms correspond to the within, across, and covariance components, respectively.

6 Quantitative Analysis

In this section, I first present the inversion results, such as sectoral productivity and amenities, and especially career incentives across regions from the model. To the

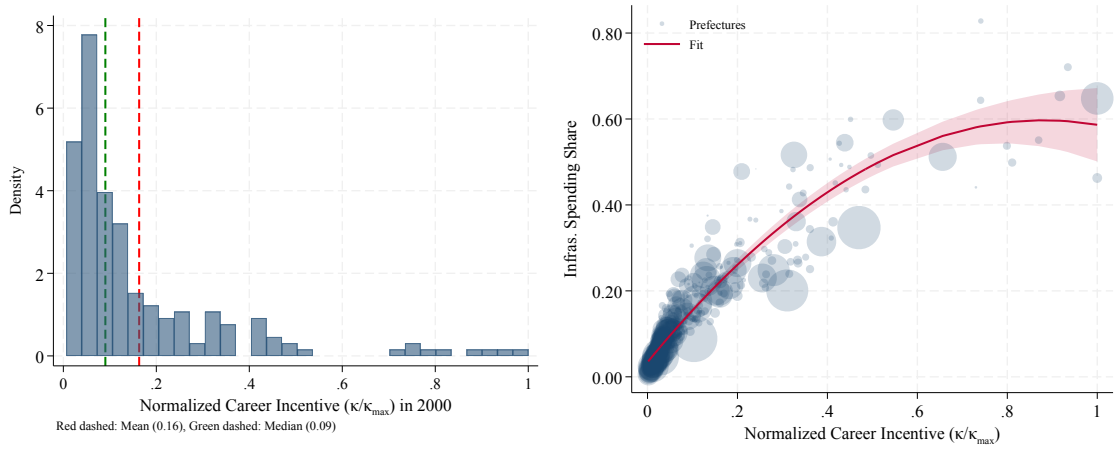
best of my knowledge, this is the first paper to present the career incentives across prefecture-level in China. These results demonstrate validation of the model. Then I will use the model to decompose contribution of various factors to spatial structural change. Finally, I will do some counterfactual analysis.

6.1 Baseline results

In this section, I present the recovered career incentive wedge and analyze its relationship with regional infrastructure spending share. Figure 15 examines the model-recovered career incentive wedge. Panel (a) reveals that the distribution of κ is heavily right-skewed: most prefectures have relatively low career incentives, with a median of 0.09 well below the mean of 0.16, indicating that strong career incentives are concentrated in a minority of jurisdictions. Panel (b) plots the infrastructure spending share against the recovered κ. Since infrastructure spending enters the inversion procedure used to recover κ, the positive relationship is expected by construction. Nevertheless, the figure is informative about the *shape* of the mapping: the concave relationship indicates that κ rises less than proportionally with the infrastructure share, consistent with prefectures that spend heavily on infrastructure also having higher equilibrium prices and wages that attenuate the recovered wedge. The right-skewness in Panel (a) implies that the aggregate counterfactual results will be shaped disproportionately by a small number of high-κ prefectures; I examine the sensitivity of the main results to this feature in Section **??**.

External validation of the recovered career incentives

To validate the recovered career incentive wedge against observable proxies, I examine its relationship with city party secretary age. Secretary age is not used in the model inversion, making this a genuine out-of-model check. Age is a standard proxy for career incentives in the Chinese political economy literature (Li and Zhou, 2005; Yao and Zhang, 2015): younger officials face longer career horizons and stronger promotion incentives, while those approaching the informal retirement threshold have little to gain from costly investment. Figure 16 plots the average recovered κ within four-year age bins against secretary age across prefectures in 2000. The relationship exhibits a hump shape, with κ peaking around age 52–56 before declining sharply for officials approaching retirement. This pattern is consistent with the promotion incentive literature: mid-career officials have both the motivation and the political capital to invest aggressively, while the youngest officials may lack the authority or networks to direct large infrastructure projects, and the oldest have little career return



(a) Career incentive distribution **(b)** Career incentive and infras. spending share

Figure 15. Career incentives and infras. spending share across prefectures in 2000. *Notes:* This figure displays the model-recovered career incentive wedge (κ) across prefectures in 2000. Panel (a) shows the distribution of κ normalized by its maximum value across prefectures. The green and red dashed lines indicate the median (0.09) and mean (0.16), respectively. Panel (b) plots the infrastructure spending share against the normalized career incentive. Each point represents a prefecture, with marker size proportional to population. The red line and shaded band show a local polynomial smooth and its 95% confidence interval.

to doing so.

6.2 Counterfactual analysis

I conduct three counterfactual exercises to quantify the aggregate and distributional effects of career incentives. In the first exercise, I set all regions' career incentives to the national median to eliminate the regional variation.

Second, I increase each prefecture's career incentive wedge κ_i by 10% relative to its baseline value and solve for the new spatial equilibrium, holding all other fundamentals fixed. This exercise quantifies how a uniform strengthening of career incentives affects infrastructure investment, structural transformation, and welfare nationwide.

