Place-based Land Policy and Spatial Misallocation: Theory and Evidence from China *

Min Fang, UF; Libin Han, DUFE; Zibin Huang, SUFE; Ming Lu, SJTU; Li Zhang, SYSU

March 25, 2024
latest version

Abstract

Place-based policies may create spatial misallocation. We investigate a major policy in China that aims to reduce regional development gaps by distributing more urban land quotas to underdeveloped inland regions. We show empirical evidence that this policy decreased productivity in more developed eastern regions relative to inland regions. We then build a prefecture-level spatial equilibrium model with migration, land constraints, and agglomeration. The model reveals that this policy led to substantial output and productivity losses by distorting both labor and production across regions. Regional output gaps shrank, but workers from underdeveloped regions reduced their migration to developed regions and earned less. Counterfactuals show that national output would have been 1.8% higher in 2010 if the policy had not been implemented, and workers from underdeveloped regions would have earned 7% more income. Instead, regional monetary transfer policies could reduce regional inequality without significantly increasing spatial misallocation.

Keywords: Place-based Policy; Land Policy; Spatial Misallocation; Migration; Labor Mobility; Regional Inequality; China; **JEL Classification Numbers:** O18, R58, E24, J61, R52;

*Min Fang (minfang@ufl.edu), Department of Economics, University of Florida; Libin Han (hanlibin@126.com), Economic and Social Development Institute, Dongbei University of Finance and Economics; Zibin Huang (huangzibin@mail.shufe.edu.cn), College of Business, Shanghai University of Finance and Economics, and Shanghai Institute of International Finance and Economics; Ming Lu (luming1973@sjtu.edu.cn), Antai College of Economics and Management, Shanghai Jiao Tong University; Li Zhang (zhangl39@mail.sysu.edu.cn), International School of Business and Finance, Sun Yat-Sen University.

We thank editor Dirk Krueger, an anonymous associate editor, four anonymous referees, George Alessandria, Yan Bai, Mark Bils, Nathaniel Baum-Snow, Ying Chen, Gaston Chaumont, Andrew Davis, Jianpeng Deng, Rui Du, Wei Duan, John Friedman, Shihe Fu, Elena Gentili, Yizhen Gu, Juncong Guo, Narayana Kocherlakota, James Liang, Lin Ma, Ronni Pavan, Yao Wang, Zhi Wang, Junichi Yamasaki, Wei You, Junfu Zhang, Qinghua Zhang, Xiaodong Zhu, Roman David Zarate, and Ben Zou for their comments and suggestions. We also thank all those attending seminars and conferences at the University of Rochester, the University of Hong Kong, the Chinese University of Hong Kong, Fudan University, Peking University, Zhejiang University, Sun Yat-sen University, Tongji University, Nanjing University, the University of International Business and Economics, Beijing Normal University, ASSA 2023, SOLE 2022, UEA North America Meeting 2021 and 2023, CCER Summer Institute 2021, Symposium on Contemporary Labor Economics, CES Annual Conference 2021, Chinese Young Economist Society 2021, China Finance Forty Forum 2021, Jinan-SMU-ABFER Conference on Urban and Regional Economics 2021, and Asia Impact Evaluation Conference 2021 for their valuable comments. We also thank Guangshun Zhu for his excellent research assistance. Earlier versions of this paper were titled "Regional Convergence or Just An Illusion? Place-based Land Policy and Spatial Misallocation". All errors are ours. First Version: May 13, 2021.

1 Introduction

Many countries regulate urban land allocation using place-based policies. These regulations commonly target underdeveloped regions to promote balanced national development (Neumark and Simpson, 2015). However, promoting balanced development may come at the cost of generating spatial misallocation, especially in the presence of spatial frictions. In this paper, we empirically and quantitatively study the consequences of a major place-based land allocation policy on both spatial misallocation and regional development in China. Specifically, we investigate a sudden shift in China's land supply policy in 2003, which transitioned from a demand-driven approach to a development-promoting approach commonly called the inland-favoring land policy.

Unlike most countries, the state owns all urban land in China. The central government sets a strict quota on how much land can be used for construction in each prefecture each year. Since the 1978 reforms, the Chinese government has distributed quotas based on each prefecture's demand, which favored rapidly growing eastern coastal regions. However, entering the 2000s, the continuing divergence of economic development across regions became a primary concern as eastern regions substantially outpaced the rest of the country. As a result, in 2003 the demand-driven approach was dramatically shifted to a development-promoting approach by reallocating land supply quota from eastern to inland regions, hence an 'inland-favoring' land supply policy. This policy has since remained in place.

This place-based policy distorted both urban floor space supply and labor markets and generated severe spatial misallocation of labor and production. Urban space constraints in more productive regions increased prices for residential and production floor space. Such changes in floor space prices led to spatial misallocation and reduced output via three channels. First, more expensive production floor space directly constrained production in more productive regions. Second, labor demand and supply in more productive regions were further constrained by more expensive production and residential floor space, hindering migration inflows. Finally, the decline in migration inflows into more productive regions further reduced agglomeration effects in these regions. All three channels shifted the spatial allocation of production and labor towards less productive regions and caused national labor productivity to stay relatively low.[1]

But has China successfully promoted balanced development despite such spatial misallocation costs? The answer depends on the measure. The policy shrank productivity and output gaps between developed eastern and underdeveloped inland regions at the cost of lowering the incomes of workers from underdeveloped regions since they became less likely to migrate to developed regions that offer higher wages. This is consistent with recent literature (Tombe and Zhu, 2019; Lagakos et al., 2020; Lagakos, 2020; Lagakos, Mobarak, and Waugh, 2023; Wu and You, 2023;

[1] All the spatial (mis)allocation of production and labor discussed here is relative to the national Chinese growth trend. With underlying structural transmission, productivity growth, population growth, total construction land, and total urban workers are still growing despite the potential spatial (mis)allocation.

Huynh, 2023) finding that reducing internal migration costs is particularly beneficial to workers in underdeveloped regions, especially rural areas where returns to migration opportunities are high. Overall national welfare was reduced while the effects on workers from poorer and rural areas are *mixed*. Thus, this policy successfully promoted geographically balanced development. However, it did not necessarily benefit workers from underdeveloped regions. We find that by replacing the policy with regional transfers, China could increase both national output and the incomes and welfare of workers from underdeveloped regions.

We analyze the effects of this place-based land policy in three steps. First, we show empirically how the policy changes measured productivity across regions. Second, we develop a spatial equilibrium model to explain the mechanism and quantify the impact of the policy. Third, we conduct several counterfactual exercises to compare the current policy to other alternatives.

In the first step, we investigate the effect of the inland-favoring policy on the prefecture average firm productivity gap between eastern and inland regions. Employing prefecture-level Difference-in-Differences regression, we find that the inland-favoring policy reduced the prefecture average firm productivity gap between the eastern and inland prefectures by 5-8%, depending on the productivity measure. The results remain consistent across various robustness exercises. Moreover, we do not observe significant productivity improvements among inland firms. We further present empirical analyses showing that the policy increased relative land and housing prices and reduced relative wages and migration inflows in eastern regions. Our empirical analysis demonstrates that the inland-favoring policy narrowed the productivity gap between eastern and inland regions by potentially increasing the spatial misallocation of labor and production.

In the second step, we construct a spatial general equilibrium model to illustrate the mechanism of policy distortion and quantify the aggregate effects. The model features several degrees of heterogeneity (multi-prefecture, multi-skill, and multi-area), migration with costs, urban production with agglomeration, and floor space constraints in both residence and production. In the model, place-based land policy may affect national productivity in three ways. First, reducing land supply in more developed prefectures directly reduces national productivity as productive firms in developed prefectures face tighter production floor space constraints. Second, it reduces migration to developed prefectures as workers face higher housing costs due to tighter residential floor space constraints and lower wages due to tighter production floor space constraints. Finally, it reduces agglomeration effects in more developed prefectures due to fewer migration inflows.

Using microdata from the Chinese Population Census, the City Statistical Yearbooks of 225 Chinese prefectures, the Urban Statistical Yearbook of China, and other supplementary databases in 2005 and 2010, we solve and quantify the model. We then estimate the agglomeration parameter by combining our empirical analysis and the structural model using indirect inference. Finally, we show quantitative equilibrium results that measured productivity is much higher, but the land constraint is much more severe in more developed eastern prefectures.

In the final step, we implement three counterfactuals. In the first, we examine what would happen if the pre-2003 land supply policy was maintained. Naturally, this increases land supply in eastern prefectures and decreases floor space prices. More migrants are attracted to these prefectures, resulting in a 1.5% (1.8%) increase in national output in 2005 (2010). We also find that the productivity loss due to the inland-favoring policy was enormous. If we remove the policy, national productivity increases by 5.9% in 2005 and by 8.1% in 2010. The removal of the policy would reduce output and productivity in underdeveloped inland prefectures and cause a larger regional output gap. However, since workers from these underdeveloped inland prefectures have better access to developed prefectures, their incomes would be higher due to more migration. Thus, removing the inland-favoring policy increases incomes for almost all workers. The inland-favoring land supply policy did promote geographical convergence but did not necessarily increase the incomes of workers from underdeveloped regions.

In the second counterfactual, we propose a direct regional transfer as an alternative regional balancing policy to replace the place-based land policy. Instead of distributing more land to less developed regions, the central government could directly tax the additional benefits from more land in developed regions and transfer the proceeds to underdeveloped regions. Without loss of generality, we show that a direct regional monetary transfer could increase the incomes and welfare of workers from underdeveloped regions with minimal spatial misallocation.

Finally, in the third, we show the effects of alleviating all land supply distortions by equalizing floor space prices both cross-prefecture and within-prefecture. We compare this optimal policy in terms of production to the current equilibrium allocation to evaluate the overall magnitude of Chinese spatial misallocation. We have three main findings. First, the policy creates a positive correlation between land supply and productivity, which is the opposite of the negative correlation in the current equilibrium. Second, it significantly increases productivity, urban output, income, and welfare. Third, by comparing to the optimal policy in terms of production, we find that the inland-favoring land policy contributes significantly to Chinese spatial misallocation, accounting for 11% in 2005 and 31% in 2010 of the productivity misallocation.

Literature Review Evaluating the effects of place-based policies or land-use regulations in emerging markets is particularly challenging. Firstly, a clean causal identification of the effects of land-use regulations is usually hard to find. Secondly, empirically identified causal effects are usually local and cannot be easily aggregated, while aggregated quantitative studies usually overlook the distributional effects. Finally, limitations in data availability usually confine the analyses to a few developed prefectures. In this paper, we attempt to address all three issues simultaneously.

First, we draw on direct causal evidence for the effects of place-based land-use regulations. Earlier literature has studied the impacts of land-use regulations on housing and welfare both theoretically (Hamilton, 1978; Wallace, 1988; Brueckner, 1995; Helsley and Strange, 1995; Hilber and Robert-Nicoud, 2013) and empirically (Glaeser, Gyourko, and Saks, 2005; Glaeser and Ward, 2009; Gyourko and Molloy, 2015), focusing mainly on the housing market in a few developed U.S. prefectures due to data availability. Meanwhile, addressing the endogeneity of the effects of land-use regulations remains a challenge (Quigley and Rosenthal, 2005). To tackle this challenge, recent literature has adopted DID strategies (Cunningham, 2007; Kahn, Vaughn, and Zasloff, 2010; Yu, 2019) around policy shifts. We leverage the sudden policy change in 2003 and the DID approach to establish the causal impact of the policy in China.

Second, we develop a comprehensive quantitative spatial equilibrium model to capture the aggregate and distributional effects. Recent literature has investigated various frictions and place-based policies[2] that result in spatial misallocation or welfare losses, including (urban-rural) migration frictions (Tombe and Zhu, 2019; Lagakos et al., 2020; Lagakos, 2020; Lagakos, Mobarak, and Waugh, 2023; Wu and You, 2023), housing constraints (Hsieh and Moretti, 2019), urban land expansion frictions (Yu, 2019; Fu, Xu, and Zhang, 2021), political manipulation (Henderson et al., 2022), and combinations of several of the frictions above (Li, Ma, and Tang, 2021; Deng et al., 2020; Chen et al., 2019). Among these, the most related study is Yu (2019), which investigates the effect of the "Farmland Red Line Policy" on economic development in China.[3] We comprehensively build our quantitative model to capture the aggregate effects by including urban-rural-skill-specific migration and housing frictions on the household side and production space frictions and agglomeration effects in density on the firm side. Additionally, the rich prefecture-urban-rural-skill structure allows us to analyze distributional effects more carefully.

Third, we take our model to comprehensive individual-level, firm-level, and prefecture-level datasets to seriously address data limitations common in emerging markets. Much literature has studied migration and regional development in China and other developing countries. In the context of China, scholars have investigated the Hukou restriction and regional trade barriers (Tombe and Zhu, 2019; Hao et al., 2020), international trade and labor mobility (Ma and Tang, 2020; Tian, 2018; Fan, 2019; Zi, 2020), housing constraints (Fang and Huang, 2022), air quality (Khanna et al., 2021), and local public services for migrants (Sieg, Yoon, and Zhang, 2021; Huang, 2020).[4] We take our model to the most granular level possible by combining the Chinese Population Census, various Statistical Yearbooks, the Land Parcel Trade Dataset, and other supplements to ensure the credibility of our aggregate and distributional quantitative results.

[2]These papers include enterprise zones (Neumark and Kolko, 2010; Freedman, 2013; Ham et al., 2011; Busso, Gregory, and Kline, 2013), discretionary grants (Crozet, Mayer, and Mucchielli, 2004; Devereux, Griffith, and Simpson, 2007), infrastructure investment (Kline and Moretti, 2014; Glaeser and Gottlieb, 2008; Becker, Egger, and Von Ehrlich, 2010), special economic zones (Wang, 2013; Lu, Wang, and Zhu, 2019), and community development (Eriksen and Rosenthal, 2010; Accetturo and De Blasio, 2012; Romero, 2009), among others.

[3]Yu (2019) finds that this restriction on converting rural farmland to urban construction land leads to severe spatial misallocation in land and labor, lowers GDP, and reduces welfare, consistent with our findings.

[4]Studies of other developing countries include Malaysia (Bertaud and Malpezzi, 2001), Indonesia (Bryan and Morten, 2019; Civelli et al., 2022), Brazil (Pellegrina, 2022), Columbia (Tsivanidis, 2019), Mexico (Monras, 2020), and India (Imbert and Papp, 2020), among others.

In summary, our study contributes to the literature by empirically, theoretically, and quantitatively examining the effect of place-based land-use regulations on China's aggregate and regional economies. We address several issues common to this literature, such as endogeneity and data limitations. By combining comprehensive individual-level, firm-level, and prefecture-level datasets, we provide a detailed analysis of the impact of place-based land policies on various aspects of the Chinese economy.

Layout This paper is organized as follows. Section 2 provides the institutional background and describes the datasets. Section 3 provides empirical evidence that the inland-favoring land policy decreased productivity in more developed eastern regions relative to inland regions. Sections 4 and 5 develop and estimate a spatial equilibrium model and solve it using microdata. Section 6 conducts a counterfactual analysis of eliminating the place-based land policy.Section 7 evaluates a counterfactual when all land frictions are removed. Section 8 provides model sensitivity checks and further discussion. Section 9 concludes.

2 Background and Data

2.1 Institutional Background

Land Ownership In China, there is no private land ownership. A village collectively owns agricultural land, while urban land is state-owned. Agricultural land is transferred to the state through land expropriation before being used for urban construction. Construction companies must buy "use rights" from the local government to develop urban land. The central government strictly controls urban expansion to ensure enough agricultural land for domestic food supply security (Yu, 2019). Each prefecture is assigned a quota of new urban construction land each year. Before 2003, the quota was mainly based on each prefecture's demand.

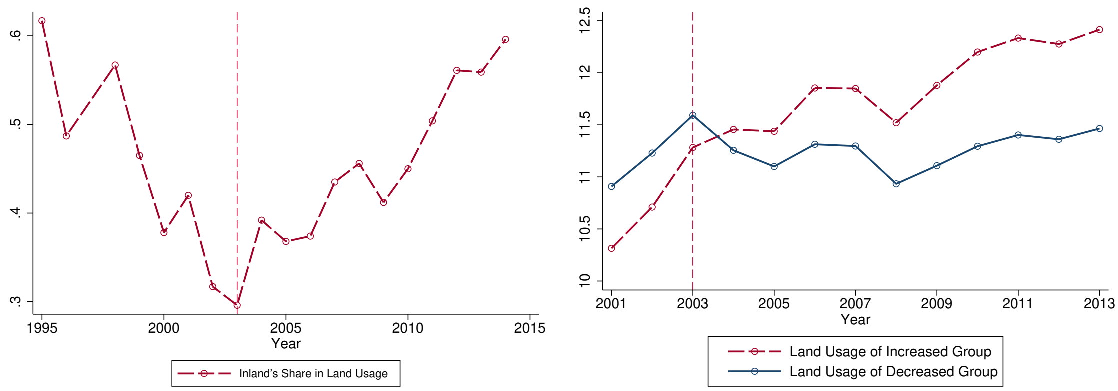
The 2003 Reform Allocation of construction land quotas has been used as a place-based policy since 2003. Before 2003, developed areas with higher land demand were usually assigned more land quota. However, after Jintao Hu and Jiabao Wen's new administration took office in 2003, the central government started to focus on balancing economic development by allocating more land quota to underdeveloped inland provinces.[5] In 2004, the central committee of the Chinese Communist Party made it clear that it is necessary to strengthen the role of land supply policy

[5]Some studies have documented this significant change, see e.g. Lu and Xiang (2016), Han and Lu (2017), Liang, Lu, and Zhang (2016), or Fu, Xu, and Zhang (2021). Another part of the policy was that 70% of development zones, also known as special economic zones, that subside land usage, were closed in 2003–2004. The planned urban construction land supply for these closed development zones was also cut. Most of these closed development zones were located in eastern regions, and many newly opened development zones have since been established inland to support local economic development (Lu and Xiang, 2016; Chen et al., 2019).

Figure 1: New Urban Land Usage Before and After 2003

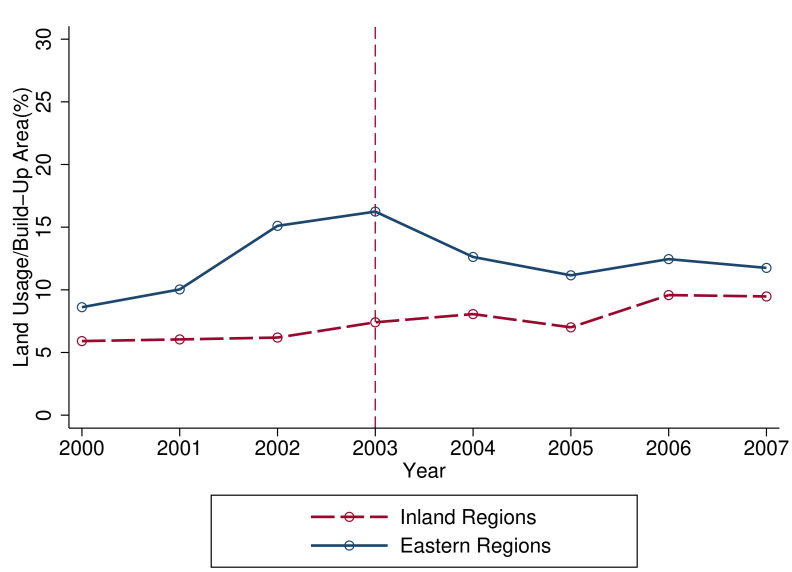
(a) Inland Provinces' Share of New Land

(b) Divergence Between Prefecture Groups



Notes: Figure shows changes in use of new urban land each year. Data sources are the National Bureau of Statistics of China, Statistical Yearbook of China's Land and Resources (2000–2016), and Yearbook of China's Land (1996–1999). The unit of subfigure (b) is the log of hectares.