The third exercise examines whether career incentives can serve as a place-based policy instrument. Specifically, I consider a provincial government that increases κ only in its poorest prefectures, using Guangdong province as a case study. I focus on Guangdong because it exhibits substantial within-province inequality in income and infrastructure, making it a natural laboratory for evaluating targeted interven-

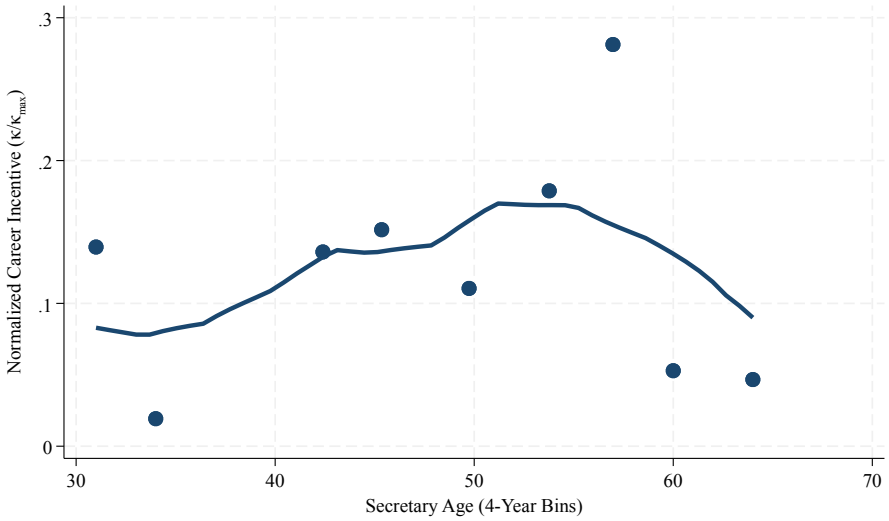


Figure 16. Career incentives and secretary age across prefectures in 2000.
Notes: This figure plots the relationship between the model-recovered career incentive wedge (κ) and city party secretary age across prefectures in the year 2000. Each point represents the average career incentive wedge within a four-year age bin, a bandwidth chosen to reflect the average tenure of a prefecture leader. The line denotes a local polynomial fit.

tions. This exercise captures the spatial spillovers of targeted incentive policies: when some prefectures within a province receive stronger career incentives, the resulting infrastructure investment may attract labor and economic activity from neighboring prefectures, generating both direct gains for targeted regions and indirect effects on untargeted ones.

6.2.1 Aggregate effects

Table 6 presents three counterfactual exercises that quantify the aggregate consequences of career incentive distortions. The first eliminates geographic dispersion by setting κ_i to the national median in all prefectures. The second uniformly raises κ_i by 10%. The third equalizes career incentives within Guangdong province, illustrating the effect of a province-level reform.

Column 1 reveals that compressing career incentives to the national median reduces the aggregate infrastructure investment ratio by 19.9%. This large decline reflects the right-skewness of the κ distribution: a small number of prefectures with exceptionally strong career incentives drives a disproportionate share of national infrastructure spending. Removing this dispersion reallocates labor toward agriculture (+0.55%) and away from manufacturing (−0.80%) and services (−1.14%).

Notably, household welfare *increases* by 0.039% despite the sharp fall in infrastructure investment. This finding implies that the baseline allocation of infrastructure is spatially inefficient from the household perspective: career incentives channel investment toward locations where private career returns are high rather than where social returns are highest. Government welfare, by contrast, falls by 50.4%, reflecting the elimination of career-driven rents. The divergence between household and government welfare quantifies the magnitude of the principal-agent friction embedded in China's cadre incentive system.

Column 2 shows that a uniform 10% increase in κ raises the investment ratio by 5.8% and generates modest labor reallocation out of agriculture (-0.06%) and into manufacturing ($+0.20\%$). Household welfare rises by 0.020%, suggesting that at current levels, marginal increases in career incentives remain welfare-improving on average. Government welfare rises by 8.9%, driven by the direct career return to public capital in the official's objective function.

Column 3 equalizes κ within Guangdong province, producing qualitatively similar but smaller effects: the investment ratio falls by 2.8% and household welfare declines by 0.024%. The negative household welfare effect contrasts with the national equalization in Column 1, where compressing incentives raised welfare. This difference suggests that within Guangdong, high-κ prefectures also tend to be high-productivity locations where infrastructure investment generates high social returns. Compressing incentives within the province therefore removes welfare-improving investment, unlike the national exercise where the dispersion is primarily distortionary.

6.2.2 Effects in space

Figure 17 summarizes the distributional effects of the three counterfactual exercises. The baseline distribution (blue) is wide and right-skewed, reflecting the substantial heterogeneity in infrastructure spending driven by dispersed career incentives. *Equalize nationally* (red) compresses the distribution dramatically: eliminating career incentive dispersion produces a tightly concentrated distribution centered around 0.3, with almost no prefectures spending above 50% of their budget on infrastructure. The sharp reduction in the right tail confirms that the highest infrastructure spending shares in the baseline are driven by a small number of prefectures with exceptionally strong career incentives. *Increase 10%* (purple) shifts the baseline distribution modestly to the right, consistent with the small aggregate effects of a uniform 10% increase. *Equalize within Guangdong* (gray) is nearly indistinguishable from the base-

Table 6. Aggregate effect.

	(1) All Prefecture Set to Median	(2) Increase by 10%	(3) All prefectures in Guangdong Set to Median
Investment Ratio	-19.920	5.826	-2.817
Agriculture Emp. Share	0.549	-0.055	0.026
Manufacturing Emp. Share	-0.802	0.199	-0.144
Services Emp. Share	-1.142	0.017	0.032
Household Welfare	0.039	0.020	-0.024
Government Welfare	-50.401	8.866	-7.706

Notes: This table reports the aggregate percentage change in key economic outcomes under three counterfactual experiments relative to the baseline equilibrium. Column 1 sets the career incentive parameter κ_i to the national median in all prefectures. Column 2 increases κ_i by 10% uniformly across all prefectures. Column 3 sets κ_i to the provincial median for all prefectures within Guangdong. Investment ratio is defined as infrastructure spending relative to total fiscal expenditure. Employment shares are sectoral employment as a fraction of total local employment. All aggregate outcomes are population-weighted averages across prefectures. Household welfare is measured as the change in workers' indirect utility. Government welfare is measured as the change in local officials' value function, which includes both consumption utility and the career return to public capital.

line at the national level, as expected given that it only modifies incentives within a single province.

Counterfactual 1: equalize career incentives nationally

Figure 18 reveals the sectoral reallocation patterns underlying the aggregate effects of CF1. The most striking feature is the heterogeneity in Panels (a) and (b). Equalizing career incentives produces a bimodal response in agriculture: roughly half of prefectures experience an increase in agricultural employment shares (up to 5%), while a smaller group experiences substantial declines (up to 10%). The manufacturing response in Panel (b) mirrors this pattern — about one-third of prefectures lose manufacturing employment (up to 5%), while many others gain substantially (up to 15%). This bidirectional reallocation reflects the spatial resorting of economic activity: prefectures that lose their above-median career incentives under CF1 see infrastructure investment fall, reducing manufacturing productivity and pushing labor back into agriculture. Conversely, prefectures that were below the median gain relative competitiveness as the playing field is leveled, attracting manufacturing employment. Panel (c) shows that the service sector response is uniformly negative across all prefectures, concentrated in a narrow band around -1.14%. The near-uniformity of the services decline suggests that it is driven by an aggregate price effect rather than by local reallocation.

Figure 19 shows the welfare consequences of equalizing career incentives. Panel (a) reveals that the worker welfare response is heterogeneous and approximately cen-

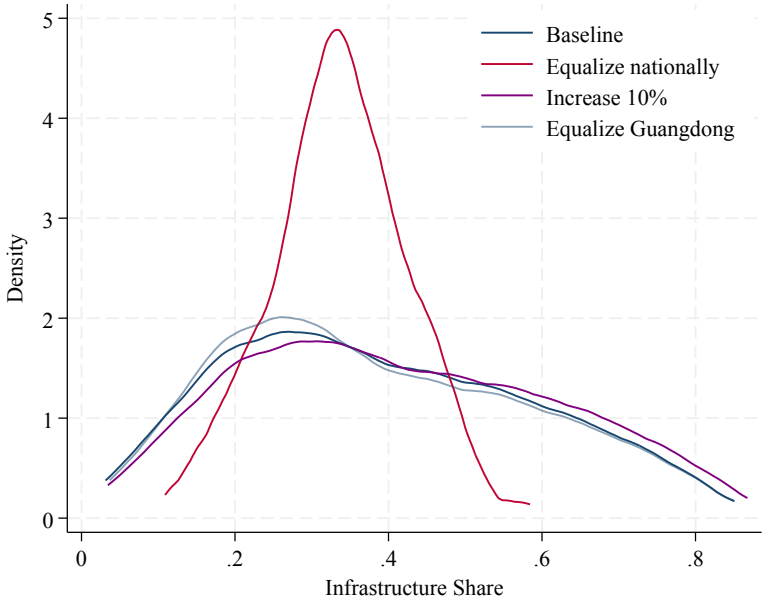
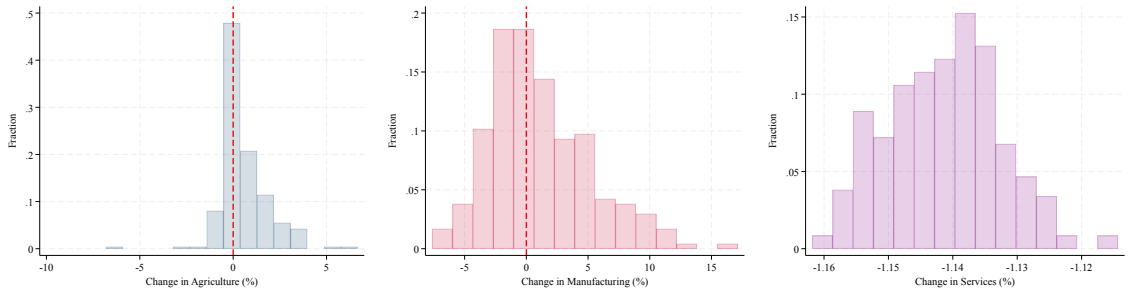