Figure 2: **Changes in New Land and Total Built Area**



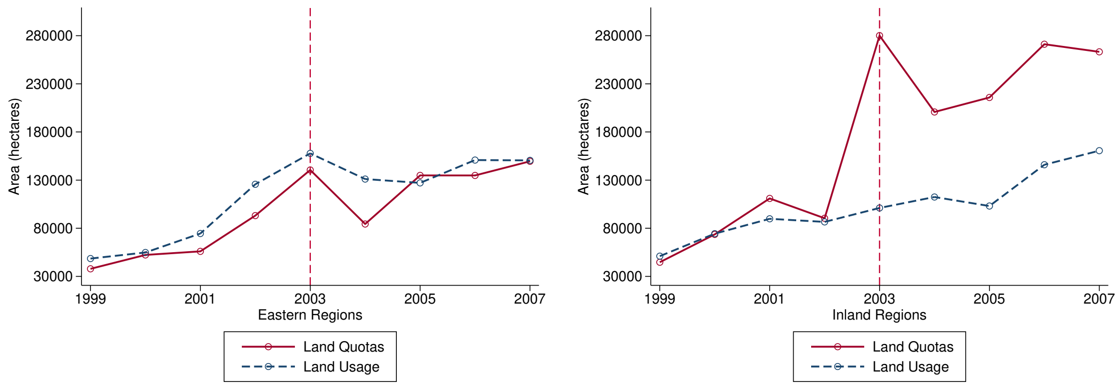
Notes: Figure shows time trends of the ratio between new urban land and total built area. The blue solid line is annual new urban land in the developed eastern region, and the red dashed line is annual new urban land in the inland region. The dashed vertical line indicates the implementation of the inland-favoring land policy.

in macroeconomic management.[6] Additionally, the National Master Land Use Plan (2006–2020) issued in 2005 officially stated that construction land use in eastern areas would be strictly con-

[6]Decision of the State Council on deepening the reform of strict land management, issued on 12/21/2004 (link).

Figure 3: Urban Land Usage and Quota Before and After 2003

(a) Land Supply and Quota in Eastern Regions (b) Land Supply and Quota in Inland Regions



Notes: Figure compares allocated quota of urban land to land actually incorporated into cities in each year. Data sources are the National Bureau of Statistics of China, Statistical Yearbook of China's Land and Resources (1999–2007), and Yearbook of China's Land (1999–2007).

trolled, and land-use quotas in inland areas would be increased.[7]

Changes in Usage We first measure actual new land usage across regions in each year. Figure 1 panel (a) shows the inland provinces' share of national new urban construction land from 1999 to 2007. This is distinct from land quota. Quota defines how much new land may be converted to urban land each year, whereas we refer to new land usage as the amount of quota actually used to convert formerly agricultural land into new urban land each year. Relative inland urban land growth declined rapidly during the east's rapid economic growth from 1995-2003 before reversing from less than 30% in 2003 to 60% in 2015. The turning point was clearly in 2003. The trend generated by this inland-favoring policy becomes even more apparent at the prefecture level. Figure 1 panel (b) divides Chinese prefectures into two groups: prefectures whose new land usage shares increased after 2003 and prefectures whose new land usage shares shrank after 2003. Land usage in the first group was lower before 2003, but jumped and surpassed the second group after 2003, with the gap growing over time. Han and Lu (2017) also shows that a prefecture's land usage share was more likely to shrink after 2003 if it had a larger share of land usage before 2003. Most of these were more developed eastern prefectures. Figure 2 shows the time trend of the proportion of new urban land usage each year over the total built area (total used urban land). It illustrates that the proportion was at 10-15% per year in eastern areas relative to 5-10% in inland areas. We also find a significant turning point in the year of 2003, after which the proportion of new urban land was reduced in eastern areas.

Changes in Quotas Another indicator is changes in new urban land quota — more specifi-

[7]The National Master Land Use Plan (2006–2020) is published by Xinhua Press in Chinese (link).

cally, changes in the amount of additional land designated for urban construction approved by the central government each year. This metric, while closely aligned with actual new land usage, may diverge due to local governments reserving land for future sale. Unfortunately, quota data at the prefecture-level is confidential, restricting our analysis to province-level urban land quotas. Figure 3 depicts the variations in land quota and land usage within eastern regions in Panel (a) and inland regions in Panel (b). We have two main observations. First, the land quota constraint is binding in eastern regions, as indicated by the close movement between the quota and actual land usage lines. In certain early years, land usage was observed to be marginally higher, a phenomenon potentially attributable to the recycling of pre-existing construction land.[8] Conversely, this constraint appears less stringent in inland regions. In particular, the growth rate of land usage in inland regions was not as fast as that of land quotas after 2003. Land usage started to increase rapidly with a lag of about two years. Second, a pivotal shift in both land usage and quota post-2003 is evident. While eastern regions saw a reduction in quotas, inland quota surged. Overall, this period marked a cessation of land usage and quota growth in eastern areas, juxtaposed with encouraging such growth inland.

2.2 Datasets

2.2.1 Data for the Empirical Analysis

The main data we use is the *National Industrial Enterprise Database (NIED)*, published by the National Bureau of Statistics. It covers all enterprises "above scale" (main business revenue greater than 5 million RMB). This dataset accounts for over 90% of all industrial production in China.[9] The dataset contains rich enterprise-level information, such as firm name, industry category, incorporation year, number of employees, total salary, and total fixed assets.[10] Table 1 shows the descriptive statistics of the enterprise data. Variables in Panel A are calculated at the firm-level. Variables in Panel B are averaged at the prefecture-level, weighted by firm employment. Our main productivity calculation is based on the OP (Olley and Pakes, 1992) estimation method. We also calculate productivity using the LP (Levinsohn and Petrin, 2003) and the ACF (Ackerberg, Caves, and Frazer, 2015) methods in Appendix A, which yield similar results. Furthermore, we investigate other outcome variables, including prefecture-level wages, land prices, housing prices, and migration, to validate the mechanism using additional datasets. Additional descriptions and results are in Appendix A.7.

[8] For instance, when an old manufacturing facility is demolished, and the land is repurposed for new commercial development, such usage is included in the annual new land usage statistics, but not in the land quota for that year.

[9] Since there is a major missing data issue after 2007, we only use data from 2001 to 2007.

[10] For unknown reasons, some companies provide missing or erroneous information. Some data cleaning and a 1% censoring process were applied to avoid abnormal observations.

Table 1: Summary Statistics

Variable	Description	Observations	Mean	Std. dev.	Min	Median	Max
Panel A. Firm-level Variables							
Ln(tfp_op)	Firm TFP (OP)	877383	3.25	1.02	-0.04	3.27	5.63
Ln(tfp_lp)	Firm TFP (LP)	877383	6.36	1.09	3.08	6.32	9.02
Ln(tfp_acf)	Firm TFP (ACF)	877383	4.72	1.46	1.03	4.71	8.03
Ln(output)	Ln(1k yuan)	877383	8.62	1.29	5.31	8.51	12.22
Ln(wage)	Ln(1k yuan yearly)	876147	2.39	0.63	0.39	2.41	4.14
Employee	Person	877383	192.37	293.80	12	97	1985
East	Dummy	877383	0.80	0.40	0	1	1
Panel B. Prefecture-level Variables							
Ln(tfp_op)	Prefecture TFP (OP)	1792	3.16	0.42	1.41	3.22	3.96
Ln(tfp_lp)	Prefecture TFP (LP)	1792	7.11	0.44	5.02	7.12	8.04
Ln(tfp_acf)	Prefecture TFP (ACF)	1792	4.70	0.65	2.39	4.74	6.15
East	Dummy	1792	0.32	0.47	0	0	1

Notes: This table summarizes the main data we use — the *National Industrial Enterprise Database (NIED)*, published by the National Bureau of Statistics. It covers all enterprises “above scale” (main business revenue greater than 5 million RMB) from 2001 to 2007. Variables in Panel A are calculated at the firm-level. Variables in Panel B are averaged at the prefecture-level, weighted by firm employment. East is a dummy variable set to 1 if the firm/prefecture is in the eastern area.

2.2.2 Data for the Quantitative Analysis

The main dataset we use in the quantitative analysis is the Chinese Population Census. It is the most comprehensive household survey in China. Every ten years, the National Bureau of Statistics thoroughly investigates all households in the country. All families must complete a short survey, which requires provision of basic demographic information such as name, education, and living address. 10% of all families must take a longer survey, including additional information such as job and place of birth. Between each decennial Census, there is a mini-Census. For each mini-Census, the statistics bureau randomly chooses 10% of the population to complete a survey similar to the long survey in the decennial Census. For simplicity, we call both the decennial and mini-census "Census data". In this study, we use Census data from 2005 and 2010. This gives us prefecture-area-level migration flows and housing rents for individuals with different education levels. In total, we have 2,585,481 (4,803,589) individuals in 2005 (2010), which covers 0.2% (0.36%) of the population.

Besides the Census, we utilize the Urban Statistical Yearbook and each prefecture’s (manually collected) City Statistical Yearbook. The Urban Statistical Yearbook summarizes key characteristics of all Chinese prefectures. We derived prefecture-level GDP growth and built urban land area data from the Urban Statistical Yearbook. Since we do not directly observe land quotas at the prefecture-level, we use built urban land area as the land supply in the quantitative analysis and provide sensitivity checks using province-level land quota data. We discuss this issue in more detail in Sections 6.1 and 8. Local branches of the statistics bureau annually compile the City Statistical Yearbooks. We use these books' prefecture-industry-level wage information to impute prefecture-skill-level wages following an impute method in the literature.[11] We also conduct sensitivity checks using another imputation method from individual-level wage data in Census 2005. A complete list of prefectures with corresponding GDP, measured productivity, and land tightness is in Appendix B1.

3 Empirical Analysis

We first empirically analyze how the inland-favoring policy affected productivity across regions. We show causal evidence that this policy shrank the productivity gap between eastern and inland prefectures. This reduction can be primarily attributed to the decreased productivity of eastern prefectures. Furthermore, we investigate other outcome variables, including prefecture-level wages, land prices, housing prices, and migrants as supplementary evidence.

3.1 Empirical Specification

In the main empirical analysis, we run a simple prefecture-level DID regression to identify the effect of the inland-favoring land supply policy on productivity. We use the region definitions published by the National Bureau of Statistics of China.[12] For prefecture j in year t, we have the following regression:

$$ln(Prod_{jt}) = \alpha + \delta_1 Post2003_t \times East_j + \phi_j + \gamma_t + \epsilon_{jt} \tag{1}$$

where $ln(Prod_{jt})$ is prefecture average firm productivity. We first calculate firm-level productivity using our firm-level data and then take the average in different prefectures, weighted by firm employment. The coefficient δ_1 is the effect of the 2003 inland-favoring policy on relative prefecture average productivity in the eastern region. $Post2003$ indicates whether the time period is after 2003 (includes 2003). $East_j$ indicates whether the prefecture is in the eastern region. ϕ_j and γ_t are the sets of prefecture and year fixed effects. ϵ_{jt} is the error term. It is important to clarify that the inland-favoring land policy can potentially affect the productivity of both regions. Therefore, the regression coefficient should be interpreted as the policy's effect on the regional gap (relative level) rather than on the absolute level of productivity for either region.

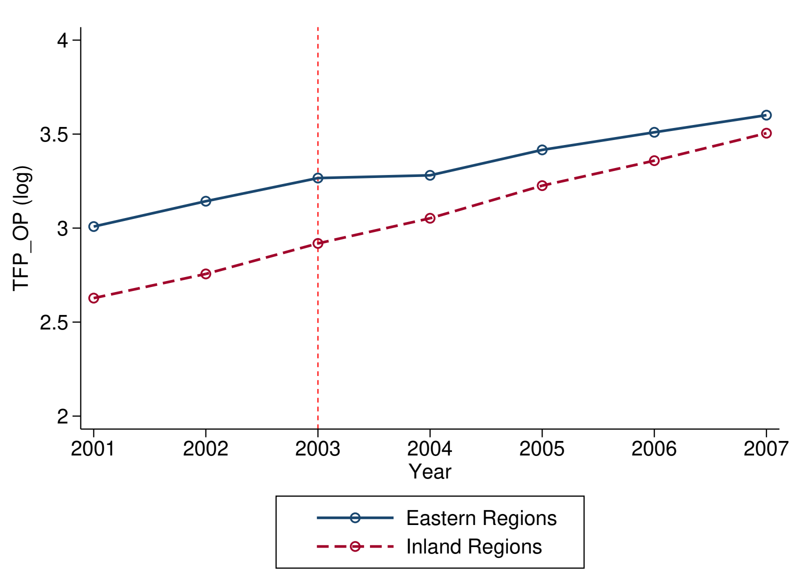
[11] The basic idea is that we know each individual's industry and skill from the Census data. We also have average wages for each industry from the City Statistical Yearbooks. We assign this average wage to each individual in the Census data based on their prefecture and industry information as imputed individual wages. We then calculate average wages in each prefecture for each skill using these imputed wages. The detailed imputation method is identical to the one used in Fang and Huang (2022).

[12] We consider northeastern provinces as inland.

3.2 Regression Assumptions Validation

We validate our regression method by checking the key DID assumptions. First, we investigate the time trend of firm productivity in the eastern and inland regions. Our regression specification assumes that productivity in eastern and inland prefectures should have a similar time trend. Figure 4 shows the time trends of firm productivity. The black line is average productivity in the developed eastern region, and the grey line is average productivity in the inland region. The dashed vertical line is located just after 2003 when the inland-favoring land policy was implemented. We find no evidence of divergent time trends in productivity before the policy. Despite the 2003 policy's aim to boost inland development, we do not observe a corresponding increase in the growth rate of inland productivity. Instead, the policy seems to have stymied the growth of eastern productivity.

Figure 4: **Time Trends of Firm Productivity**

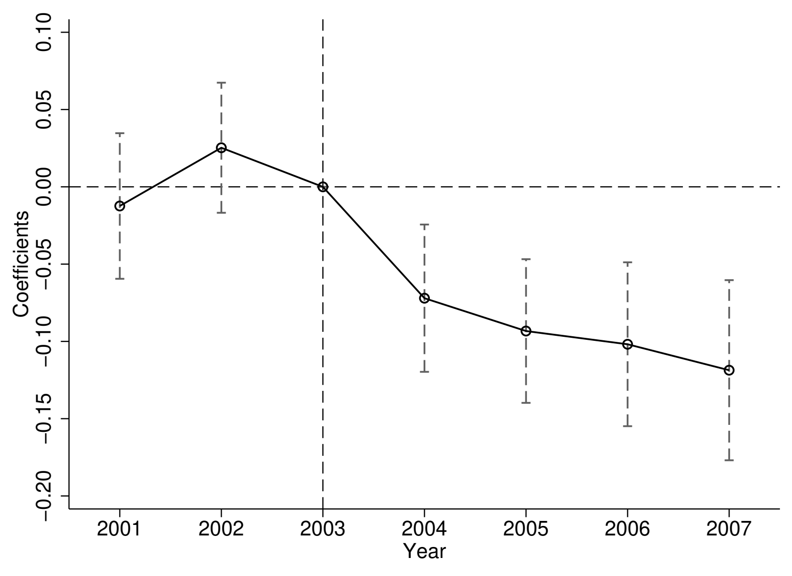


Notes: This figure shows the time trends of firm-level productivity calculated using the Olley and Pakes (1992) method. The blue solid line is average productivity in the developed eastern region, and the red dashed line is average inland productivity. The dashed vertical line indicates the implementation of the inland-favoring land policy.

Second, we implement a traditional event study regression to investigate the evolution of the eastern region effect across time. We take 2003 as the baseline year and then run the following regression for the event study:

$$ln(Prod_{jt}) = \alpha + \sum_{s \neq 2003} \delta_{1s} \mathbf{1}(s = t) \times East_j + \phi_j + \gamma_t + \epsilon_{jt} \tag{2}$$

Figure 5: **Event Study: Productivity**



Notes: The dependent variable is average firm productivity in different prefectures calculated using the Olley and Pakes (1992) method. The corresponding confidence interval is 95%. We control for prefecture and year-fixed effects. We also control for linear time trends in different provinces and prefectures with different initial period (2001) characteristics, including GDP per capita and industry composition.

We plot the evolution of the coefficient δ_{1s} across time s in Figure 5, illustrating the changing of the eastern region effect across time, with 95% confidence intervals. We find that all coefficients are very close to zero before 2003. They become statistically and economically distinguishable from zero only after the policy implementation. The results from this event study confirm that there is no divergent pre-trend in our data. These figures also give us a preview of the main results. After the central government imposed the inland-favoring land policy in 2003, there was a decrease in the productivity gap between eastern and inland prefectures.

3.3 Empirical Results

Main Results on Productivity Table 2 shows the regression results for productivity. In the first column, we control for prefecture fixed effects, year fixed effects, and linear time trends in prefectures with different initial period (the year 2001) characteristics, including GDP per capita and industry composition. In the second column, we further control for linear time trends in different provinces. When including all control variables, we find that the reduction in land supply after 2003 reduced the measured productivity gap of eastern prefectures relative to inland prefectures by about 7.5%. The qualitative results are consistent across regression settings.

Other Variables and Potential Mechanism We further investigate the policy's effect on additional outcome variables, including prefecture-level wages, land prices, housing prices, and migrants in Appendix A.7. This investigation aims to briefly discuss the policy's mechanism while assembling empirical evidence to support our quantitative model. The results are summarized in Table 3.

Our findings reveal that the inland-favoring land policy directly led to relative increases in inland land and housing prices, and relative reductions in eastern wages and migration. The mechanism is as follows. On one hand, the surge in eastern land prices raised costs for firms, leading to a decrease in wages and a reduction in labor demand. On the other hand, the rise in housing prices drove up the cost of living, further diminishing labor supply. These channels combined to noticeably reduce worker migration from inland to eastern regions. Consequently, the 2003 land policy impacted productivity not merely by distorting the land market but also by distorting the decision-making processes of firms and workers in the labor market. We intend to explore this mechanism more comprehensively through a quantitative spatial model in the forthcoming sections.

Table 2: **DID Results on Productivity**

	(1)	(2)
Post2003×East	-0.0705***	-0.0749***
	(0.0267)	(0.0266)
Province × Time Trend	N	Y
GDP Per Capita × Time Trend	Y	Y
Industry Share × Time Trend	Y	Y
Year FE	Y	Y
Prefecture FE	Y	Y
Observations	1,792	1,792
R-squared	0.7529	0.7537

Notes: The dependent variable is prefecture-level average firm productivity. We first measure firm productivity by the Olley and Pakes (1992) method, then take an average for each prefecture, weighted by firm employment. The standard errors are clustered at the prefecture-level. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Robustness Checks We further implement six groups of robustness analyses to address an extensive set of potential empirical concerns. The results are available in Appendix A. Our main results are robust across all checks. First, in Appendix A.1, we address concerns with the robustness of our productivity estimates. We verify robustness by repeating the empirical analysis using productivity calculated with the methods proposed by Levinsohn and Petrin (2003) and Ackerberg, Caves, and Frazer (2015). Second, in Appendix A.2, we change the model specification using province-level quota changes as the treatment variable. Similar to the main results, we find that prefectures with larger quota reductions experienced larger productivity drops. We do

Table 3: **Summary of Policy Effects**

	Land Price	Housing Price	Average Wage	Migration Inflow
Post2003×East	$\Uparrow$	$\Uparrow$	$\Downarrow$	$\Downarrow$

Notes: This table summarizes the policy's effect on additional outcome variables, including prefecture-level wages, land prices, housing prices, and migrantion. Detailed regression results are in Appendix A.7. We present the direction of changes in these variables to indicate the potential policy transmission mechanism.

not use this as the main specification since we only have province-level quota data. Third, the policy was enacted in 2003, and we categorize 2003 as part of the treatment group in the main context. In Appendix A.3, we change the definition and include 2003 in the control group.