Figure 17. Infrastructure spending share distribution

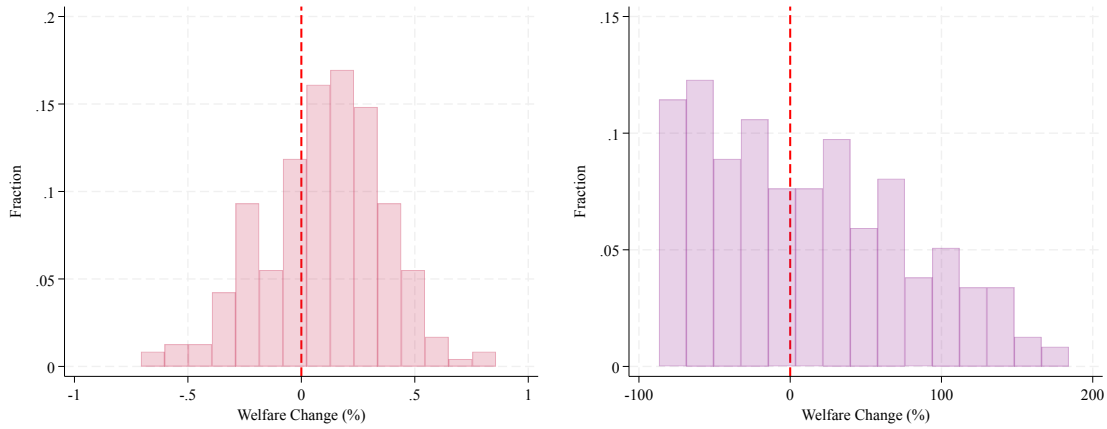
Notes: This figure plots the kernel density of infrastructure spending shares across prefectures under the baseline and three counterfactual scenarios. *Equalize nationally* sets κ_i equal to the national median in all prefectures. *Increase 10%* denotes to increase κ_i by 10% uniformly. *Equalize within Guangdong* equalizes κ_i within Guangdong province. All other fundamentals are held fixed.



(a) Agriculture **(b)** Manufacturing **(c)** Services

Figure 18. Sectoral employment share change from equalizing career incentives nationally

Notes: This figure shows the counterfactual change in sectoral employment shares across prefectures following set all regions' career incentives to the national median. Panels (a), (b), and (c) plot the distribution of changes in the agricultural, manufacturing, and services employment shares, respectively. The red dashed line indicates zero change.



(a) Private workers **(b)** Local Officials

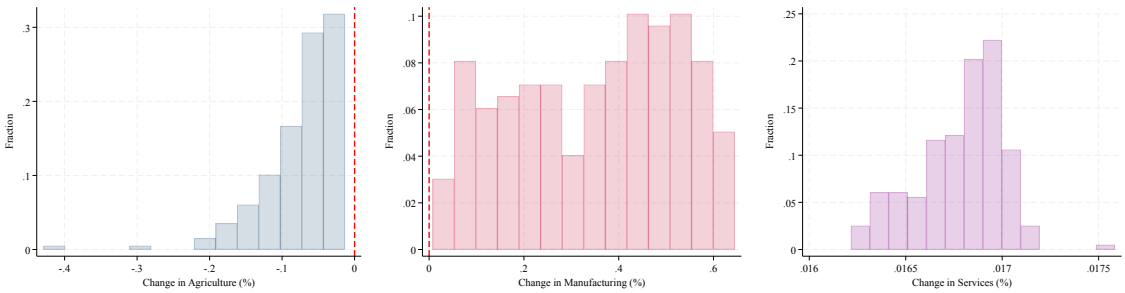
Figure 19. Welfare change for private workers and local officials

Notes: This figure shows the distribution of welfare changes across prefectures from equalizing career incentives to the national median (CF1). Panel (a) plots welfare changes for private workers, measured as the change in indirect utility. Panel (b) plots welfare changes for local officials, measured as the change in the official's value function, which includes both consumption utility and the career return to public capital ($\kappa \log G$). See equations (3) and (37) for formal definitions.

tered around zero: some prefectures gain up to 1% while others lose up to 1%. The aggregate welfare gain of 0.039% thus masks substantial redistribution — workers in prefectures that previously benefited from high-κ officials lose, while those in previously disadvantaged prefectures gain. This pattern confirms that the baseline career incentive dispersion generates spatial misallocation of infrastructure from the household perspective: equalizing incentives reshuffles investment toward locations with higher social returns, benefiting workers there at the expense of workers in formerly favored jurisdictions.

Panel (b) shows a dramatically different picture for officials. Welfare changes range from -100% to $+200\%$, reflecting the direct effect of κ on the official's value function. Officials in prefectures where κ falls to the median experience large welfare losses as their career returns to public capital are eliminated, while those where κ rises gain substantially. The two welfare measures are not directly comparable: the worker measure captures changes in real purchasing power, while the official measure also reflects the revaluation of career rents. The worker welfare distribution in Panel (a) is therefore the more economically informative object for evaluating the efficiency consequences of career incentive equalization.

Counterfactual 2: a uniform 10% increase in career incentives (κ)[10] Figure 20 traces the structural transformation implications of the same counterfactual. Panel (a) shows that nearly all prefectures experience a decline in agricultural employment shares, with most reductions on the order of 0.05-0.15% and a left tail extending to about 0.4% for the most agricultural prefectures. Panel (b) shows that manufacturing absorbs the bulk of the reallocation, with employment share increases ranging from 0 to 0.6% across prefectures. Panel (c) reveals that the service sector response is positive but an order of magnitude smaller, concentrated around 0.017%. The asymmetry between manufacturing and services reflects differences in infrastructure intensity in the production function: the infrastructure elasticity in manufacturing ($\gamma_M^G = 0.025$) is more than twice that in services ($\gamma_S^G = 0.01$) (Song and Xiong, 2024), so an increase in public capital disproportionately raises manufacturing productivity and draws labor into that sector.



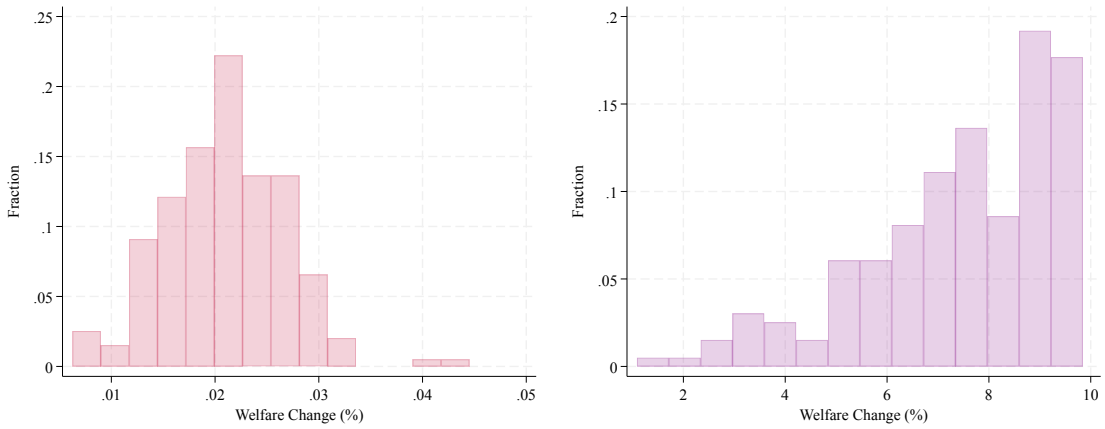
(a) Agriculture **(b)** Manufacturing **(c)** Services

Figure 20. Sectoral employment share change from increasing career incentives by 10% uniformly

Notes: This figure shows the counterfactual change in sectoral employment shares across prefectures following a uniform 10% increase in career incentives (κ). Panels (a), (b), and (c) plot the distribution of changes in the agricultural, manufacturing, and services employment shares, respectively. The red dashed line indicates zero change.

Figure 21 reports the welfare implications of the counterfactual. Two features stand out. First, the increase in career incentives generates welfare gains for both private workers and local officials across all prefectures, confirming that career incentives operate as a Pigouvian subsidy that partially corrects the underinvestment in infrastructure. Second, the gains are dramatically unequal: private workers experience modest welfare increases of 0.01-0.03%, while local officials gain 2-10%.

[10] Since the investment wedge κ is highly skewed and standard deviation is affected by outliers (as shown in Figure 15), I choose to increase by 10% not by 1 standard deviation.



(a) Private workers **(b)** Local Officials

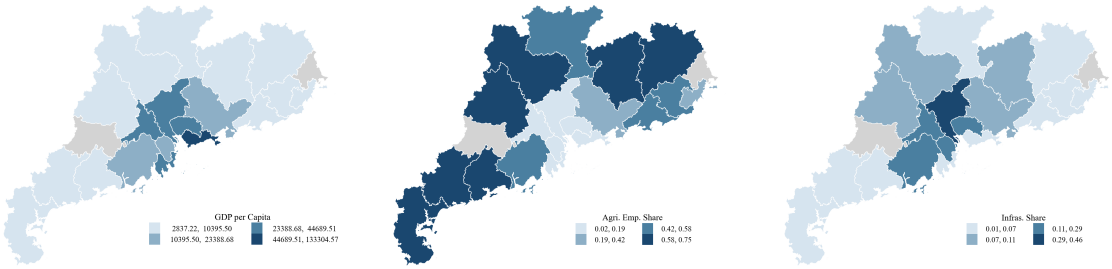
Figure 21. Welfare change for private workers and local officials

Notes: This figure shows the distribution of welfare changes across prefectures from a uniform 10% increase in career incentives (κ). Panel (a) plots welfare changes for private workers; Panel (b) plots welfare changes for local officials. Worker welfare is measured as the change in indirect utility, which incorporates changes in real wages and sectoral prices, $V_{it} = \frac{1}{\eta}\Gamma\frac{\zeta}{\eta}(\bar{w}_{it}/(P_{iAt}^{\phi_A}P_{iMt}^{\phi_M}P_{iSt}^{\phi_S}))^{\eta} + \sum_{s=A,M,S}\nu_s ln(P_{ist})$. Official welfare is measured as the change in the official's value function, which includes both consumption utility and the career return to investment ($\kappa \log G$), $V_{it}^{G} = (1/(1-\beta)) \cdot (1/\eta \cdot (eG_{it}/(P_{iAt}^{\phi_A}P_{iMt}^{\phi_M}P_{iSt}^{\phi_S}))^{\eta} + \sum_{s=A,M,S}\nu_s ln(P_{ist}) + \kappa_{it}\log G_{it})$.