We also address concerns about possible confounding policies around 2003. In Appendix A.4, we discuss the potential spatial effects of China joining the WTO in 2001. To address this issue, we run regressions keeping only firms with zero exports and regressions controlling for prefecture-level exports to eliminate any WTO effect. In Appendix A.5, we try to rule out the effects of other firm subsidy and tax policies implemented around 2003. In Appendix A.6, we investigate potential confounding effects from two rural reform policies.

3.4 Empirical Remarks

This empirical analysis shows that the inland-favoring land policy decreased the productivity gap between developed eastern regions and the underdeveloped inland regions. As depicted in Figure 4, this change is primarily driven by a slowdown in eastern productivity growth rather than an acceleration in inland productivity growth. Our supplementary findings regarding land prices, wages, housing prices, and migration patterns offer preliminary evidence supporting our proposed mechanism. These findings suggest that while the government's policy succeeded in reducing eastern-inland gaps it may have created significant distortions in Chinese land and labor markets. This regional convergence is potentially achieved at the cost of spatial misallocation. To better understand the aggregate and spatial effects and the mechanism, we construct a spatial equilibrium model to conduct further quantitative analysis in the following sections.

4 The Model

The economy consists of discrete locations, precisely, **prefectures** (administrative cities in China), indexed by $i = 1, ..., K$. Each prefecture j consists of two areas: urban u and rural r. The economy is populated by an exogenous measure of H workers, who are imperfectly mobile within the economy and subject to migration costs. Each worker is either low-skill $s = l$ or high-skill $s = h$. They are endowed with a Hukou/hometown location which cannot be changed. Each location i has an inelastic supply of urban floor space S_i^u, produced by a fixed amount of urban land supply L_i^u. In urban areas, floor space can be used for production or residence. We denote the endogenous fractions of floor space allocated to production and residential use by θ_i and $(1-\theta_i)$, respectively. Rural housing markets are simplified such that their rents are proportional to the average urban rent in the same prefecture.[13]

After observing idiosyncratic utility shocks between each possible pair of destinations and their original location, workers decide whether and where to move given their skills and Hukou locations. Firms produce a single final good, which is costlessly traded within the country and is chosen as the numeraire.[14] Locations differ in terms of their final urban goods productivity (A_i^u), rural final goods productivity (A_i^r), and supply of urban floor space (S_i^u). Finally, agglomeration effects exist in urban production, where prefecture-level productivity in urban areas is positively related to the density of workers. We estimate the agglomeration parameters using our empirical findings above, joint with our structural model, with an indirect inference method.

4.1 Worker Preferences

The utility of worker o with skill s, originating from region i area n, migrating to region j area k, is a combination of final good consumption ($c^o_{in,jk}$), residential floor space consumption ($s^o_{in,jk}$), migration cost ($\tau^s_{in,jk}$), and an idiosyncratic shock ($z^o_{in,jk}$) in a Cobb-Douglas form:

$$U^o_{in,jk} = \frac{z^o_{in,jk}}{\tau^s_{in,jk}} \left(\frac{c^o_{in,jk}}{\beta}\right)^{\beta} \left(\frac{s^o_{in,jk}}{1-\beta}\right)^{1-\beta} \tag{3}$$

We model the heterogeneity in the utility that workers derive from working in different parts of the economy following the migration literature (Tombe and Zhu, 2019; Fan, 2019). We also do not distinguish between urban and rural residence in the utility function but allow rural workers to construct their own residential floor space by paying construction costs. For each worker o originating from region i area n, migrating to region j area k, the idiosyncratic component of

[13] This model reflects rural China's unique land distribution system. All land in rural China is owned collectively by the village but not by individuals. There is no housing market in rural areas. The village council first distributes land to farmers (housing land, or in Chinese, *Zhaijidi*), and then farmers build their houses by themselves. Farmers effectively cannot sell or buy houses. Thus, their housing cost is the building cost.

[14] We do not specifically model prefecture-to-prefecture trade flows mainly due to data limitations. The most dis-aggregate intra-China trade flow data is the trade flows between Chinese provinces constructed from China's 2002 inter-regional input-output table, which is insufficient to support our analysis of prefecture-to-prefecture flows. Literature dealing with trade and migration (Tombe and Zhu, 2019; Fan, 2019; Zi, 2020) shows that reducing internal and external trade costs would accelerate labor reallocation towards more developed regions. In our model that does not include trade, such an effect would be mapped into urban final goods productivity.

utility ($z^o_{in,jk}$) is drawn from an independent Fréchet distribution:

$$F(z^o_{in,jk}) = e^{-{z^o_{in,jk}}^{-\epsilon}},\ \epsilon > 1$$

where the shape parameter $\epsilon > 1$ controls the dispersion of idiosyncratic utility. We assume that migration costs can be separated into two parts, $\tau^s_{in,jk} = \bar{\tau^s_{in}} d_{in,jk}$, where $d_{in,jk}$ captures the physical distance and institutional costs due to the Hukou system and other frictions in migrating from prefecture i area n to prefecture j area k, and $\bar{\tau^s_{in}}$ captures cost differences between individuals with different skills which may include skill-biased migration policies or differences in their preferences for specific amenities such as schools, entertainment, or transportation.[15]

After observing the realizations of idiosyncratic utility for each pair of origination and potential employment locations, workers choose their locations and areas of employment to maximize utility, taking as given residential housing prices, factor prices, and the decisions of other workers and firms. Residential housing prices serve as the first congestion effect in our model because when more and more people migrate to a city, the housing prices will be increased, resisting further migration (Allen and Arkolakis, 2014; Eckert and Peters, 2022).

Each worker is endowed with one unit of labor that is supplied inelastically with zero disutility. Taking the final good as numeraire and combining the worker's first-order conditions, we obtain the following demands for the final good and residential floor space for worker o with skill s from location i area n who migrates to location j area k:

$$c^o_{in,jk} = \beta v^s_{in,jk}, \quad s^o_{in,jk} = (1-\beta)\frac{v^s_{in,jk}}{Q_{jk}}$$

where $v^s_{in,jk}$ is total income for a worker with skill s who stays in area k, and Q_{jk} is the rental cost of residential floor space in area k in prefecture j.

Floor space is not tradeable across political boundaries and is owned in common by Hukou-registered workers from prefecture i area n. This assumption is broadly consistent with the institutional features of China and implies that migrant workers have no claim to this fixed factor income. Therefore, the income $v^s_{in,jk}$ is a combination of wage income which depends on skill s in prefecture j area k and equally-divided residential floor space rental income among all Hukou registrants in prefecture i area n:

$$v^s_{in,jk} = w^s_{jk} + \frac{Q_{in} S^R_{in}}{H^R_{in}} \tag{4}$$

[15] The Hukou system is a household registration system in China that restricts worker mobility. A household's social welfare programs, including educational, medical, and other public services, are tied to their Hukou registration. Households who attempt to use such services in non-Hukou-registered prefectures pay a substantially higher cost in terms of both money and time. For more details, please refer to Song (2014).

where H_{in}^R denotes all Hukou registrants, including those who migrated to work elsewhere, and S_{in}^R denotes all the residential floor space owned by H_{in}^R Hukou registrants.[16] Substituting equilibrium consumption of the final good and residential land use into utility, we obtain the following expression for the indirect utility function:

$$U_{in,jk}^o = \frac{z_{in,jk}^o v_{in,jk}^s Q_{jk}^{\beta-1}}{\tau_{in,jk}^s} \tag{5}$$

4.2 Distribution of Migration Flows

Using the monotonic relationship between utility and the idiosyncratic shock, the distribution of utility for a worker migrating from prefecture i area n and moving to the prefecture j area k is also Fréchet distributed:

$$G_{in,jk}^s(u) = Pr[U \leq u] = F\Big(\frac{u\tau_{in,jk}^s Q_{jk}^{1-\beta}}{v_{in,jk}^s}\Big)$$

$$G_{in,jk}^s(u) = e^{-\Phi_{in,jk}^s u^{-\epsilon}}, \ \Phi_{in,jk}^s = (\tau_{in,jk}^s Q_{jk}^{1-\beta})^{-\epsilon}(v_{in,jk}^s)^{\epsilon}$$

Since the maximum of a sequence of Fréchet distributed random variables is itself Fréchet distributed, the distribution of utility across all possible destinations is

$$1 - G_{in}^s(u) = 1 - \prod_{jk=11}^{JK} e^{-\Phi_{in,jk}^s u^{-\epsilon}}$$

Therefore we have

$$G_{in}^s(u) = e^{-\Phi_{in}^s u^{-\epsilon}}, \ \Phi_{in}^s = \sum_{jk=11}^{JK} \Phi_{in,jk}^s$$

We derive the gravity equation for migration flow in spatial equilibrium models as follows. Let $\pi_{in,jk}^s$ denote the share of workers with skill s registered in in who migrated to jk. The law of large numbers implies that the proportion of workers who migrate to area-region jk is

$$\pi_{in,jk}^s = \frac{(\tau_{in,jk}^s Q_{jk}^{1-\beta})^{-\epsilon}(v_{in,jk}^s)^{\epsilon}}{\sum_{j'k'=11}^{JK}((\tau_{in,j'k'}^s Q_{j'k'}^{1-\beta})^{-\epsilon}(v_{in,j'k'}^s)^{\epsilon})} = \frac{\Phi_{in,jk}^s}{\Phi_{in}^s} \tag{6}$$

[16]This assumption is different than Tombe and Zhu (2019), which assumes that migrant workers have no claim to any fixed factor income from the land of either their current working prefecture or their Hukou prefecture. In their model, whenever a worker migrates, she loses all fixed factor income from her previously owned local property in her Hukou prefecture. Our mechanism in this paper would be even stronger with their assumption.

4.3 Production

A single final good y is costlessly traded within the economy. In urban regions, it is produced with constant returns to scale following a Cobb-Douglas form, using some efficient combination of labor X_j and production floor space S_j^M:

$$Y_{ju} = (X_{ju})^{\alpha}(S_{ju}^M)^{1-\alpha}, \text{ where } X_{ju} = [(A_{ju}^h H_{ju}^h)^{\frac{\sigma-1}{\sigma}} + (A_{ju}^l H_{ju}^l)^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}} \tag{7}$$

where X_{ju} is a CES combination of high skill labor H_{ju}^h and low skill labor H_{ju}^l multiplied by their corresponding prefecture-level efficiencies A_{ju}^h and A_{ju}^l. In rural regions, production is simply $Y_{jr} = A_{jr}H_{jr}$. Since we are not focusing on trade or substitution between agricultural goods and other goods, we assume that Y_r and Y_u are perfect substitutes. In equilibrium, A_{jr} equals the agricultural wage w_{jr} in prefecture j rural area r.[17]

Firm Optimization We assume that the goods market is perfectly competitive. Urban firms choose their inputs of workers and production floor space to maximize profits, taking as given final goods productivity ($\{A_{ju}^h, A_{ju}^l\}$), the distribution of idiosyncratic utility, factor prices, and decisions of other firms and workers. The production input factor prices serve as the second congestion effect in this model since when more and more people migrate to a city, production floor space prices will be increased and wages will be decreased, resisting further migration. From the first-order conditions, we obtain the following:

$$w_{ju}^l = \alpha X_{ju}^{\alpha-1} S_{ju}^{M\,1-\alpha} A_{ju}^{l\,\frac{\sigma-1}{\sigma}} X_{ju}^{\frac{1}{\sigma}} H_{ju}^{l\,-\frac{1}{\sigma}} \tag{8}$$

$$w_{ju}^h = \alpha X_{ju}^{\alpha-1} S_{ju}^{M\,1-\alpha} A_{ju}^{h\,\frac{\sigma-1}{\sigma}} X_{ju}^{\frac{1}{\sigma}} H_{ju}^{h\,-\frac{1}{\sigma}} \tag{9}$$

$$S_{ju}^M = \left(\frac{1-\alpha}{q_{ju}}\right)^{\frac{1}{\alpha}} X_{ju} \tag{10}$$

The zero profit property from the constant returns to scale production function determines the equilibrium production floor price q_{ju} by:

$$(X_{ju})^{\alpha}(S_{ju}^M)^{1-\alpha} - W_{ju}X_{ju} - q_{ju}S_{ju}^M = 0$$

where $W_{ju}X_{ju} = w_{ju}^l H_{ju}^l + w_{ju}^h H_{ju}^h$. This, together with profit maximization (10), yields the following expression for the equilibrium production floor price:

$$q_{ju} = (1-\alpha)\left(\frac{\alpha}{W_{ju}}\right)^{\frac{\alpha}{1-\alpha}} \tag{11}$$

[17] We make a simplification such that $w_{jr}^h = w_{jr}^l = w_{jr}$.

Agglomeration We now introduce endogenous agglomeration forces as in Ahlfeldt et al. (2015) with slight modifications at the prefecture-level. We allow urban labor productivity for both skills to depend on production fundamentals (a^h_{ju} and a^l_{ju}) and production externalities (D_{ju}). Production externalities impose structure on how the productivity of a given region is affected by the density of workers within the urban area of the prefecture,

$$A^s_{ju} = a^s_{ju} \times (D_{ju})^\gamma \tag{12}$$

where $D_{ju} = (H^h_{ju} + H^l_{ju})/\bar{L}_{ju}$ is the urban density, in thousands of workers per square kilometer of administrative prefecture urban districts (urban core and its surroundings) as in Chauvin et al. (2017), and γ controls density's relative importance in determining overall productivity.[18]

4.4 Land Market Clearing

Urban Regulations Before moving to urban land market clearing, we highlight the regulation of the supply of urban floor space. For total supply, the central and local governments jointly determine a quota on how much floor space can be built each year in each prefecture. Such a quota is determined by the regulated density of development ϕ_j (the ratio of floor space to land) and the geographic construction land L_j. Therefore, we assume that floor space S_{ju} is supplied by a highly-regulated construction sector that uses construction land L_j and a regulated density of development ϕ_j to produce $S_{ju} = \phi_j L^u_j$.

Local governments then exogenously determine the usage allocation between production and residence by their preferences. Such preferences are heterogeneous across prefectures and depend on many characteristics. We treat this preference heterogeneity as creating a reduced form wedge between prices of production (q_{ju}) and residential (Q_{ju}) floor space $q_{ju} = \eta_j Q_{ju}$ where η_j captures the prefecture-specific land use regulations that restrict the price of production land relative to the price of residential land.

Urban Clearing Production land market clearing requires that the demand equals the supply of floor space allocated to production use in each location: $\theta_j S_{ju}$. Using the first-order conditions for profit maximization, this production land market clearing condition is:

$$S^M_{ju} = \left(\frac{(1-\alpha)}{q_{ju}}\right)^{\frac{1}{\alpha}} X_{ju} = \theta_j S_{ju} \tag{13}$$

[18]We choose to use administrative prefecture urban districts rather than construction land area as our main measure of $\bar{L}_{ju}$ for two main reasons: (1) most importantly, to be consistent with existing literature so our results are comparable, and (2) many loosely constructed amenities including some parks and all scenic tourism areas are not included in construction land areas. We use the other measure for sensitivity checks.

where $\theta_j \in (0, 1)$ is the measured proportion of floor space allocated to production use.[19]

Residential land market clearing implies that the demand for residential floor space equals the supply of floor space allocated to residential use in each location: $(1 - \theta_j)S_j$. Using utility maximization for each worker and taking expectations over the distribution for idiosyncratic utility, this residential land market clearing condition can be expressed as:

$$S^R_{ju} = E[s_{ju}]H_{ju} = (1 - \beta)\frac{E[v_{ju}]H_j}{Q_{ju}} = (1 - \theta_j)S_{ju} \tag{14}$$

Rural Clearing Rural housing markets are more straightforward as there is no production land. We assume that rural housing costs are a fixed fraction of the urban cost $Q_{jr} = \tau Q_{ju}$. Therefore, the price Q_{jr} is the cost of building a unit of floor space on rural land. Given the cost, rural residents choose the optimal floor space to build.

4.5 Definition of Spatial General Equilibrium

We now define and characterize the properties of a spatial general equilibrium given the model's fixed parameters $\{\beta, \epsilon, \alpha, \sigma, \mu, \gamma\}$.

Definition 1 A **Spatial General Equilibrium** for this economy is defined by a set of exogenous economic conditions $\{\tau^s_{in,jk}, a^s_j, \eta_j, \phi_j, L_j, H^s_{in}\}$, a list of endogenous prices $\{Q_{ju}, q_{ju}, w^s_{jk}\}$, quantities $\{v^s_{in,jk}, Y_{jk}, H^s_{jk}, S_{ju}\}$, and proportions $\{\pi^s_{in,jk}, \theta_j\}$ that solve the firms' problem, workers' problem, floor space producers' problem, and satisfy market clearing such that:

(i).**[Worker Optimization]** Taking the exogenous economic conditions $\{\tau^s_{in,jk}, A^s_{jk}\}$ and the aggregate prices $\{Q_{ju}, w^s_{jk}\}$ as given, workers' optimal migration choices pin down the equilibrium labor supply in each prefecture H^s_{jk} and the migration flow between each prefecture pair $\pi^s_{in,jk}$.

(ii).**[Firm Optimization]** Taking the exogenous economic conditions $\{A^s_{jk}\}$ and the aggregate prices $\{q_{ju}, w^s_{jk}\}$ as given, firms' optimal production choices pin down the equilibrium labor demand H^s_j and equilibrium production floor space demand $\theta_j S_{ju}$ in each prefecture.

(iii).**[Market Clearing]** For all prefectures, labor supply equals labor demand, floor space supply equals floor space demand, and final good supply equals final goods demand. This pins down the equilibrium aggregate prices $\{Q_{ju}, q_{ju}, w^s_{jk}\}$, equilibrium floor space S_{ju}, and equilibrium output Y_{ju}.

[19]Because production requires both production land and labor, and there is no commuting to work across prefectures, a prefecture cannot have 100% production or 100% residential land, $\theta_j \in (0, 1)$ always hold.

5 Equilibrium Analysis

In this section, we first solve the model for the unobserved fundamentals of the economy using the Census data in 2005 and 2010. We then estimate the agglomeration parameters using indirect inference (Gourieroux, Monfort, and Renault, 1993), which combines our prefecture-level regression from the empirical analysis and the solved unobserved fundamentals of the economy in 2005. Finally, we quantitatively analyze the spatial distributions of measured productivity and land tightness across regions with different levels of development. We conduct a thorough sensitivity check in Section 8 to ensure the robustness of our quantitative results.

5.1 Calibrating the Parameters

We fix a set of parameters to match data moments. Table 4 summarizes our calibrated parameters. Our calibration relies on various data sources and estimates from Fang and Huang (2022) for the migration elasticity (ϵ).

Table 4: Parameters

Parameter	Description	Value	Source
From Our Microdata			
β	share of consumption in utility	0.77	Urban Household Survey
α	share of labor in production	0.88	Enterprise Surveys
η_j	relative cost of production to residential land	prefecture-specific	China Land Market Website
ϵ	migration elasticity	1.9	Fang and Huang (2022)
τ	relative cost of rural housing	0.34	Population Census
γ	agglomeration elasticity	0.13	Indirect Inference
From Literature			
σ	elasticity of skill substitution	1.4	Katz and Murphy (1992)

Notes: This table summarizes all calibrated parameters. We first match $(1-\beta)$ to the cost share of residential floor space in consumer expenditure from the Urban Household Survey of China, $(1-\alpha)$ to the cost share of production floor space in firm costs from the Enterprise Surveys of Chinese manufacturing firms conducted by the World Bank in 2005, and $(\eta - 1)$ to the ratio of production land price to residential land price in each prefecture from land transaction data via the China Land Market Website (http://www.landchina.com/). We then calibrate the prefecture pair migration elasticity (ϵ) to be 1.9, which is estimated in Fang and Huang (2022) using the same Census data and the relative cost of rural housing (τ) to be 0.34 using the average rent paid by rural workers over the average rent paid by urban workers in the Population Census. Unfortunately, we failed to generate a robust estimate for σ using our microdata and various empirical methods. As a result, we rely on Katz and Murphy (1992) to choose the elasticity of substitution between high and low skill (σ) to be 1.4. We have conducted various sensitivity checks concerning all of our parameters and ensured the robustness of the model mechanisms.

We match $(1-\beta)$ to the cost share of residential floor space in consumer expenditure, $(1-\alpha)$ to the cost share of production floor space in firm costs, and $(\eta - 1)$ to the ratio of production land price to residential land price. To match $(1-\beta)$, we use the average accommodation expenditure share of total consumption from the Urban Household Survey of China (UHS). The National Bureau of Statistics of China conducts the survey and partially redesigned it in 2012. We believe the post-2012 measurement standard is more realistic, which gives us an average share of roughly 23% from 2013 to 2017.[20] Hence, we choose β to be 0.77. Second, to match $(1-\alpha)$, we use average production floor space cost per output unit. Unfortunately, there is no direct measure of floor space costs available. We rely on the Enterprise Surveys of Chinese Manufacturing Firms conducted by the World Bank in 2005. Firms reported tax payments based on land usage, through which we can infer the costs of production land. The mean across all firms and prefectures is 12% of output. Therefore, we choose the labor share of production (α) to be 0.88. Finally, to match $(\eta-1)$, we need to compare the prices of production and residential land. Prefecture governments may have different incentives to promote residential or production construction through tax or development motivations. Therefore, we use land price differences to match η_j for each prefecture j. The land price differences in each prefecture come from land transaction data via the China Land Market Website (http://www.landchina.com/). We define land used for both industrial and service firms as production land.

The elasticity of substitution between skills (σ) is calibrated to be 1.4 as in Katz and Murphy (1992), which has been widely used in previous literature.[21] The prefecture pair migration elasticity (ϵ) is calibrated to be 1.9. Tombe and Zhu (2019) estimates this elasticity at the province-area pair level and finds a value of 1.5. Fang and Huang (2022) show that the migration elasticity is around 1.9.[22] We choose the latter value since it is estimated in an almost identical model context to this study. Finally, the relative cost of rural housing (τ) is calculated using the average rent paid by rural area workers over the average rent paid by urban area workers in each prefecture in both Census 2005 and Census 2010. This gives us a value of 0.34.

5.2 Solving for Unobservables

Based on the data we have on the observed equilibrium allocations and prices $\{H^s_{jk}, \pi^s_{in,jk}, w^s_{jk}, Q_{jk}, q_{jk}\}$, we can calculate all unobserved variables except the agglomeration parameters: productivities $\{A^l_{jk}$ and $A^h_{jk}\}$; migration costs $(\tau^s_{in,jk})$, floor spaces $\{S^M_{ju}, S^R_{ju}, S^R_{jr}\}$, and construction density (ϕ_i) in both 2005 and 2010 as follows. We then estimate the agglomeration parameters.

Productivities First, from profit maximization and zero profits, we can infer productivity from

[20] According to the old statistical standard, the average housing expenditure share ranged from 11.7% in 2012 to 14.3% in 2002, which is very low because imputed rent costs of self-owned houses and apartments were not included. They were added in 2013, resulting in a range from 22.7% in 2017 to 23.3% in 2013. The average expenditure share is stable across time within each of these measurement regimes.

[21] Unfortunately, we failed to generate a robust estimate for σ using our microdata and other individual-level datasets across various empirical methods, including several IVs and the 1999 college expansion quasi-natural experiment, among others. We test for the sensitivity of this parameter in the following section.

[22] In a different but related setup, Bryan and Morten (2019) and Fan (2019) have a relatively higher elasticity.

the data on employment and wages. First, we solve for productivity A_j^h as a function of A_j^l using the first order conditions $A_{ju}^h = A_{ju}^l \left(\frac{H_{ju}^h}{H_{ju}^l}\right)^{\frac{1}{\sigma-1}} \left(\frac{w_{ju}^h}{w_{ju}^l}\right)^{\frac{\sigma}{\sigma-1}}$. Plugging A_{ju}^h into the definition of X_{ju}, we have:

$$X_{ju} = A_{ju}^l H_{ju}^l \left[\frac{w_{ju}^h H_{ju}^h + w_{ju}^l H_{ju}^l}{w_{ju}^l H_{ju}^l}\right]^{\frac{\sigma}{\sigma-1}} \equiv A_{ju}^l H_{ju}^l (\Xi_{ju}^l)^{-\frac{\sigma}{\sigma-1}}$$

where $\Xi_{ju}^l = \frac{w_{ju}^l H_{ju}^l}{w_{ju}^h H_{ju}^h + w_{ju}^l H_{ju}^l}$ is the share of labor income distributed to low skill workers. We also assume that agricultural productivity equals agricultural wages $A_{jr}^s = w_{jr}, \quad \textit{for both } s = \{h, l\}$. Combining the previous equation with the definition of W_{ju}, we have $W_{ju} = \frac{w_{ju}^h H_{ju}^h + w_{ju}^l H u_{ju}^l}{X_{ju}} = \frac{w_{ju}^l}{A_{ju}^l} (\Xi_{ju}^l)^{\frac{1}{\sigma-1}}$. Plugging W_j into the price function of q_j, we can solve:

$$A_{ju}^l = \frac{q_{ju}^{\frac{1-\alpha}{\alpha}} w_{ju}^l (\Xi_{ju}^l)^{\frac{1}{\sigma-1}}}{\alpha(1-\alpha)^{\frac{1-\alpha}{\alpha}}}, \quad A_{ju}^h = \frac{q_{ju}^{\frac{1-\alpha}{\alpha}} w_{ju}^h (\Xi_{ju}^h)^{\frac{1}{\sigma-1}}}{\alpha(1-\alpha)^{\frac{1-\alpha}{\alpha}}} \tag{15}$$

where $\Xi_{ju}^h = 1 - \Xi_{ju}^l$. Intuitively, higher production floor prices, wages, or skill shares s require higher skill s productivity at equilibrium.

Land Market Clearing Second, from workers' first-order conditions for residential floor space, the summation of all workers residing in each prefecture j (residential demand), and firms' first-order conditions for production floor space, we can calculate both urban and rural floor space:

$$S_{ju}^R = \frac{1-\beta}{\beta Q_{ju}} \left[w_{ju}^l H_{ju}^l + w_{ju}^h H_{ju}^h\right], \quad S_{ju}^M = \left(\frac{(1-\alpha)}{q_{ju}}\right)^{\frac{1}{\alpha}} X_{ju}, \quad S_{jr}^R = \frac{1-\beta}{\beta Q_{jr}} \left[w_{jr} H_{jr}\right]$$

We are then able to calculate the total amount of urban floor space $S_{ju} = S_{ju}^R + S_{ju}^M$ and finally back out the implied construction intensity $\phi_j = S_{ju}/L_j$.

Migration Costs To compute migration costs, we need first to compute the prefecture-level equally-divided rent income for residents $\frac{Q_i S_i^R}{H_i}$ from the residential floor space S_i^R calculated above, to which we can add observed wages to determine incomes of workers of skill s moving from in to jk: $v_{in,jk}^s = w_{jk}^s + \frac{Q_{jn} S_{jn}^R}{H_{in}^R}$. Then, we can calculate all migration costs between all prefecture pairs from the gravity equations. We assume the iceberg migration cost for staying in one's original prefecture is $\tau_{in,in}^s = 1$. With Q_{in}, $v_{in,jk}^s$ and $\pi_{in,jk}^s$ in hand, along with the gravity equation, we have:

$$\Phi_{in}^s = \sum_{jk=11}^{JK} (\tau_{in,jk}^s Q_{jk}^{1-\beta})^{-\epsilon} (v_{in,jk}^s)^{\epsilon} = \frac{(Q_{jk}^{1-\beta})^{-\epsilon} (v_{in,in}^s)^{\epsilon}}{\pi_{in,in}^s}$$

by inserting Φ_{in}^s into the original gravity equation, we have:

$$\tau_{in,jk}^s = \frac{v_{in,jk}^s}{Q_{jk}^{1-\beta} (\pi_{in,jk}^s \Phi_{in}^s)^{1/\epsilon}}, \text{ for } i \neq j \tag{16}$$

and for prefecture-area pairs with zero migration flow we assign a migration probability $\pi^s_{in,jk} \sim 0$, resulting in a prohibitive migration cost approaching infinity.

5.3 Estimating the Agglomeration Parameters

Finally, we employ a novel method similar to Ahlfeldt et al. (2015) to identify the agglomeration effect by exploiting the inland-favoring land supply policy natural experiment in an indirect inference regression.[23] We lay out the basic ideas below and the details of the estimation process are presented in Appendix B.3.

Method The estimation is in three steps. The first step is our prior regression (1), which gives us an estimate of the coefficient $\hat{\delta}_1$. The second step is to simulate productivity in different prefectures using our model. We simulate productivity in two cases. The first case is the original equilibrium in 2005 after the inland-favoring policy, as in the real world. The second case is a counterfactual equilibrium in 2005 assuming no inland-favoring land supply policy. Given different guessed agglomeration parameters γ, we calculate different simulated productivities in each scenario. The third step is to run regressions same to (1) using the simulated data from both the original and the counterfactual equilibria. We repeat this progress until the model-simulated regression coefficient $\hat{\delta}_1^*$ converges to our empirical estimation $\hat{\delta}_1$ in regression (1).

Results From step one, we find the 2003 inland-favoring policy led to a 5-7.5% (with different productivity measures) decrease in eastern prefecture average productivity relative to inland (1). From step three, we find a monotonic negative relationship: the stronger agglomeration effects are, the larger the loss generated by the inland-favoring land policy in the model. Matching the model-simulated coefficient $\hat{\delta}_1^* \in [-0.075, -0.05]$ gives us a range of estimates for $\gamma \in [0.13, 0.21]$.

This estimated range is larger than the common point estimate of 0.07 in developed countries Combes and Gobillon (2015). As documented in the literature, the estimates in developing countries tend to be larger than in developed countries.[24] Chauvin et al. (2017) estimated a density elasticity for wages as high as 0.19 for China, while Combes, Démurger, and Li (2013) estimates between 0.10 to 0.12. Since the agglomeration parameter plays an essential role in the magni-

[23]Previous studies have used various strategies to tackle this issue, such as instrumenting current variables with lagged historical variables (Ciccone and Hall, 1996; Combes, Duranton, and Gobillon, 2008) or geological variables (Rosenthal and Strange, 2008; Combes et al., 2010). However, data restrictions make it hard to identify the causal agglomeration effect in China. Previous studies in China have typically calibrated agglomeration parameters using values estimated from developed countries.

[24]There are two explanations. First, China has much higher regional trade and migration costs than developed countries (Fan, 2019; Tombe and Zhu, 2019), making supply chain integration much more profitable. Second, it is very hard for inland regions to benefit from technological progress in developed areas when China is still relatively underdeveloped. Thus, knowledge spillover effects are strong within Chinese prefectures or regions relative to across regions. Our result also aligns with other studies of China (Glaeser and Lu, 2018; Khanna et al., 2021). Although these studies consider a different kind of externality, namely human capital externalities, they also find that the effect of prefecture-level average education on wages is much larger in China than in developed countries (Moretti, 2004).

tude of misallocation, we conservatively choose the parameter as our estimated lower bound of $\gamma = 0.13$, which is within the range in the literature. We check the sensitivity of our results across a wide range of values for γ, and our results hold qualitatively.

5.4 Equilibrium Productivity and Land Tightness

Our model quantifies the spatial distribution of productivity and land tightness. The complete list of prefectures by measured productivity and land tightness is provided in Appendix B1; here, we show only the crucial moments. We first show how productivity differs across regions with different levels of development and which component of productivity contributes most to these differences. We then show similar patterns for land tightness. Finally, we examine the model-implied spatial correlation of productivity and land tightness in the equilibrium.

Spatial Distribution of Productivity To start, we define and decompose the measured productivity in our model. We define measured productivity by dividing local output by the local labor force, mirroring the productivity calculated in the empirical analysis. Importantly, both these productivity measures incorporate land input as a component. The decomposition of measured productivity in the model is executed as follows:

$$
\begin{aligned}
ln(\widetilde{Prod}_{ju}) =& ln\left(\frac{Y_{ju}}{(H^h_{ju}+H^l_{ju})^{\alpha}}\right) \\
=&(1-\alpha)ln(S^M_{ju}) + \alpha ln\left(\frac{[(A^h_{ju}H^h_{ju})^{\frac{\sigma-1}{\sigma}} + (A^l_{ju}H^l_{ju})^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}}}{H^h_{ju}+H^l_{ju}}\right) \\
=&\underbrace{(1-\alpha)ln(S^M_{ju})}_{\text{land scale premium}} + \frac{\alpha\sigma}{\sigma-1}\left(\underbrace{ln\left((\frac{A^h_{ju}}{A^l_{ju}}\Gamma^h_{ju})^{\frac{\sigma-1}{\sigma}} + (\Gamma^l_{ju})^{\frac{\sigma-1}{\sigma}}\right)}_{\text{skill premium}} + \underbrace{ln(a^l_{ju})}_{\text{fundamental}} + \underbrace{\gamma ln(D_{ju})}_{\text{agglomeration}}\right)
\end{aligned}
\tag{17}
$$

where $\Gamma^h_{ju} = \frac{H^h_{ju}}{H^h_{ju}+H^l_{ju}}$ and $\Gamma^l_{ju} = 1-\Gamma^h_{ju} = \frac{H^l_{ju}}{H^h_{ju}+H^l_{ju}}$ are the corresponding high-skill and low-skill labor shares. The decomposition shows that measured productivity in prefecture j can be decomposed into four components: a land scale premium (LSP) from more construction land, a skill premium (SP) from a higher share of high-skill workers, fundamental low-skill productivity (Fund), and agglomeration (Agg) from a higher population density. The place-based land policy's effect is transmitted through these four components to measured productivity.

Using this decomposition, we calculate each component of the measured productivity for each prefecture. To better illustrate the spatial patterns, we display the results by summarizing six regions classified by location (eastern or inland) and level of development in 2005. For level of development, we divide all prefectures into three categories {high, mid, and low} to capture

{10%, 45%, 45%} of the distribution of GDP per capita.[25] Each region has the same prefectures in 2005 and 2010 for consistent comparisons. We first highlight that the magnitude of differences between the components are not the focus since these depend on the unit of measure. The essential differences are the gaps across regions.

Table 5: Spatial Distribution of Measured Productivity and Land Tightness

		Measured Productivity										Land Tightness	
Regions	No. of	2005					2010					2005	2010
(loc., dev.)	prefectures	Total	LSP	SP	Fund	Agg	Total	LSP	SP	Fund	Agg	Land/Worker	
National	225	33.84	2.19	0.59	31.06	-0.01	35.86	2.22	0.62	32.92	0.11	0.093	0.083
(east, high)	21	35.21	2.24	0.67	32.07	0.22	36.81	2.29	0.67	33.51	0.33	0.077	0.068
(east, mid)	51	33.84	2.25	0.49	31.06	0.04	35.75	2.24	0.57	32.76	0.17	0.084	0.082
(east, low)	25	32.61	2.13	0.50	30.00	-0.02	34.84	2.06	0.50	32.57	-0.30	0.080	0.108
(inland, high)	2	33.69	2.06	0.59	31.44	-0.40	35.24	2.13	0.77	32.65	-0.33	0.127	0.130
(inland, mid)	50	32.97	2.11	0.69	30.34	-0.17	35.35	2.17	0.69	32.40	0.09	0.140	0.101
(inland, low)	76	32.50	2.09	0.56	30.21	-0.37	35.10	2.14	0.52	32.74	-0.30	0.104	0.086

Notes: This table displays a summary of measured productivity $ln(\widetilde{Prod}_{ju})$ and land tightness in the model by group (weighted by population) in 2005 and 2010, as well as the decomposition of measured productivity. *LSP* stands for land scale premium, *SP* stands for skill premium, *Fund* stands for fundamental, and *Agg* stands for agglomeration. Land tightness is measured by km^2/thousand workers. Regions are classified by the location of the prefecture (east or inland) and the level of development (GDP per capita) in 2005, as in the data. For the level of development, we divide all prefectures into three categories {high, mid, and low} to capture {10%, 45%, 45%} of the distribution of GDP per capita. Each region has the same prefectures in 2005 and 2010 for consistent comparisons.

Table 5 shows a summary of measured productivity and its decomposition following equation (17) across regions. There are two main observations. First, the significant differences in measured productivity across regions are from the fundamentals and agglomeration effects. The more developed eastern prefectures have much higher fundamental productivity and agglomeration effects than inland or less developed prefectures. Regional variations in the land scale premium and the skill premium are smaller. Second, measured productivity changes are also mainly attributed to growth in fundamental productivity and agglomeration effects rather than the land scale or skill premium.

Since national productivity is the average of prefecture-level productivity weighted by the number of workers, we can investigate the changes in national productivity from place-based land policy in later sections using our decomposition. National productivity directly affects the land scale premium (LSP) across regions and indirectly affects labor demand and supply, and consequently the skill premium (SP) and fundamental low-skill productivity (Fund) across regions. Finally, it modifies regional agglomeration (Agg) effects.

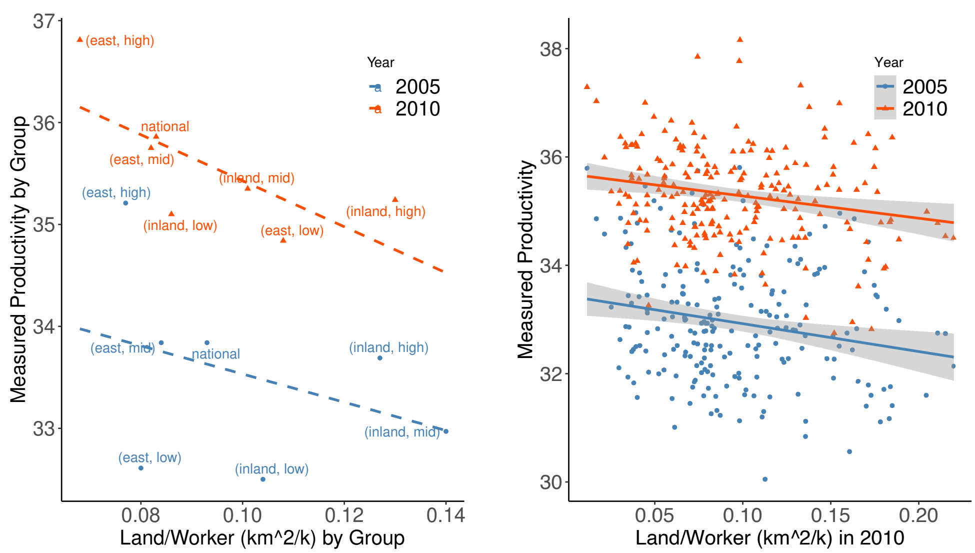
Spatial Distribution of Land Tightness As discussed in the empirical section, the inland-

[25]We also examined several alternate summary presentations, but the results are consistently robust.

favoring land allocation policy likely constrains land supply in eastern and more developed prefectures. Now, we examine the spatial distribution of land tightness. We measure cross-prefecture differences in land tightness using land per thousand workers. The last two columns of Table 5 summarize land tightness across regions. The cross-prefecture differences in land tightness show that eastern and more developed prefectures have much lower and decreasing land tightness, which matches the trend in Figure 1. Compared to inland and less developed prefectures, eastern and more developed prefectures have, on average, 30% to 50% less land per worker. Though the total construction land supply is growing, much land quota is distributed to prefectures with many people migrating out. Hence, the population-weighted national average land tightness is worsening even though the total land supply is increasing faster than the Chinese population.