The asymmetry arises from the structure of the two objective functions. The official's value function includes a direct career return term $\kappa \log G$, so increasing κ has a first-order effect on official welfare for any given level of public capital. Worker indirect utility, by contrast, depends on real wages and sectoral prices, both of which respond only indirectly to infrastructure through its effect on sectoral productivity. The modest worker welfare gains suggest that general equilibrium price adjustments, higher local prices driven by increased economic activity, partially offset the wage gains from improved infrastructure. The two welfare measures are therefore not directly comparable: the official's measure reflects both material consumption and career returns, while the worker's measure captures changes in real purchasing power. For evaluating the aggregate efficiency consequences of career incentives, the worker welfare change is the more informative measure, as it isolates the real economic effects of infrastructure provision net of price adjustments.

Counterfactual 3: Guangdong province increases career incentives in some poor regions The third counterfactual exercise examines whether career incentives can serve as a targeted place-based policy instrument. I focus on Guangdong

province, which exhibits stark within-province inequality that makes it a natural laboratory for this exercise. Figure 22 documents the baseline conditions in 2000. Panel (a) shows a pronounced east-west gradient in GDP per capita: the Pearl River Delta prefectures, anchored by Guangzhou, Shenzhen, and Dongguan, are an order of magnitude richer than the inland prefectures in the province's north and west. Panel (b) reveals the mirror image in economic structure: agricultural employment shares exceed 60% in the peripheral prefectures while falling below 20% in the Delta, reflecting the sharp spatial divide between industrialized coastal areas and the agricultural interior. Panel (c) shows that infrastructure spending shares are highest in Guangzhou, the capital of Guangdong, but are otherwise relatively low and uniform outside the Delta, suggesting that lagging regions are not compensating for their lower income levels through higher public investment.



(a) GDP per Capita **(b)** Agri. Emp. Share **(c)** Infras. Spending Share

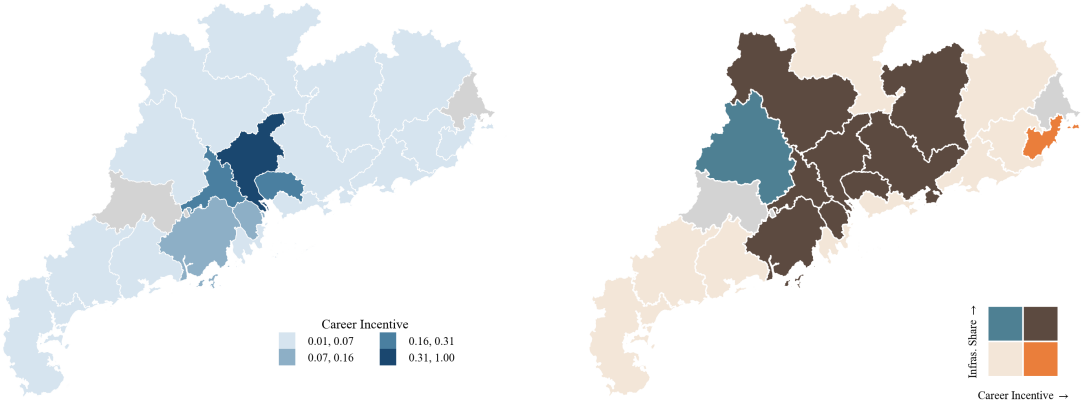
Figure 22. Economic Conditions across Prefectures in Guangdong Province (2000)
Notes: This figure shows the economic conditions across prefectures in Guangdong province in 2000. Panel (a) plots GDP per capita; Panel (b) plots the agricultural employment share; Panel (c) plots the infrastructure spending share. Prefectures are classified into four groups using the Jenks natural breaks algorithm, which minimizes within-group variance. There are total 21 prefectures in Guangdong, but 2 prefectures' data is missing. Gray areas denote missing data.

Figure 23 examines the spatial distribution of recovered career incentives within Guangdong. Panel (a) reveals that high-κ prefectures are not concentrated in the Pearl River Delta but instead appear in the province's western and central interior. This pattern is notable because it diverges from the spatial distribution of GDP per capita and infrastructure shown in Figure 22: some of the poorest prefectures have among the highest recovered career incentives.

Panel (b) makes this divergence precise using a bivariate classification. Four groups emerge. The teal prefectures, high career incentives and high infrastructure spending, are the jurisdictions where career motivation appears to have translated

into actual investment. The orange prefecture in the province's east has high career incentives but low infrastructure spending, suggesting that strong political motivation alone is insufficient to generate high investment when economic fundamentals are unfavorable. The dark brown prefectures, primarily in the northern interior, have high infrastructure shares despite low career incentives, potentially reflecting transfers or policy mandates rather than career-driven investment. Finally, the light prefectures in the Delta combine low career incentives with low infrastructure shares, consistent with already-industrialized regions where the marginal return to additional public capital is lower.