Figure 6: Correlation between Productivity and Land Tightness

(a) By Prefecture Group (b) By Individual Prefecture



Notes: This figure plots the correlation between productivity and land tightness in the model. Plot (a) shows the correlation by prefecture group as in the tables above. Plot (b) shows the correlation between individual prefectures. Plot (b) excludes six extreme values for visual clarity; for the plot with the whole sample, please refer to Figure B2 in Appendix B.4. The correlation is stronger when we include the extreme values.

Correlation Between Productivity and Land Tightness We further show the correlation between productivity and land tightness in Figure 6. Plot (a) shows the correlation by prefecture group as in the tables above. Plot (b) shows the correlation by individual prefectures, from which the prefecture group plot is created. We have two observations. First, there is a strong negative correlation between productivity and land tightness. More developed eastern prefectures are much more productive but much more land-constrained. Second, the negative relation is increasingly severe across time, even though productivity is generally improving. Both patterns show the existence of substantial spatial misallocation of land and labor in the presence of the place-based land policy.

Additional Results We provide additional results that examine the spatial distribution of economic development and income in depth, containing three key observations consistent with our findings in Appendix B.5. First, more developed eastern prefectures have much higher output, especially urban output. Second, these prefectures are much more densely populated with higher floor space prices. Third, workers in these prefectures earn higher incomes (higher wages for all workers and higher non-wage incomes for Hukou workers). These findings supplement our results above on the spatial misallocation created by the place-based land policy.

5.5 Equilibrium Remarks

The patterns in measured productivity and the spatial distribution of land tightness indicate potential losses in productivity and equality due to the place-based land policy that reallocates construction land supply from eastern and more developed prefectures to inland and less developed prefectures. Since eastern and more developed prefectures have much higher fundamental productivity but tighter land constraints, this land reallocation mitigates migration to these developed prefectures and generates much lower national average productivity. The losses grow when agglomeration effects are taken into consideration.

6 Counterfactual Analysis

This section simulates counterfactual land allocation policies to alleviate land supply distortions. In the counterfactual world, we assume that the inland-favoring land supply policy was not implemented, and the pre-2003 land allocation rule was maintained. Then, we investigate the effects in two scenarios. First, we remove the policy without any other changes. Second, we remove the policy and replace it with regional transfers.[26]

6.1 Constructing the Counterfactual Land Policy

Removing the Inland-favoring Policy We investigate what would have happened if the 2003 inland-favoring land supply policy was not implemented. To do so, we preserve the total new land supply increments from 2003 to 2005 and 2010 but redistribute the total new land supply based on the land supply growth rate from 2000 to 2003. We choose the 2000-2003 growth rate because pre-1999 land supply data at the prefecture-level is unavailable. The following equation

[26] Since the model features non-linear interactions between skills and contains multiple floor space markets, classical hat algebra is not feasible. Therefore, we develop a multi-layer global solution iteration algorithm to compute the counterfactuals. The algorithm clears all markets, including labor, production floor space, and residential floor space markets across prefectures and areas. The details are described in Appendix B.2.

shows the details of the new supply rule:

$$\widehat{L_j(t)} = L_j(2003) + \underbrace{\sum_j [L_j(t) - L_j(2003)]}_{\text{actual total increment of land}} \times \underbrace{\frac{L_j(2003)(1+g_{L_j})^{t-2003}}{\sum_j L_j(2003)(1+g_{L_j})^{t-2003}}}_{\text{prefecture j's share if no inland-favoring}} \tag{18}$$

where the first component $L_j(2003)$ is prefecture j's urban land stock in 2003, just before the structural change happened. The second component multiplies the actual national total increment of land $\sum_j [L_j(t) - L_j(2003)]$ and prefecture j's share of land supply if total land supply followed the pre-2003 growth rate. We consider this constrained counterfactual policy since it still fulfills the central government's strict goal of controlling the national total urban land usage.

A key question is whether developed regions have enough land to fulfill these allocations. We contend that this issue is not a concern. First, according to satellite data, in 2005, only 23% of land in tier-1 prefectures (the most developed) was developed, and a mere 9.3% of land in tier-2 prefectures was developed (Wu and You, 2023). Second, a significant portion of land in developed regions remains farmland due to the farmland redline policy (Yu, 2019).

Another important question is the difference between actual land usage and the land quota, as we explained in Section 2. *In this quantitative model, land supply refers to actual land usage in the data.* Given the absence of detailed land quota data at the prefecture level, we cannot rely on an analysis of land quota. Consequently, we abstract from the reality that some local governments may reserve land for future sales, assuming that the land market clears in each period. One potential concern is whether sufficient market demand exists to ensure land utilization upon reallocating supply to a new location when we implement our counterfactual. We claim that this will not change our counterfactual analysis. As illustrated in Figure 3, the constraint imposed by land quotas is quite stringent in eastern regions, where, in certain years, land usage even slightly exceeds the quota. Conversely, inland regions have not fully utilized their quotas since the inland-favoring land policy was enacted in 2003. Therefore, by reallocating land supply (usage) from inland to eastern regions within our model, we anticipate an actual increase in land utilization in eastern areas alongside a corresponding decrease in inland regions. We implement a sensitivity check in Section 8 by using imputed (from province-level quotas) prefecture-level land quotas as land supply, and it shows no qualitative changes.

Policy Summary The counterfactual land allocation policy is summarized in Table 6. Columns 3-4 present actual land supply under the policy, while Columns 5-6 display the counterfactual land supply based on the allocation rule in equation (18). Without the inland-favoring policy in 2003, more developed prefectures would have received more land. For example, the land quota for highly developed eastern prefectures would have been 10,958 km^2 in 2010 without the inland-favoring policy instead of the observed 7,272 km^2. Conversely, the land quota for low-development inland prefectures would have been 4,244 km^2 2010 without the policy, compared

Table 6: Counterfactual Total Land Supply (km^2)

Regions (loc., dev.)	No. of prefectures	Reality 2005	Reality 2010	Counterfactual $\widehat{2005}$	Counterfactual $\widehat{2010}$
National	225	22268	28336	22268	28336
(east, high)	21	5838	7272	6597	10958
(east, mid)	51	5875	7832	5734	6551
(east, low)	25	1418	1681	1472	1596
(inland, high)	2	169	206	169	169
(inland, mid)	50	5131	6578	4537	4819
(inland, low)	76	3837	4767	3760	4244

Notes: This table displays a summary of total urban land supply data by prefecture group (summations within the group) in 2005 and 2010, as well as the counterfactual land supply in 2010 (unit: km^2). Regions are classified by prefecture location (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

to the observed 4,767 km^2. Further details of the changes are in Appendix C.1.

6.2 Constructing the Regional Transfer Policy

Regional Transfer Policy We want to demonstrate that a direct monetary regional transfer produces less spatial misallocation and genuinely assists people from poor regions. Rather than implementing the place-based land policy, we consider that the central government opts to redistribute the additional land income generated by the counterfactual land allocations from developed to underdeveloped prefectures. The sole difference between *Removing the Inland-favoring Policy With Regional Transfers* and *Removing the Inland-favoring Policy Without Transfer* counterfactuals is that the former incorporates a feasible direct regional transfer on top of the latter.

Policy Summary We choose a specific but sophisticated transfer rule since we only aim to demonstrate that such a regional transfer can reduce regional income gaps and spatial misallocation. The detailed construction of the policy is in Appendix C.2. We only provide the key idea here. The essence of the transfer is: (1) preserve urban land income by transferring funds from land-gaining prefectures to land-losing prefectures, (2) adjust for housing prices by transferring from price-decreasing prefectures to price-increasing prefectures, and (3) transfer additional production land income from urban to rural regions. We also provide a simpler transfer rule in Appendix C.3 that also works. Notice that the sophisticated transfer rule redistributes additional production land income to rural workers as aggregate income would be much higher.

6.3 Calculating Welfare Changes

We can calculate the ex-ante expected utility of workers based on the properties of the Fréchet distribution. The cumulative distribution function of the utility of workers originating from region i area n with skill s is $G_{in}^{s}(u) = e^{-\Phi_{in}^{s} u^{-\epsilon}}$ where $\Phi_{in}^{s} = \sum_{j'k'=11}^{JK} (\tau_{in,j'k'}^{s} Q_{j'k'}^{1-\beta})^{-\epsilon} (v_{in,j'k'}^{s})^{\epsilon}$. Therefore, their expected utility is $\mathbf{E}_{in}^{s}[u] = \Gamma\left(1 - \frac{1}{\epsilon}\right) \times (\Phi_{in}^{s})^{\frac{1}{\epsilon}}$ where the Gamma function $\Gamma\left(1 - \frac{1}{\epsilon}\right)$ is a constant and Φ_{in}^{s} reflects the expected utility from access to all alternative regions and areas. Φ_{in}^{s} is positively correlated with potential income $v_{in,j'k'}^{s}$ and is negatively correlated with migration and housing costs. We can then calculate the changes in ex-ante welfare as follows:

$$\Delta \mathbf{E}_{in}^{s}[u] = \frac{\widehat{\mathbf{E}_{in}^{s}[u]}}{\mathbf{E}_{in}^{s}[u]} - 1$$

When calculating aggregate or regional welfare, we assign equal weights to each worker and sum across all individuals nationally or within each region.

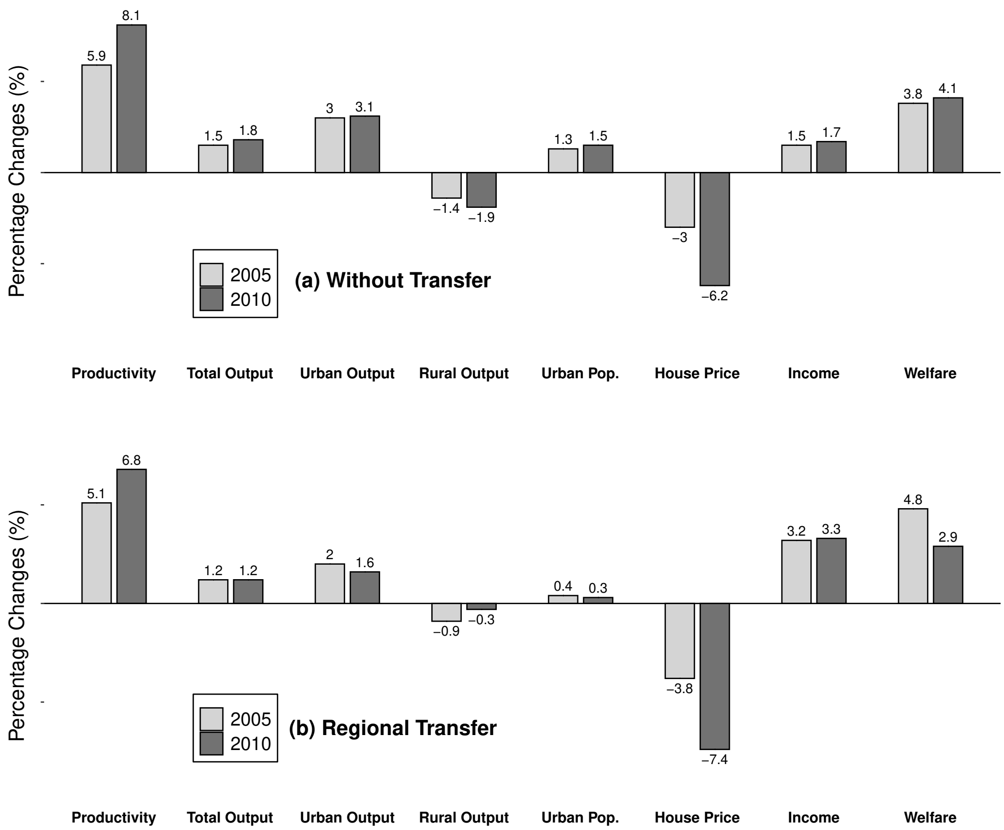
6.4 Aggregate Effects

We first present the aggregate effects of removing the inland-favoring land policy with and without regional transfers on measured national productivity, urban output, rural output, urban population, house prices, national average income, and welfare.

The results are illustrated in Figure 7. Eliminating the place-based land policy significantly increased productivity, urban output, average income, and welfare in 2005 and 2010, with or without the regional transfer. First, aggregate economic development is significantly boosted by removing the inland-favoring land policy. Without the regional transfer, the national gain in productivity is 5.9% in 2005 and 8.1% in 2010, while total output rises by 1.5% and 1.8%, respectively. With the regional transfer, the national gain in productivity is 5.1% in 2005 and 6.8% in 2010, while total output rises by 1.2% in both years. Removal of the policy also boosts the urban population by lowering the price of residential floor space in developed prefectures' urban areas. In contrast, rural output declines due to worker emigration. With the regional transfer, the economic development gains are weaker but qualitatively in the same direction. The results for the simple regional transfer are in Appendix C.4.

Second, income and welfare increase, but magnitudes vary significantly depending on the regional transfer. Incomes with the regional transfer are significantly higher than without because the additional return to more production land in more productive prefectures is redistributed to rural workers. Aggregate welfare is also sensitive to whether or not the regional transfer is applied as welfare is more affected by rich urban workers becuase they have much larger initial welfare level and sensitive to the housing prices. For instance, the 4.1% welfare gain in 2010 with-

Figure 7: Aggregate Effects of Removing the Inland-favoring Policy



Notes: This figure shows the aggregate effects of removing the inland-favoring policy on the Chinese economy in 2005 and 2010. Grey columns represent changes in 2005. Black columns represent changes in 2010. In both years, we find substantial national changes in productivity, total output, urban output, urban population, house prices, income, and welfare. Plot (a) shows the results without the regional transfer, and plot (b) shows the results with the regional transfer.

out the transfer is mainly driven by large gains in more developed regions. We explain further in Section 6.7 below.

6.5 Aggregate Effects Decomposition

We now show the decomposition of the aggregate effects into three channels: (1) the direct effect from production floor space changes, (2) the indirect effect from induced labor demand and supply changes, and (3) the agglomeration effect from induced population density changes. All three channels of the inland-favoring land policy lead to spatial misallocation of production and labor towards less productive regions and reduce national productivity. Please refer to Appendix C.5 for details of constructing the decomposition.

Table 7: Aggregate Effects Decomposition

Decomp.	Δ Productivity 2005	Δ Productivity 2010	Δ Urban Output 2005	Δ Urban Output 2010	Δ Rural Output 2005	Δ Rural Output 2010	Δ Urban Pop. 2005	Δ Urban Pop. 2010
	(a) Without Transfer							
Total	5.9%	8.1%	3.0%	3.1%	-1.4%	-1.9%	1.3%	1.5%
Direct	0.3%	-0.8%	0.3%	-0.8%	0.0%	0.0%	0.0%	0.0%
Indirect	3.2%	5.8%	1.6%	3.2%	-1.4%	-1.7%	1.3%	1.2%
Agglomeration	2.4%	3.1%	1.0%	0.8%	0.0%	-0.3%	0.0%	0.3%
	(b) Regional Transfer							
Total	5.1%	6.8%	2.0%	1.6%	-0.9%	-0.3%	0.4%	0.3%
Direct	0.3%	-0.8%	0.3%	-0.8%	0.0%	0.0%	0.0%	0.0%
Indirect	2.9%	5.3%	1.1%	2.4%	-0.9%	-0.6%	0.4%	0.3%
Agglomeration	1.9%	2.3%	0.6%	0.0%	0.0%	0.3%	0.0%	0.0%

Notes: This table summarizes the decomposition of the aggregate effects into three components in 2005 and 2010 for the production and allocation variables. Other variables are shown in Table C3. All numbers are relative changes from the observed data to the counterfactual results without the inland-favoring policy. The three channels are (1) the direct effect from production floor space changes, (2) the indirect effect from induced labor demand and supply changes, and (3) the agglomeration effect from induced population density changes. All three channels of the inland-favoring land policy lead to spatial misallocation of production and labor towards less productive regions and cause national productivity to stay relatively low. Please refer to Appendix C.5 for details of constructing the decomposition and additional results (Table C3).

Table 7 shows the decomposition of the production and allocation variables. Our main focus is on changes in measured productivity and total output. We have three observations in general. First, the direct effect is the least important in magnitude and may work in the opposite direction. This is because the national land input is unchanged. Second, the indirect effect of worker reallocation plays a central role. It contributes the most to the gains in measured productivity and urban output. Finally, agglomeration is also important. Agglomeration is about half to two-thirds of the indirect effect on measured productivity and total output. Other variables, including house prices, income, and welfare, follow similar patterns and are displayed in Table C3 in Appendix C.5. These decomposition results highlight that migration and agglomeration are the essential considerations for place-based policies (Morten, 2019; Duranton and Puga, 2023).

6.6 Spatial Effects on Economic Development

We further show the spatial effects of removing the inland-favoring policy on economic development. Table 8 shows the changes in productivity, urban output, rural output, urban population, and housing prices across different regions without transfers. For results with the regional transfer, see Appendix C.7. Three main conclusions can be drawn. First, after eliminating the inland-favoring land policy, housing prices decreased significantly in developed eastern prefectures but increased in other prefectures. Second, more workers migrated to developed eastern prefectures, resulting in a 13.9% rise in the urban population in 2010. Third, productivity and output increased in developed eastern prefectures and decreased in other prefectures. Specifically, measured productivity rose by 14.9% and urban output grew by 17.8% in these prefectures in 2010 under our counterfactual. The declines in productivity and output in other prefectures are smaller in magnitude. We provide additional results in Appendix C.6, C.7, and C.8, including a productivity decomposition and changes in the urban population by skill type. We discover that most of the increases in national productivity result from improvements in fundamental productivity and agglomeration.

Table 8: Spatial Effects on Economic Development

Regions (loc., dev.)	No. of prefectures	Δ Productivity		Δ Urban Output		Δ Rural Output		Δ Urban Pop.		Δ House Price	
		$\widehat{2005}$	$\widehat{2010}$	$\widehat{2005}$	$\widehat{2010}$	$\widehat{2005}$	$\widehat{2010}$	$\widehat{2005}$	$\widehat{2010}$	$\widehat{2005}$	$\widehat{2010}$
National	225	5.9%	8.1%	3.0%	3.1%	-1.4%	-1.9%	1.3%	1.5%	-3.0%	-6.2%
(east, high)	21	7.4%	14.9%	8.1%	17.8%	0.0%	3.3%	6.9%	13.9%	-17.4%	-32.4%
(east, mid)	51	-0.3%	-2.3%	-0.7%	-4.4%	-0.4%	0.0%	-0.7%	-3.0%	1.4%	11.9%
(east, low)	25	-0.6%	-2.7%	-0.8%	-4.6%	-1.4%	-3.5%	-0.6%	-3.2%	-3.3%	2.8%
(inland, high)	2	-0.1%	-2.6%	0.0%	-3.2%	0.0%	1.7%	0.1%	-1.0%	1.6%	18.5%
(inland, mid)	50	-0.7%	-7.8%	-2.6%	-11.8%	-1.5%	-2.9%	-1.9%	-7.5%	1.6%	9.6%
(inland, low)	76	-0.4%	-4.9%	-1.7%	-6.7%	-1.9%	-3.2%	-1.6%	-5.1%	-3.8%	-1.7%

Notes: This table displays a summary of changes in core economic development variables by prefecture group (weighted by population) in 2005 and 2010 without transfer. All numbers are relative changes from the observed data to the counterfactual results without the inland-favoring policy. For each variable, we show the changes in 2005 and 2010. Regions are classified by prefecture location (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

In general, our findings indicate that removing the inland-favoring policy can increase national productivity and output. However, it exacerbates the regional development gap and attracts more migrants to developed areas. Consequently, the inland-favoring land policy seems to have achieved its original objective of balancing development between eastern and inland regions. However, does this mean workers from underdeveloped regions benefited from this policy? Not necessarily.

6.7 Spatial Effects on Income and Welfare

The first four columns in Table 9 display income and welfare changes for workers from different regions when we remove the inland-favoring policy. Additional results are provided in Appendix C.9. Incomes of workers from all regions increased in 2005. Incomes of workers from inland (eastern) prefectures with low development levels rose by 2.24% (1.10%) in 2005 and by 1.92%

(1.92%) in 2010. This highlights a paradox: the inland-favoring land policy narrows the regional output gap but reduces the incomes of workers from impoverished regions because the policy diminishes land supply in developed areas, leading to higher housing costs and reduced labor demand. Consequently, many workers from underdeveloped regions who would have migrated remain in their hometowns with lower wages.

Table 9: Spatial Effects on Income and Welfare

Regions (loc., dev.)	No. of prefectures	Without Transfer: Δ Income $\widehat{2005}$	Without Transfer: Δ Income $\widehat{2010}$	Without Transfer: Δ Welfare $\widehat{2005}$	Without Transfer: Δ Welfare $\widehat{2010}$	Regional Transfer: Δ Income $\widehat{2005}$	Regional Transfer: Δ Income $\widehat{2010}$	Regional Transfer: Δ Welfare $\widehat{2005}$	Regional Transfer: Δ Welfare $\widehat{2010}$
National	225	1.46%	1.74%	3.8%	4.1%	3.18%	3.26%	4.8%	2.9%
(east, high)	21	2.69%	7.43%	10.8%	14.5%	-10.3%	-10.9%	7.7%	2.5%
(east, mid)	51	0.28%	-0.08%	-0.2%	-4.0%	0.49%	5.03%	1.2%	2.1%
(east, low)	25	1.10%	1.92%	-1.5%	1.2%	0.72%	6.49%	1.9%	6.3%
(inland, high)	2	0.01%	-1.61%	-0.6%	-5.3%	2.30%	5.63%	2.0%	3.1%
(inland, mid)	50	0.95%	-0.91%	-0.1%	-5.1%	20.0%	6.94%	5.8%	4.2%
(inland, low)	76	2.24%	1.92%	2.7%	-3.5%	6.49%	7.05%	5.0%	4.0%

Notes: This table summarizes income and welfare changes in our main counterfactuals in 2005 and 2010. Regions are classified by prefecture location (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5. Each row represents all workers whose hometowns are in the relevant prefectures. Columns 1-4 show the changes when we remove the inland-favoring land policy. Columns 5-8 show the changes when we replace the inland-favoring land policy with a direct regional transfer.

What about welfare? Are workers from poorer regions better off because they can find jobs in their hometowns thanks to the inland-favoring policy? The answer is not necessarily. We observe that the changes in utility for workers from underdeveloped prefectures are *mixed*. When eliminating the inland-favoring policy, the average utility of workers from eastern low-development prefectures decreases by 1.5% in 2005. In contrast, the average utility of workers from inland low-development prefectures increases by 2.7%. However, the situation reversed in 2010. Overall, we find mixed evidence of whether the inland-favoring land supply policy enhanced the welfare of workers from poorer regions. This policy significantly reduces national welfare without clearly assisting workers from impoverished regions.

Columns 5-8 in Table 9 display the income and welfare changes experienced by workers from different regions when we replace the inland-favoring land policy with a regional transfer. There are two main findings. First, the regional transfer effectively reduces the income disparities between workers from developed and underdeveloped regions. Incomes of workers from inland prefectures with low (middle) development levels increased by 6.49% (20.0%) in 2005 and 7.05% (6.94%) in 2010. The incomes of workers from eastern and developed regions decrease. Second, national welfare still rises following the regional transfer. Workers from nearly all regions benefit from replacing the inland-favoring land policy with the regional transfer. Specifically, welfare increases by 2.5% for those from eastern high-development prefectures and by 4.0% for those from inland low-development prefectures in 2010. Workers from underdeveloped regions benefit from better opportunities to migrate to developed regions with higher wages, while workers from developed regions benefit from significantly lower housing costs. Generally, compared with the inland-favoring land policy, a regional transfer policy can unambiguously promote the welfare and incomes of workers from poor regions without creating large aggregate efficiency losses.

6.8 Counterfactual Remarks

We show that the inland-favoring land supply policy resulted in a severe misallocation of both production and labor. It increased the price of residential and production floor space and discouraged workers in underdeveloped prefectures from migrating to developed prefectures. This resulted in lower national output and productivity. The observed regional convergence is geographical. The government achieved its goal of reducing regional output and productivity gaps; however, workers from developed and underdeveloped regions did not necessarily benefit from this. The income gap narrowed not because incomes of people from impoverished areas increased but because everyone's income decreased, and those from affluent areas were impacted more severely.

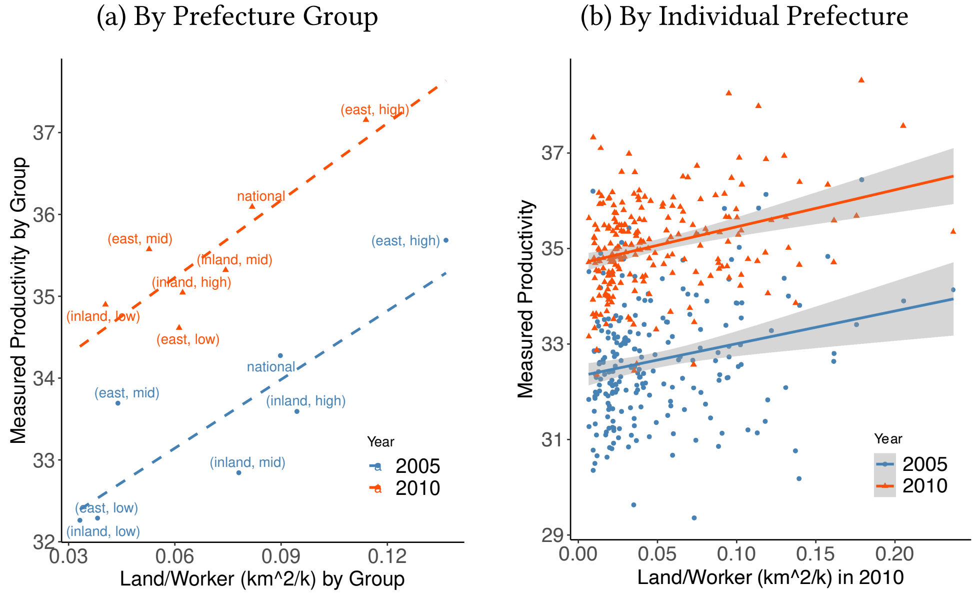
Furthermore, this policy reduced national welfare but did not necessarily improve worker welfare in underdeveloped regions. In essence, this place-based land policy aided underdeveloped regions but potentially failed to help the people from those regions. Finally, we demonstrate that a direct regional monetary transfer policy could reduce regional inequality without intensifying spatial misallocation. It effectively reduces inequality by directly assisting workers from poorer regions rather than causing a substantial spatial misallocation of production and labor.

7 Eliminating All Land Frictions

This section simulates a counterfactual land allocation policy to eliminate all land supply distortions. In this counterfactual world, we make three assumptions. First, the central government distributes construction land supply to equalize the marginal product of land across all regions. Second, the distortion between residential and production floor space prices is eliminated. Third, the allocation policy never hits the natural limits of each region. These conditions are unattainable in practical terms. However, this counterfactual scenario is constructed to serve as a benchmark for efficient land allocation. By comparing actual outcomes to this idealized baseline, we can quantify the overall magnitude of spatial misallocation within China's economy and how much the inland-favoring land policy contributed to it.

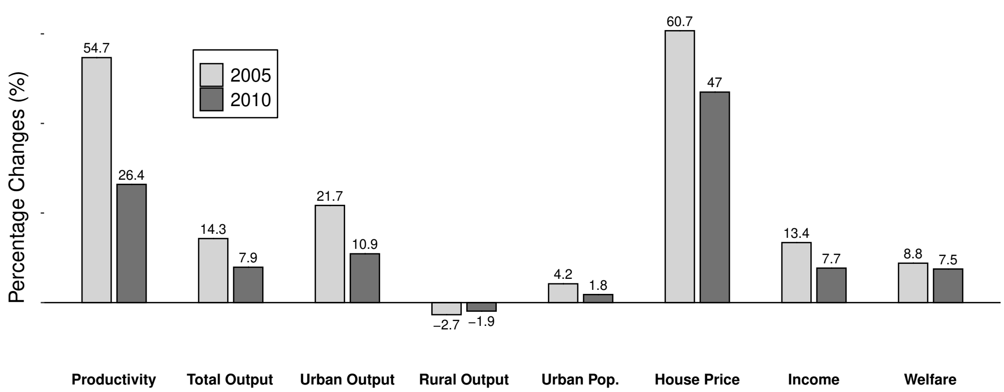
Land Frictions There are three layers of land frictions in the current equilibrium: national,

Figure 8: Correlation between Productivity and Land Tightness with Optimal Policy



Notes: This figure plots the correlation between productivity and land tightness in the model with optimal policy. Plot (a) shows the correlation by prefecture group as in the tables above. Plot (b) shows the correlation by individual prefecture. Plot (b) excludes six extreme values for visual clarity; please refer to Appendix D for the plot with the whole sample. The correlation is stronger when the extreme values are included. The optimal policy reverses the negative correlations between productivity and land per thousand workers in Table 6 and distributes more land to more productive prefectures.

Figure 9: Aggregate Effects of Eliminating All Land Frictions



Notes: This figure shows the aggregate effects of removing the inland-favoring policy on the Chinese economy in 2005 and 2010. Grey columns represent changes in 2005. Black columns represent changes in 2010. In both years, we find substantial changes in national productivity, total output, urban output, urban population, house prices, incomes, and welfare. Plot (a) shows the results without the regional transfer, and plot (b) shows the results with the regional transfer.

cross-prefecture, and within-prefecture. Natural limits and national food security concerns constrain national construction land supply, which is not our focus.[27] We focus on the cross-prefecture and within-prefecture distortions. Given all other frictions are fixed, cross-prefecture distortions exist as long as $S_{ju} \neq S_{ju}^{opt}$ for any prefecture ju, where S_{ju}^{opt} denotes the optimal allocation and $\sum S_{ju} = \sum S_{ju}^{opt}$. Meanwhile, within-prefecture distortions exist as long as $\eta_j \neq 1$, indicating that the marginal returns to residential and production floor space are unequal.

Optimal Policy Given these definitions of land frictions, we derive an optimal national productivity policy taking the national total construction land supply as given. Optimality requires no cross-prefecture distortions in production demand and no within-prefecture distortions between production and residential demands, that is (1) $\partial Y_{ju}/\partial S_{ju}^M = \partial Y_{iu}/\partial S_{iu}^M$, ($q_{ju} = q_{iu}$), for any i, j, and (2) $\eta_j = 1$, ($q_{ju} = Q_{ju}$), for any j. Certainly, these optimal conditions are rarely met in reality. However, it is still useful to serve as an efficient allocation baseline compared to the current equilibrium.

Main Results We show how far the current equilibrium allocation is from the hypothetical optimal allocation. We focus on two results: (1) the relationship between land tightness and productivity and (2) the aggregate effects. Additional results are in Appendix D.

We first show the correlation between productivity and land tightness in Figure 8. This optimal policy scenario yields two notable observations. First, a pronounced positive correlation emerges between productivity and land tightness, starkly contrasting with the strong negative relationship observed under the current equilibrium. This indicates that more developed eastern prefectures exhibit higher productivity with looser land constraints. Second, as productivity generally improves over time, land tightness is slightly alleviated.

We delve into the aggregate outcomes in Figure 9. Eliminating all land frictions results in substantial productivity, urban output, income, and welfare gains. Productivity in 2005 and 2010 increases by 55% and 26%, respectively, while total output rises by 14.3% and 7.9%. The smaller improvement in 2010 suggests a reduction in frictions over time, likely attributable to economic reforms (Tombe and Zhu, 2019). The welfare effects are not that large since the policy does not target national welfare maximization but production maximization.

Finally, we quantify how much the inland-favoring land policy contributed to aggregate spatial misallocation. First, we have the changes of outcomes when moving from real world equilibrium to the optimal no-friction equilibrium in this section. We then compare this change with the changes stemming from the removal of the inland-favoring policy in Section 6.1. We conclude that the contribution is significantly sizable. More specifically, 11% in 2005 and 31% in 2010 of the productivity misallocation, and 10% in 2005 and 23% in 2010 of the total output misallocation

[27] The natural limits are beyond our discussion. National security needs are mainly food security, also known as the "Farmland Red Line," which is well-studied in Yu (2019). The central government of China is very restrictive on total construction land supply.

can be ascribed to the inland-favoring land policy.

8 Sensitivity Checks

To address concerns regarding model robustness, we perform several sensitivity checks for our quantitative model, focusing on critical parameter values, model data inputs, and counterfactual policy specifications. The key sensitivity results are in Appendix E. Many others are largely redundant and very close to what is presented in the paper, and are omitted for brevity.

Parameter Values We tested our results using numerous alternative specifications for parameter values. Our alternative specifications include variations in agglomeration strength ($\gamma \in [0.0, 0.21]$), migration elasticity ($\epsilon \in [1.0, 2.0]$), elasticity of substitution between H/L-skills ($\sigma \in [1.0, 4.0]$)[28], share of consumption in utility ($\beta \in [0.60, 0.90]$), share of labor in production ($\alpha \in [0.75, 0.95]$), and relative cost of rural housing ($\tau \in [0.20, 0.40]$). None of these overturn our results concerning either (1) the correlation between productivity and land tightness and (2) the gains in removing the inland-favoring policy.

Model Data Inputs We have also tested two alternative model data inputs. The first is to purge our observed wage measures using the method of Fajgelbaum and Gaubert (2020). The second is to use prefecture-level land quotas (imputed from the actual province-level land quotas) as the construction land supply in the model. Again our results are qualitatively unaffected.

Counterfactual Policies We use 2000-2003 prefecture-level land supply growth rates for the counterfactual post-2003 land allocation policy across prefectures, which follows the trend in Figure 1. We also test two alternative counterfactual allocations. The first is to use pre-2003 prefecture-level GDP growth rates, and the second uses pre-2003 prefecture-level migration inflow growth rates. Since these alternative trends are highly correlated with the pre-2003 prefecture-level land supply growth rates, our results are effectively unchanged.

Elastic Floor Space Supply We choose a fixed construction intensity in the model due to strong government regulations. We also model that construction intensity is a positive function of urban density (Ahlfeldt et al., 2015). The gains from removing the inland-favoring policy increase with elastic floor space supply.

Additional Congestion Effects We include additional congestion effects besides floor space constraints in workers' migration costs as an increasing function of urban density Allen and Arkolakis (2014); Allen and Donaldson (2020); Eckert and Peters (2022). Adding an upper bound to such congestion effects weakens the effect of removing the inland-favoring policy, but the gains are still substantial.

[28] In a recent paper, Bils, Kaymak, and Wu (2022) argue this elasticity should be as large as 4. Our results hold qualitatively and are robust even under this upper bound in the literature.

9 Conclusion

This paper studies how place-based land allocation policy creates spatial misallocation of production and labor. We focus on a significant land policy in China that favors less-developed inland regions, intending to balance regional growth and reduce spatial inequality. Causal evidence demonstrates that this policy lowered productivity in developed eastern regions relative to underdeveloped inland regions. A spatial equilibrium model shows that this policy directly distorted the land market and indirectly distorted the labor market, causing spatial misallocation. A simulated counterfactual removing this inland-favoring policy suggests that resolving this spatial misallocation would increase national productivity and output.

Despite sacrificing national productivity and output, the inland-favoring policy did not necessarily benefit workers from underdeveloped regions. Eliminating this policy would increase incomes of workers from underdeveloped regions through increased migration to developed areas. Although the inland-favoring policy reduced regional output gaps, it adversely affected workers from underdeveloped regions by restricting their migration opportunities to higher-wage developed regions. The welfare effect on workers from underdeveloped regions is mixed and undetermined. Instead of the inland-favoring land supply policy, we propose a direct regional transfer that promotes regional convergence by enhancing income and welfare for workers from underdeveloped regions with fewer efficiency losses due to spatial misallocation.

References

Accetturo, Antonio and Guido De Blasio. 2012. "Policies for Local Development: An Evaluation of Italy's "Patti Territoriali"." *Regional Science and Urban Economics* 42 (1-2):15–26.

Ackerberg, Daniel A, Kevin Caves, and Garth Frazer. 2015. "Identification Properties of Recent Production Function Estimators." *Econometrica* 83 (6):2411–2451.

Ahlfeldt, Gabriel M, Stephen J Redding, Daniel M Sturm, and Nikolaus Wolf. 2015. "The Economics of Density: Evidence from the Berlin Wall." *Econometrica* 83 (6):2127–2189.

Allen, Treb and Costas Arkolakis. 2014. "Trade and the Topography of the Spatial Economy." *The Quarterly Journal of Economics* 129 (3):1085–1140.

Allen, Treb and Dave Donaldson. 2020. "Persistence and Path Dependence in the Spatial Economy." Tech. rep., National Bureau of Economic Research.

Becker, Sascha O, Peter H Egger, and Maximilian Von Ehrlich. 2010. "Going NUTS: The Effect of EU Structural Funds on Regional Performance." *Journal of Public Economics* 94 (9-10):578–590.

Bertaud, Alain and Stephen Malpezzi. 2001. "Measuring the Costs and Benefits of Urban Land Use Regulation: A Simple Model with an Application to Malaysia." *Journal of Housing Economics* 10 (3):393–418.

Bils, Mark, Bariş Kaymak, and Kai-Jie Wu. 2022. "Labor Substitutability among Schooling Groups." Tech. rep., National Bureau of Economic Research.

Brueckner, Jan K. 1995. "Strategic Control of Growth in a System of Cities." *Journal of Public Economics* 57 (3):393–416.

Bryan, Gharad and Melanie Morten. 2019. "The Aggregate Productivity Effects of Internal Migration: Evidence from indonesia." *Journal of Political Economy* 127 (5):2229–2268.

Busso, Matias, Jesse Gregory, and Patrick Kline. 2013. "Assessing the Incidence and Efficiency of a Prominent Place Based Policy." *American Economic Review* 103 (2):897–947.

Chauvin, Juan Pablo, Edward Glaeser, Yueran Ma, and Kristina Tobio. 2017. "What is Different about Urbanization in Rich and Poor Countries? Cities in Brazil, China, India and the United States." *Journal of Urban Economics* 98:17–49.

Chen, Binkai, Ming Lu, Christopher Timmins, and Kuanhu Xiang. 2019. "Spatial Misallocation: Evaluating Place-based Policies Using a Natural Experiment in China." Tech. rep., National Bureau of Economic Research.

Ciccone, Antonio and Robert E Hall. 1996. "Productivity and the Density of Economic Activity." *The American Economic Review* :54–70.

Civelli, Andrea, Arya Gaduh, Alexander D Rothenberg, and Yao Wang. 2022. "Urban Sprawl and Social Capital: Evidence from Indonesian Cities." Tech. rep., National Bureau of Economic Research.

Combes, Pierre-Philippe, Sylvie Démurger, and Shi Li. 2013. "Urbanisation and Migration Externalities in China." .

Combes, Pierre-Philippe, Gilles Duranton, and Laurent Gobillon. 2008. "Spatial Wage Disparities: Sorting Matters!" *Journal of Urban Economics* 63 (2):723–742.