This heterogeneity motivates the second counterfactual exercise. The coexistence of high-incentive and low-incentive prefectures within a single province raises the question: what would happen if the provincial government could strategically strengthen career incentives in lagging jurisdictions, for instance, by appointing politically connected officials to prefectures that currently lack both connections and infrastructure?



(a) Career Incentives **(b)** Career Incentives and Infras. Share

Figure 23. Career incentives and infrastructure spending share across prefecturesin Guangdong province in 2000.

Notes: This figure displays the recovered career incentive wedge (κ) and its relationship with infrastructure spending across prefectures in Guangdong province in 2000. Panel (a) plots the geographic distribution of κ, normalized by its maximum value, with prefectures classified into four groups using the Jenks natural breaks algorithm. Panel (b) presents a bivariate choropleth that jointly maps career incentives (horizontal axis) and infrastructure spending share (vertical axis). Each prefecture is classified as above or below the provincial median on each dimension, producing four categories: low incentive–low infrastructure (light), low incentive–high infrastructure (dark brown), high incentive–low infrastructure (orange), and high incentive–high infrastructure (teal). Gray areas denote missing data.

7 Conclusion

This paper studies how political career incentives shape infrastructure investment and structural transformation in China. I provide reduced-form evidence that the loss of political connections induced by provincial leadership turnover causes prefecture leaders to reduce infrastructure spending, decelerating local structural change. To quantify the aggregate consequences of these political frictions, I develop a dynamic spatial equilibrium model in which career incentives operate as an endogenous wedge on local infrastructure investment.

The model yields three main findings. First, the recovered career incentive wedge exhibits substantial geographic dispersion, with a 90th-to-10th percentile ratio of approximately 13, indicating that political motivation for infrastructure investment varies enormously across Chinese prefectures. Second, compressing career incentives to the national median reduces aggregate infrastructure investment by 19.9% yet raises household welfare, implying that the baseline spatial allocation of public capital is inefficient: career incentives channel investment toward locations where private political returns are high rather than where social returns are highest. Third, the welfare consequences of equalizing incentives depend critically on the level of aggregation — national equalization raises welfare while within-province equalization in Guangdong reduces it, because high-incentive prefectures within Guangdong also tend to be high-productivity locations.

These findings have implications for the design of cadre incentive systems. The promotion tournament that governs Chinese local officials' careers partially corrects the underinvestment in infrastructure that arises from fiscal decentralization, but it does so in a spatially inefficient manner. A central planner seeking to maximize household welfare would reallocate investment incentives away from politically favored jurisdictions and toward locations with higher social returns to public capital. However, the Guangdong counterfactual cautions that such reallocation must account for local productivity differences — naive equalization within a province can reduce welfare if high-incentive officials happen to govern high-productivity jurisdictions.

Several limitations suggest directions for future research. The model recovers career incentives at a single cross-section, precluding analysis of how the incentive distribution evolves over time or responds to institutional reforms such as the anti-corruption campaign that began in 2012. Extending the framework to a fully dynamic setting with endogenous political connections would allow for richer policy counterfactuals. The external validation of the recovered wedge, while consistent with the

promotion incentive literature, remains imprecise given the cross-sectional sample size; panel variation in career incentives would strengthen identification. Finally, the model abstracts from land markets, housing, and fiscal transfers across levels of government, each of which interacts with infrastructure investment in important ways. Incorporating these channels would provide a more complete picture of how political frictions shape China's spatial economy.

Appendix

A Institutional background of China

In this paper, geographic location is defined by prefectures, which is an adminstrative definition. China's administrative system comprise five hierarchical layers: 1 central government, 34 province-level units, 333 prefectural-level units, 2,844 county-level units, and 38,739 town-level units, as shown in Figure A-1. Within each province, there are some prefectures. Prefectures themselves are differentiated into four administrative categories: normal prefectures, provincial capitals, vice-provincial level, and municipality[11].

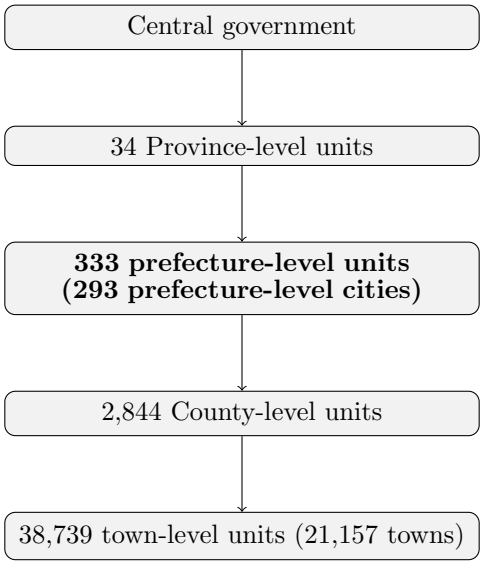


Figure A-1. Hierarchical Governance Structure of Chinese Economy
Notes: The number of regions is in 2020. It changes in various years, but not a lot. Data source: the National Bureau of Statistics

[11]There are four municipalities: Beijing, Tianjin, Chongqing, and Shanghai. There are at the provincial level. I will exclude them as robustness check in the empirical analysis

B Micro-foundation of career incentives of local officials

Following Song and Xiong (2024), I introduce local officials' career incentives. Due to the *regionally decentralized authoritarian system* (Xu, 2011), local officials face career promotion incentive and spatial competition across regions. They can only be promoted to higher position within the political hierarchy based on the central government's evaluation on their ability. Governors at higher political ranks experience stronger career incentive. These officials strategically allocate resources toward infrastructure investment to maximize their probability of promotion.