Combes, Pierre-Philippe, Gilles Duranton, Laurent Gobillon, and Sébastien Roux. 2010. "Estimating Agglomeration Economies with History, Geology, and Worker Effects." In *Agglomeration Economics*. University of Chicago Press, 15–66.

Combes, Pierre-Philippe and Laurent Gobillon. 2015. "The Empirics of Agglomeration Economies." In *Handbook of Regional and Urban Economics*, vol. 5. Elsevier, 247–348.

Crozet, Matthieu, Thierry Mayer, and Jean-Louis Mucchielli. 2004. "How do Firms Agglomerate? A Study of FDI in France." *Regional Science and Urban Economics* 34 (1):27–54.

Cunningham, Christopher R. 2007. "Growth Controls, Real Options, and Land Development." *The Review of Economics and Statistics* 89 (2):343–358.

Deng, Yongheng, Yang Tang, Ping Wang, and Jing Wu. 2020. "Spatial Misallocation in Chinese Housing and Land Markets." Tech. rep., National Bureau of Economic Research.

Devereux, Michael P, Rachel Griffith, and Helen Simpson. 2007. "Firm Location Decisions, Regional Grants and Agglomeration Externalities." *Journal of Public Economics* 91 (3-4):413–435.

Duranton, Gilles and Diego Puga. 2023. "Urban Growth and Its Aggregate Implications." *Econometrica* 91 (6):2219–2259.

Eckert, Fabian and Michael Peters. 2022. "Spatial Structural Change." Tech. rep., National Bureau of Economic Research.

Eriksen, Michael D and Stuart S Rosenthal. 2010. "Crowd Out Effects of Place-based Subsidized Rental Housing: New Evidence from the LIHTC Program." *Journal of Public Economics* 94 (11-12):953–966.

Fajgelbaum, Pablo D and Cecile Gaubert. 2020. "Optimal Spatial Policies, Geography, and Sorting." *The Quarterly Journal of Economics* 135 (2):959–1036.

Fan, Jingting. 2019. "Internal Geography, Labor Mobility, and the Distributional Impacts of Trade." *American Economic Journal: Macroeconomics* 11 (3):252–88.

Fang, Min and Zibin Huang. 2022. "Migration, Housing Constraints, and Inequality: A Quantitative Analysis of China." *Labour Economics* 78:102200.

Freedman, Matthew. 2013. "Targeted Business Incentives and Local Labor Markets." *Journal of Human Resources* 48 (2):311–344.

Fu, Shihe, Xiaocong Xu, and Junfu Zhang. 2021. "Land Conversion Across Cities in China." *Regional Science and Urban Economics* 87:103643.

Glaeser, Edward L and Joshua D Gottlieb. 2008. "The Economics of Place-making Policies." Tech. Rep. w28401, National Bureau of Economic Research.

Glaeser, Edward L, Joseph Gyourko, and Raven Saks. 2005. "Why is Manhattan So Expensive? Regulation and the Rise in Housing Prices." *The Journal of Law and Economics* 48 (2):331–369.

Glaeser, Edward L and Ming Lu. 2018. "Human-capital Externalities in China." Tech. rep., National Bureau of Economic Research.

Glaeser, Edward L and Bryce A Ward. 2009. "The Causes and Consequences of Land Use Regulation: Evidence from Greater Boston." *Journal of Urban Economics* 65 (3):265–278.

Gourieroux, Christian, Alain Monfort, and Eric Renault. 1993. "Indirect Inference." *Journal of Applied Econometrics* 8 (S1):S85–S118.

Gyourko, Joseph and Raven Molloy. 2015. "Regulation and Housing Supply." In *Handbook of Regional and Urban economics*, vol. 5. Elsevier, 1289–1337.

Ham, John C, Charles Swenson, Ayşe İmrohoroğlu, and Heonjae Song. 2011. "Government Programs Can Improve Local Labor Markets: Evidence from State Enterprise Zones, Federal Empowerment Zones and Federal Enterprise Community." *Journal of Public Economics* 95 (7-8):779–797.

Hamilton, Bruce W. 1978. "Zoning and the Exercise of Monopoly Power." *Journal of Urban Economics* 5 (1):116–130.

Han, Libin and Ming Lu. 2017. "Housing Prices and Investment: An Assessment of China's Inland-favoring Land Supply Policies." *Journal of the Asia Pacific Economy* 22 (1):106–121.

Hao, Tongtong, Ruiqi Sun, Trevor Tombe, and Xiaodong Zhu. 2020. "The effect of migration policy on growth, structural change, and regional inequality in China." *Journal of Monetary Economics* 113:112–134.

Helsley, Robert W and William C Strange. 1995. "Strategic Growth Controls." *Regional Science and Urban Economics* 25 (4):435–460.

Henderson, J Vernon, Dongling Su, Qinghua Zhang, and Siqi Zheng. 2022. "Political Manipulation of Urban Land Markets: Evidence from China." *Journal of Public Economics* 214:104730.

Hilber, Christian AL and Frédéric Robert-Nicoud. 2013. "On the Origins of Land Use Regulations: Theory and Evidence from US Metro Areas." *Journal of Urban Economics* 75:29–43.

Hsieh, Chang-Tai and Enrico Moretti. 2019. "Housing Constraints and Spatial Misallocation." *American Economic Journal: Macroeconomics* 11 (2):1–39.

Huang, Zibin. 2020. "Peer Effects, Parental Migration and Children's Human Capital: A Spatial Equilibrium Analysis in China." *Available at SSRN 3678300* .

Huynh, Nghiêm Q. 2023. "Place-based Policy, Migration Barriers, and Spatial Inequality." *Working Paper* .

Imbert, Clément and John Papp. 2020. "Short-term Migration, Rural Public Works, and Urban Labor Markets: Evidence from India." *Journal of the European Economic Association* 18 (2):927–963.

Kahn, Matthew E, Ryan Vaughn, and Jonathan Zasloff. 2010. "The Housing Market Effects of Discrete Land Use Regulations: Evidence from the California Coastal Boundary Zone." *Journal of Housing Economics* 19 (4):269–279.

Katz, Lawrence F and Kevin M Murphy. 1992. "Changes in Relative Wages, 1963–1987: Supply and Demand Factors." *The Quarterly Journal of Economics* 107 (1):35–78.

Khanna, Gaurav, Wenquan Liang, Ahmed Mushfiq Mobarak, and Ran Song. 2021. "The Productivity Consequences of Pollution-induced Migration in China." *NBER Working Paper* (w28401).

Kline, Patrick and Enrico Moretti. 2014. "Local Economic Development, Agglomeration Economies, and the Big Push: 100 Years of Evidence from the Tennessee Valley Authority." *The Quarterly Journal of Economics* 129 (1):275–331.

Lagakos, David. 2020. "Urban-rural Gaps in the Developing World: Does Internal Migration Offer Opportunities?" *Journal of Economic Perspectives* 34 (3):174–192.

Lagakos, David, Samuel Marshall, Ahmed Mushfiq Mobarak, Corey Vernot, and Michael E Waugh. 2020. "Migration Costs and Observational Returns to Migration in the Developing World." *Journal of Monetary Economics* 113:138–154.

Lagakos, David, Ahmed Mushfiq Mobarak, and Michael E Waugh. 2023. "The Welfare Effects of Encouraging Rural–urban Migration." *Econometrica* 91 (3):803–837.

Levinsohn, James and Amil Petrin. 2003. "Estimating Production Functions Using Inputs to Control for Unobservables." *The Review of Economic Studies* 70 (2):317–341.

Li, Xiaolu, Lin Ma, and Yang Tang. 2021. "Migration and Spatial Misallocation in China." *Available at SSRN 3925339* .

Liang, Wenquan, Ming Lu, and Hang Zhang. 2016. "Housing Prices Raise Wages: Estimating the Unexpected Effects of Land Supply Regulation in China." *Journal of Housing Economics* 33:70–81.

Lu, Ming and Kuanhu Xiang. 2016. "Great Turning: How Has the Chinese Economy Been Trapped in an Efficiency-and-Balance Tradeoff?" *Asian Economic Papers* 15 (1):25–50.

Lu, Yi, Jin Wang, and Lianming Zhu. 2019. "Place-based policies, Creation, and Agglomeration Economies: Evidence from China's Economic Zone Program." *American Economic Journal: Economic Policy* 11 (3):325–360.

Ma, Lin and Yang Tang. 2020. "Geography, Trade, and Internal Migration in China." *Journal of Urban Economics* 115:103181.

Monras, Joan. 2020. "Immigration and Wage Dynamics: Evidence from the Mexican Peso Crisis." *Journal of Political Economy* 128 (8):3017–3089.

Moretti, Enrico. 2004. "Human Capital Externalities in Cities." In *Handbook of Regional and Urban Economics*, vol. 4. Elsevier, 2243–2291.

Morten, Melanie. 2019. "Temporary Migration and Endogenous Risk Sharing in Village India." *Journal of Political Economy* 127 (1):1–46.

Neumark, David and Jed Kolko. 2010. "Do Enterprise Zones Create Jobs? Evidence from California's Enterprise Zone Program." *Journal of Urban Economics* 68 (1):1–19.

Neumark, David and Helen Simpson. 2015. "Place-based Policies." In *Handbook of Regional and Urban Economics*, vol. 5. Elsevier, 1197–1287.

Olley, G Steven and Ariel Pakes. 1992. "The Dynamics of Productivity in the Telecommunications Equipment Industry." Tech. rep., National Bureau of Economic Research.

Pellegrina, Heitor S. 2022. "Trade, Productivity, and the Spatial Organization of Agriculture: Evidence from Brazil." *Journal of Development Economics* 156:102816.

Quigley, John M and Larry A Rosenthal. 2005. "The effects of Land Use Regulation on the Price of Housing: What Do We Know? What Can We Learn?" *Cityscape* :69–137.

Romero, Roxana Gutiérrez. 2009. "Estimating the Impact of England's Area-based Intervention 'New Deal for Communities' on Employment." *Regional Science and Urban Economics* 39 (3):323–331.

Rosenthal, Stuart S and William C Strange. 2008. "The Attenuation of Human Capital Spillovers." *Journal of Urban Economics* 64 (2):373–389.

Sieg, Holger, Chamna Yoon, and Jipeng Zhang. 2021. "Migration Controls, Fiscal Externalities, and Access to Educational Opportunities in China." .

Song, Yang. 2014. "What Should Economists Know About the Current Chinese Hukou System?" *China Economic Review* 29:200–212.

Tian, Yuan. 2018. "International Trade Liberalization and Domestic Institutional Reform: Effects of WTO Accession on Chinese Internal Migration Policy." *UCLA Manuscript* .

Tombe, Trevor and Xiaodong Zhu. 2019. "Trade, Migration, and Productivity: A Quantitative Analysis of China." *American Economic Review* 109 (5):1843–72.

Tsivanidis, Nick. 2019. "Evaluating the Impact of Urban Transit Infrastructure: Evidence from Bogota's Transmilenio." Tech. rep., UC Berkeley (mimeo), 2020.

Wallace, Nancy E. 1988. "The Market Effects of Zoning Undeveloped Land: Does Zoning Follow the Market?" *Journal of Urban Economics* 23 (3):307–326.

Wang, Jin. 2013. "The Economic Impact of Special Economic Zones: Evidence from Chinese Municipalities." *Journal of Development Economics* 101:133–147.

Wu, Wenbin and Wei You. 2023. "Should Governments Promote or Slow the Pace of Urbanization? A Quantitative Analysis of the Internal Migration Restrictions in China." *Available at SSRN 3637557* .

Yu, Yue. 2019. "Land-Use Regulation and Economic Development: Evidence from the Farmland Red Line Policy in China." *Working Paper* .

Zi, Yuan. 2020. "Trade Liberalization and the Great Labor Reallocation." *Working Paper* .

Appendix to "Place-based Land Policy and Spatial Misallocation: Theory and Evidence from China" *

Min Fang
UF

Libin Han
DUFE

Zibin Huang
SUFE

Ming Lu
SJTU

Li Zhang
SYSU

March 25, 2024
latest version

Contents

*This is the online appendix to Fang et al. (2022). If you have any questions or inquiries, please get in touch with Min Fang (minfang@ufl.edu), Department of Economics, University of Florida. All errors are ours.

A Supplements to the Empirical Analysis

In this section, we implement six groups of robustness checks for our empirical analysis. We also investigate the policy effect on some other outcome variables in the last subsection to provide preliminary empirical evidence for the mechanism and motivate our quantitative model.

A.1 Robustness Checks for Productivity Estimation Method

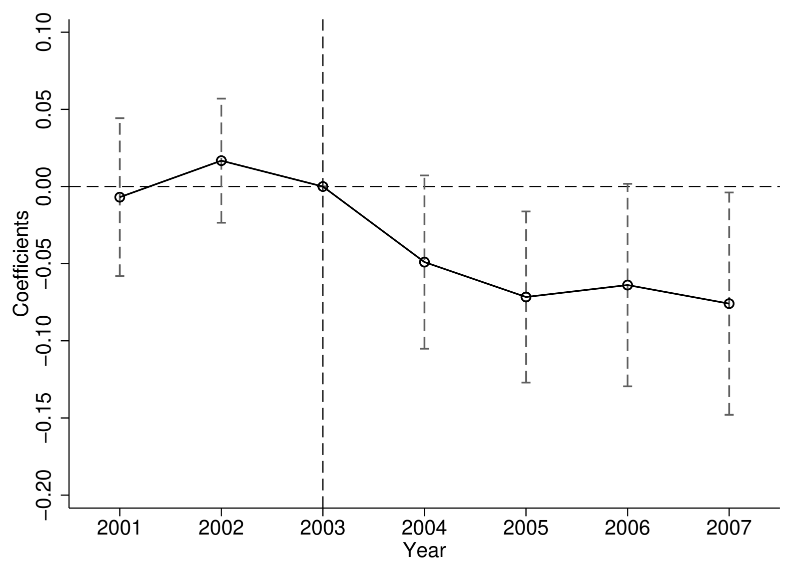
First, we implement the empirical analysis using productivity calculated with methods proposed by Levinsohn and Petrin (2003) and Ackerberg, Caves, and Frazer (2015). Table A1 shows the main regression results. Figures A1 and A2 show the results of the event study regression. All results are very similar to the results when we calculate productivity using the OP method. The event study regressions detect no evidence for unparalleled pre-trend.

Table A1: DID Results on Productivity (LP and ACF)

	(1) LP	(2) ACF
Post2003×East	-0.0516*	-0.0836**
	(0.0296)	(0.0343)
Province × Time Trend	Y	Y
GDP Per Capita × Time Trend	Y	Y
Industry Share × Time Trend	Y	Y
Year FE	Y	Y
Prefecture FE	Y	Y
Observations	1,792	1,792
R-squared	0.6351	0.6381

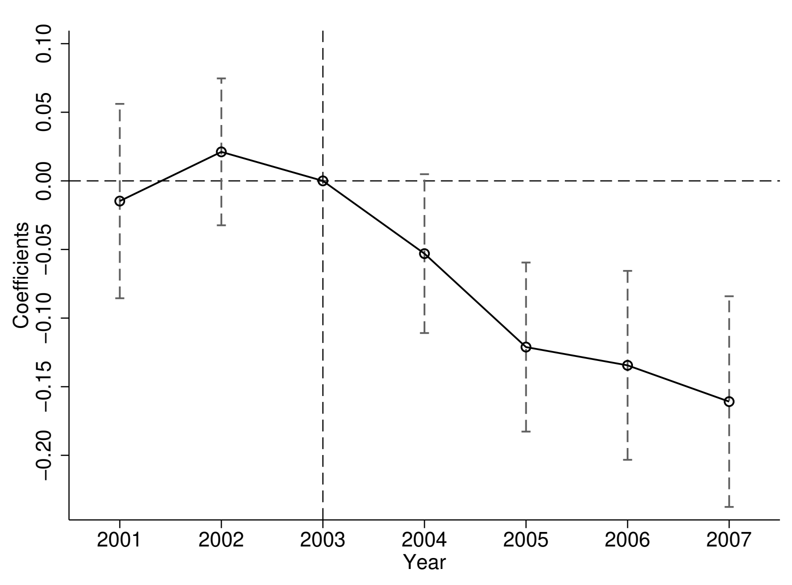
Notes: The dependent variables are prefecture-level average firm productivity measured by the Levinsohn and Petrin (2003) and the Ackerberg, Caves, and Frazer (2015) method. The regression specifications are identical to column (3) of Table 2. The standard errors are clustered at the prefecture level. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Figure A1: **Event Study - Productivity (LP)**



Notes: The dependent variable is the prefecture-level average firm productivity in different prefectures calculated using the Levinsohn and Petrin (2003) method. The corresponding confidence interval is 95%.

Figure A2: **Event Study - Productivity (ACF)**



Notes: The dependent variable is the prefecture-level average firm productivity in different prefectures calculated using the Ackerberg, Caves, and Frazer (2015) method. The corresponding confidence interval is 95%.

A.2 Using Quota Changes as Treatment

Second, we change the regression specification and directly use the quota change as the treatment variable to run the following regression:

$$ln(Prod_{jt}) = \alpha + \delta_1 Post2003_t \times QS_j + \phi_j + \gamma_t + \epsilon_{jt} \tag{1}$$

QS_j is the change (the 2000-2002 share minus the 2003-2007 share) in the quota share of the province where prefecture j is located before and after the policy. Compared with the main regression, we use QS_j instead of $East_j$ as the treatment variable. This exposure design considers prefectures with larger quota changes as experiencing larger policy shocks. Unfortunately, we do not have prefecture-level quota data and have to use province-level quota to approximate this exposure. Similar to the main regression, we find that prefectures in provinces with larger land quota losses experienced larger productivity reductions after the policy in 2003. Figures A3, A4, and A5 demonstrate the dynamic effect using event study regressions, taking quota shares as the treatment. We find no evidence of different pre-trends in productivity for regions with different quota changes.

Another straightforward way to estimate the effect of the quota changes on TFP is to directly regress prefecture-level TFP on the absolute quota level of the province (where the prefecture is located) in each year. Table A3 shows that province quota level is positively correlated with prefecture TFP. This indicates that policy-driven quota reductions lead to TFP declines for prefectures in that province.