Since the central government cannot directly observe officials' ability, I assume that it infer local officials' ability from local economic development. In particular, the central government evaluates local officials solely on the regional output.

To incorporate career incentives, I assume local officials' ability can affect productivity in non-agricultural sector. Specifically, the TFP in manufacturing sector is:

$$\tilde{Z}_{iMt} = Z_{iMt} G_{it}^{\gamma} e^{a_{it}+\varsigma_{it}} \tag{A-1}$$

where $a_{it} \sim N(\bar{a}_i, \sigma_a^2)$ is local officials' ability to affect local economy, with a normal distribution of mean $\bar{a}_i$, and variance σ_a^2. $\varsigma_{it} \sim N(0, \sigma_\varsigma^2)$ denotes region-specific component independent of the officials, which is unobservable and their distributions are common knowledge.

The central government infer local officials' ability from the regional output.

$$\hat{a}_{it} = \mathbb{E}[a_{it}|Y_{it}] \tag{A-2}$$

where $\hat{a}_{it}$ is the central government's estimate of local officials' ability, and Y_{it} is an indicator of local output, defined as $Y_{it} = Y_{iAt}^{\varphi_A} Y_{iMt}^{\varphi_M} Y_{iSt}^{1-\varphi_A-\varphi_M}$. We take log of the output to simplify the estimation.

$$\mathcal{Y}_{it} = log(Y_{it}) = \varphi_A log(Y_{iAt}) + \varphi_M log(Y_{iMt}) + (1-\varphi_A-\varphi_M) log(Y_{iSt}) \tag{A-3}$$

$$= (a_{it} + \varsigma_{it} + \gamma log(G_{it}) + Const)(\varphi_M) \tag{A-4}$$

From this equation, we can see that $\mathcal{Y}_{it}$ is a signal of local officials' ability. $\varphi \in [0,1]$ denotes the weight of agricultural output of total output. For simplicity, I will use $\mathcal{Y}'_{it} = \frac{\mathcal{Y}_{it}}{\varphi_M}$ as the signal. The central government uses this signal to evaluate local officials' ability. Therefore, to increase next period promotion probability, local officials have incentives to invest in local public goods.

For the central government, we assume it has rational expectations and anticipates local governments' behavior, $G_{it} = G^*_{it}$. Therefore, when the central government assess local officials' performance, it will calculate the gap between observable output (log) and the expected level, using the statistic:

$$z_{it} \equiv \mathcal{Y}'_{it} - \gamma log(G^*_{it}) = a_{it} + \varsigma_{it} + \gamma[log(G_{it}) - log(G^*_{it})] \tag{A-5}$$

$$= a_{it} + \varsigma_{it} \tag{A-6}$$

Applying Bayes' Theorem, the central government assesses the governor following the rule:

$$\hat{a}_{it} = \mathbb{E}[a_{it}|\{z_{it}\}_{i=1,...,R}] = \bar{a}_i + \frac{\sigma_a^2/\sigma_\varsigma^2}{\sigma_a^2/\sigma_\varsigma^2 + 1}(z_{it} - \bar{z}_{it}) \tag{A-7}$$

For the local officials, they can affect z_{it} via local public goods provision, $log(G_{it})$. Thus, they have incentives to increase local public goods to increase the central government's perception of their ability.

$$\hat{a}_{it} - \bar{a}_i = \frac{\sigma_a^2/\sigma_\varsigma^2}{\sigma_a^2/\sigma_\varsigma^2 + 1}(z_{it} - \bar{z}_{it}) \tag{A-8}$$

$$= \frac{\sigma_a^2/\sigma_\varsigma^2}{\sigma_a^2/\sigma_\varsigma^2 + 1}[(a_{it} - \bar{a}_i) + \varsigma_{it} + \gamma(log(G_{it}) - log(G^*_{it}))] \tag{A-9}$$

Furthermore, we specify that the central government reward local officials based on their ability inferred from equation A-9: $\hat{\kappa}_{it}(\hat{a}_{it} - \bar{a}_i)$, where $\hat{\kappa}_{it} > 0$ indicates the intensity of the career promotion incentives, which may vary over time.

$$\hat{\kappa}_{it}(\hat{a}_{it} - \bar{a}_i) = \hat{\kappa}_{it}\frac{\sigma_a^2/\sigma_\varsigma^2}{\sigma_a^2/\sigma_\varsigma^2 + 1}[(a_{it} - \bar{a}_i) + \varsigma_{it} + \gamma(log(G_{it}) - log(G^*_{it}))] \tag{A-10}$$

which provides a direct incentive to boost local public goods provision.

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