Table A2: Quota Regression

	(1) OP	(2) LP	(3) ACF
Post2003×QS	-0.0132*	-0.0122	-0.0195**
	(0.0069)	(0.0075)	(0.0087)
Province × Time Trend	Y	Y	Y
GDP Per Capita × Time Trend	Y	Y	Y
Industry Share × Time Trend	Y	Y	Y
Year FE	Y	Y	Y
Prefecture FE	Y	Y	Y
Observations	1,792	1,792	1,792
R-squared	0.7527	0.6350	0.6379

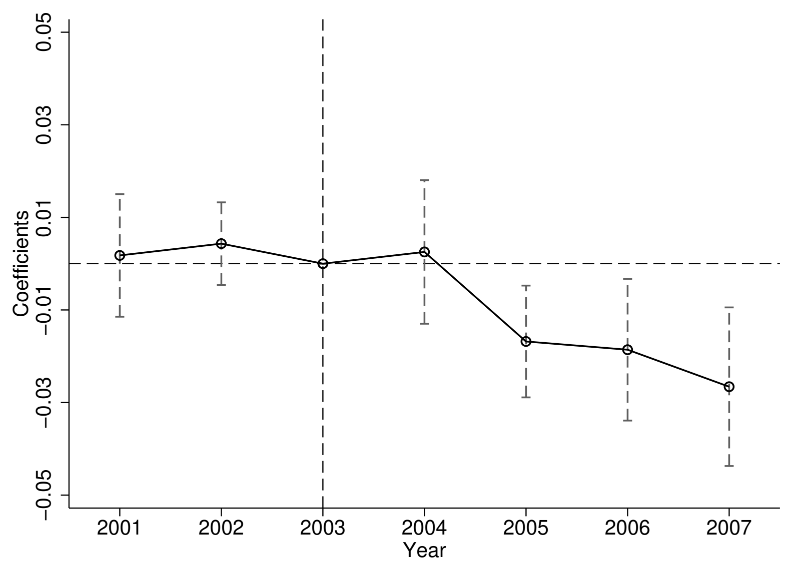
Notes: The dependent variables are prefecture-level average firm productivity measured by the Olley and Pakes (1992), the Levinsohn and Petrin (2003) and the Ackerberg, Caves, and Frazer (2015) methods. We use quota changes in each province as the treatment variable. The standard errors are clustered at the prefecture level. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Table A3: Quota Regression

	(1) OP	(2) LP	(3) ACF
Quota Level	0.0117**	0.0063	0.0157*
	(0.0056)	(0.0055)	(0.0088)
Province × Time Trend	Y	Y	Y
GDP Per Capita × Time Trend	Y	Y	Y
Industry Share × Time Trend	Y	Y	Y
Year FE	Y	Y	Y
Prefecture FE	Y	Y	Y
Observations	1,792	1,792	1,792
R-squared	0.7519	0.6338	0.6364

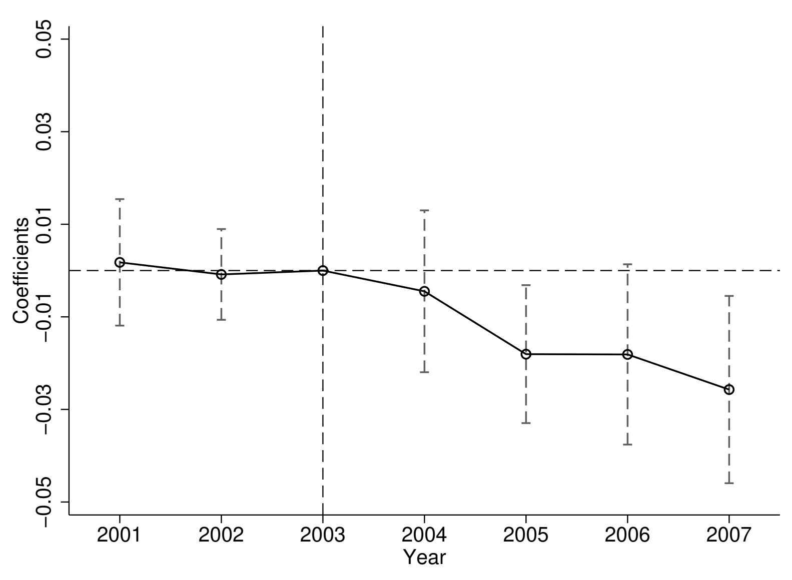
Notes: The dependent variables are prefecture-level average firm productivity measured by the Olley and Pakes (1992), the Levinsohn and Petrin (2003) and the Ackerberg, Caves, and Frazer (2015) methods. We use quota level (10 thousand hectare) in each province as the treatment variable. The standard errors are clustered at the prefecture level. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Figure A3: **Province Quota Event Study - Productivity (OP)**



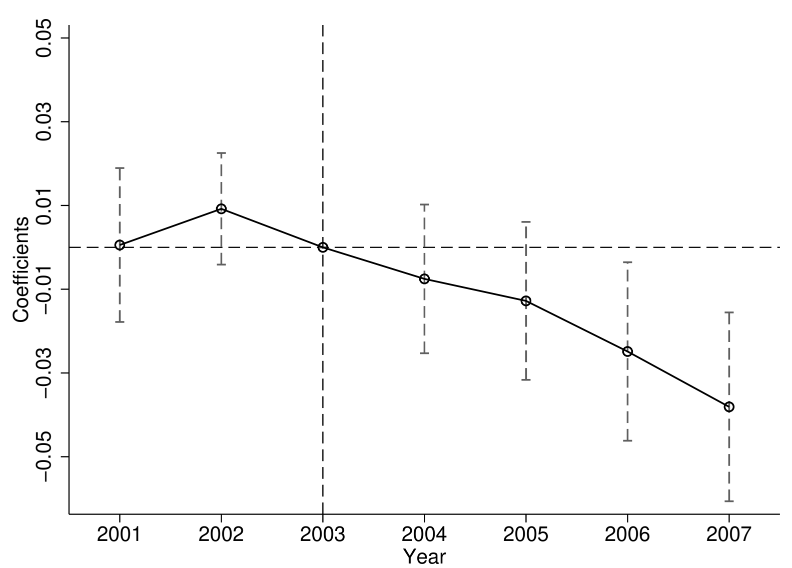
Notes: This is the province quota event study regression. The dependent variable is the average firm productivity in different prefectures calculated using the Olley and Pakes (1992) method. The corresponding confidence interval is 95%.

Figure A4: **Province Quota Event Study - Productivity (LP)**



Notes: This is the province quota event study regression. The dependent variable is the average firm productivity in different prefectures calculated using the Levinsohn and Petrin (2003) method. The corresponding confidence interval is 95%.

Figure A5: **Province Quota Event Study - Productivity (ACF)**



Notes: This is the province quota event study regression. The dependent variable is the average firm productivity in different prefectures calculated using the Ackerberg, Caves, and Frazer (2015) method. The corresponding confidence interval is 95%.

A.3 Excluding the Year of 2003 from the Treatment

Third, in the main context, we include 2003 in the treatment group. However, the policy was officially enacted in the middle of 2003 when the new administration of Jintao Hu and Jiabao Wen took office, which left limited time for the market to respond. In this robustness check, we exclude 2003 from the treatment and implement the main regression. Table A4 shows that the results are moderately amplified but not changed qualitatively.

Table A4: The Year of 2003 in Control Group

	(1) OP	(2) LP	(3) ACF
Post2003×East	-0.0985***	-0.0673**	-0.1139***
	(0.0264)	(0.0312)	(0.0329)
Province × Time Trend	Y	Y	Y
GDP Per Capita × Time Trend	Y	Y	Y
Industry Share × Time Trend	Y	Y	Y
Year FE	Y	Y	Y
Prefecture FE	Y	Y	Y
Observations	1,792	1,792	1,792
R-squared	0.7560	0.6364	0.6409

Notes: The dependent variables are prefecture-level average firm productivity measured by the Olley and Pakes (1992), the Levinsohn and Petrin (2003) and the Ackerberg, Caves, and Frazer (2015) methods. We exclude 2003 from the treatment group and consider the policy effect to start from 2004. The standard errors are clustered at the prefecture level. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

A.4 Robustness Checks for The WTO Effect

Fourth, China joined the WTO at the end of 2001, significantly changing the country's economic structure. While two years before the inland-favoring land supply policy, we are still concerned about the potential confounding effects of reducing trade barriers, which may have influenced eastern and inland prefectures differently. In column (1) of Table A5, we run the main regression while controlling for prefecture-level exporting. In column (2) of the same table, we calculate the average productivity for each prefecture, restricting our analysis to firms that report zero exports. This approach is based on the premise that firms with no export activity will likely be the least affected by any WTO-related effects. We do not detect any qualitative changes when eliminating WTO-related influences.

Table A5: Eliminating WTO Effects

	(1)	(2)
Post2003×East	-0.0747***	-0.0819***
	(0.0277)	(0.0308)
ln(Export)	0.0065	
	(0.0042)	
Province × Time Trend	Y	Y
GDP Per Capita × Time Trend	Y	Y
Industry Share × Time Trend	Y	Y
Year FE	Y	Y
Prefecture FE	Y	Y
Observations	1,792	1,792
R-squared	0.7468	0.7422

Notes: The dependent variable is prefecture-level average firm productivity measured by the Olley and Pakes (1992) method. In column (1), we control for prefecture-level export aggregated from the firm dataset. In column (2), we drop all firms involved in exporting when calculating TFP. The standard errors are clustered at the prefecture level. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

A.5 Robustness Checks for Subsidy and Tax Policies

Fifth, we attempt to rule out the effects of other concurrent subsidy and tax policies that may have been implemented alongside the land reform. Apart from the land supply policy, the Chinese government also enacted other inland-favoring measures to promote inland economic growth, such as manufacturing subsidies. We calculate average government subsidies, financing costs (interest cost divided by total debt), and taxes for firms in different prefectures. Then, we conduct the DID regression using these prefecture-level variables as the outcomes to check whether government support for firms in other dimensions changed differently for eastern and inland regions around 2003. Table A6 indicates that firms in each region experienced similar government subsidies, financing costs, and taxes before and after 2003. We then estimate the productivity regressions with these three variables as additional controls. Table A7 demonstrates that the main results are consistent across all regression settings.

Table A6: Effect on Subsidies, Financing Costs, and Taxes

	(1) Subsidies	(2) Financing Costs	(3) Taxes
Post2003×East	0.4830	-0.1246	0.3864
	(0.5411)	(0.1028)	(0.5967)
Province × Time Trend	Y	Y	Y
GDP Per Capita × Time Trend	Y	Y	Y
Industry Share × Time Trend	Y	Y	Y
Year FE	Y	Y	Y
Prefecture FE	Y	Y	Y
Observations	1,792	1,792	1,792
R-squared	0.4372	0.7380	0.5782

Notes: The dependent variables are prefecture-level average firm subsidies, financing costs, and taxes. The standard errors are clustered at the prefecture level. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Table A7: Main Regression Controlling for Other Policies

	(1) OP	(2) LP	(3) ACF
Post2003×East	-0.0702***	-0.0492*	-0.0743**
	(0.0257)	(0.0296)	(0.0322)
Subsidy	-0.0027**	-0.0021*	-0.0013
	(0.0011)	(0.0012)	(0.0015)
Financing Cost	0.0702***	0.0464***	0.0893***
	(0.0097)	(0.0104)	(0.0103)
Tax	-0.0027	-0.0009	-0.0013
	(0.0021)	(0.0021)	(0.0025)
Province × Time Trend	Y	Y	Y
GDP Per Capita × Time Trend	Y	Y	Y
Industry Share × Time Trend	Y	Y	Y
Year FE	Y	Y	Y
Prefecture FE	Y	Y	Y
Observations	1,792	1,792	1,792
R-squared	0.7664	0.6500	0.6669

Notes: The dependent variable are prefecture-level average firm productivity measured by the Olley and Pakes (1992), the Levinsohn and Petrin (2003) and the Ackerberg, Caves, and Frazer (2015) method. We also control government subsidies, financing costs, and taxes. The standard errors are clustered at the prefecture level. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

A.6 Robustness Checks for Rural Reforms

During the early 2000s, there were two other important reforms happening in rural China, the passage of the Rural Land Contracting Law (Chari et al., 2021) and the removal of the agricultural tax (Wang and Shen, 2014). We further check the robustness of our main results by controlling for the effect of these two policies.

For the passage of the Rural Land Contracting Law (RLCL), we additionally control for a traditional staggered DID dummy term of whether the treated province started to implement this policy in a given year in the main regression. For the removal of the agricultural tax, we additionally employ an exposure design to add an interaction term between the agricultural tax share before the policy year (average of 1999 to 2005) and the starting policy year (2006) indicator. The agricultural tax share is calculated by dividing the average annual agricultural tax income from 1999 to 2005 by the average annual government total income in the prefecture. That is, prefectures with higher agricultural tax share before the reform were more exposed to the abolition of the tax. Table A8 shows that when we control for these two rural reform policies, the main regression result is not changed. In addition, we do not detect any effects of these two rural reforms on prefecture-level TFP gaps between the eastern and the inland regions.

Table A8: Main Regression Controlling for Rural Reforms

	(1) OP	(2) LP	(3) ACF	(4) OP	(5) LP	(6) ACF	(7) OP	(8) LP	(9) ACF
Post2003×East	-0.0725***	-0.0493	-0.0818**	-0.0931***	-0.0698**	-0.0979***	-0.0908***	-0.0677**	-0.0963***
	(0.0270)	(0.0301)	(0.0346)	(0.0274)	(0.0283)	(0.0357)	(0.0275)	(0.0283)	(0.0356)
Agricultural Tax Share × Abolition	-0.0019	-0.0018	-0.0014				-0.0015	-0.0014	-0.0011
	(0.0024)	(0.0027)	(0.0029)				(0.0023)	(0.0026)	(0.0028)
RLCL Passing Dummy				0.0011	-0.0364	0.0247	0.0008	-0.0366	0.0245
				(0.0217)	(0.0231)	(0.0286)	(0.0216)	(0.0230)	(0.0285)
Province × Time Trend	Y	Y	Y	Y	Y	Y	Y	Y	Y
GDP Per Capita × Time Trend	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry Share × Time Trend	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Prefecture FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	1,792	1,792	1,792	1,789	1,789	1,789	1,789	1,789	1,789
R-squared	0.7540	0.6353	0.6382	0.7565	0.6412	0.6396	0.7567	0.6414	0.6396

Notes: The dependent variable are prefecture-level average firm productivity measured by the Olley and Pakes (1992), the Levinsohn and Petrin (2003) and the Ackerberg, Caves, and Frazer (2015) method. We also control for the effect of two rural reform policies, the passage of the Rural Land Contracting Law and the abolition of the agricultural tax. The standard errors are clustered at the prefecture level. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

A.7 Additional Results for Mechanism Validation

This section investigates the inland-favoring land supply policy's effect on other variables, illustrating the potential channels to validate our mechanism in the quantitative model. First, we use land transaction data to examine the direct effect on land prices. Second, we consider the transmission channels on prefecture-level wages and housing prices from the City Statistical Yearbooks. Finally, we show the resulting indirect effect on across-region migrations using the Chinese Population Census data. Our findings indicate that, in comparison to inland regions, the 2003 inland-favoring land supply policy resulted in a notable increase in relative land prices in eastern areas. This policy then suppressed relative wages and elevated relative housing prices in these regions. The combined effect of reduced labor demand and increased living costs subsequently acted as a deterrent to migration toward eastern regions.

A.7.1 Additional Data for Additional Results

The land transaction data is the only dataset used in this section, which has not been introduced in the main context. We provide a brief summary below. To estimate the effect of the inland-favoring land policy on land prices, we utilize land transaction data from 2002 to 2018, collected from the China Land Market Website (http://www.landchina.com/). The dataset includes unique land IDs, parcel locations, land usage (industrial land, commercial/service sector land, housing land, and others), land area, and leasing prices. Table A9 shows the summary statistics of land prices by their selling categories. There are three categories based on the function of the land, including land parcels for housing construction, commercial business construction, and manufacturing factory construction. We detect a price disparity such that land prices for commercial constriction are more expensive.

Table A9: Summary Statistics of Land Prices

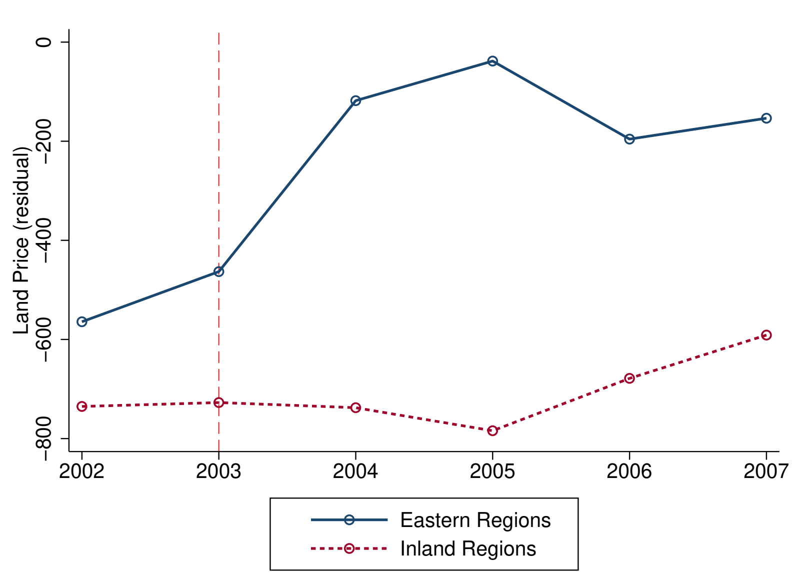
Variable	Observations	Mean	Std. dev.	Min	Median	Max
Panel A. Land Prices in (2002-2007)						
Ln(landprice)	192317	4.69	1.45	0.62	4.68	9.92
Ln(landprice Housing)	84553	4.63	1.67	0.62	4.61	9.62
Ln(landprice Commercial)	29080	5.74	1.44	2.48	5.73	9.92
Ln(landprice Manufacturing)	78684	4.37	0.94	1.94	4.49	7.03
Panel B. Land Prices (2002-2018)						
Ln(landprice)	1549444	5.79	1.47	0.61	5.70	9.93
Ln(landprice Housing)	749495	5.95	1.70	0.61	6.05	9.62
Ln(landprice Commercial)	275739	6.56	1.31	2.48	6.58	9.93
Ln(landprice Manufacturing)	524210	5.14	0.78	1.94	5.19	7.03

Notes: We summarize land transaction data from 2002 to 2018, collected from the China Land Market Website. Panel A uses data from 2002 to 2007. Panel B uses data from 2002 to 2018.

A.7.2 Policy Effect on Land Prices

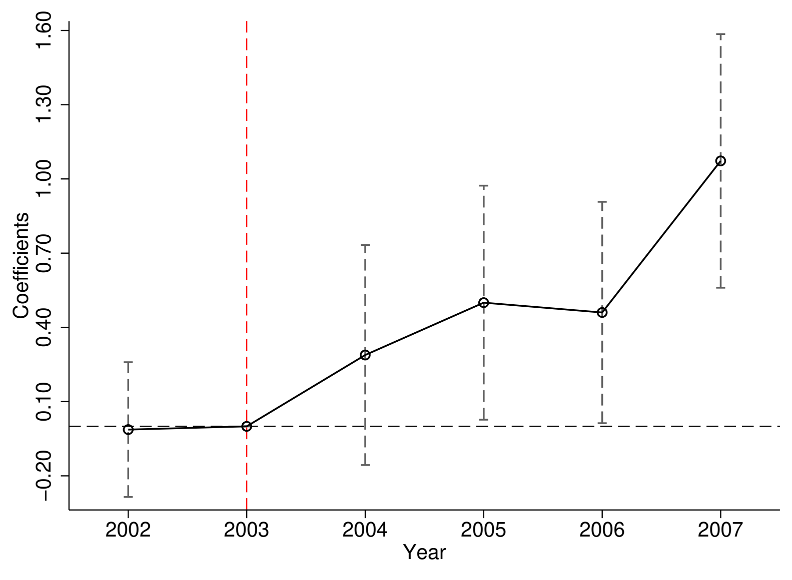
Our empirical strategy for analyzing land prices is a simple DID regression at the land parcel level, similar to the main regression. Additionally, we control for land selling categories. Local land administration departments were required to publish information on the transfer of state-owned land-use rights only after the passage of *The Regulations on the Disposition of State-Owned Land Use Rights for Auctions and Biddings* in 2007. Consequently, the transaction data before 2007 is not comprehensive. The sample size becomes reasonable only after 2002; therefore, we ran the regression using data from 2002 to 2018. Figure A6 and A7 display the time trends and the event study regression results for land prices. The coefficient before 2003 is insignificant (although we have only one data point). Furthermore, we observe a notable increase in the land price gap between eastern and inland regions after 2003. Table A10 presents the DID regression results. Column (1) showcases the results when using the same sample years as in the productivity regression (before 2007), while column (2) includes the results when incorporating all available sample years. Our findings suggest that the inland-favoring land policy expanded the land price gap between eastern and inland regions by 50 percentage points.

Figure A6: **Time Trends of Land Price**



Notes: This figure shows land parcel price time trends. The black line is the average outcome value in the developed eastern region, and the grey line is the average outcome value in the inland region. The dashed vertical line indicates the implementation of the inland-favoring land policy.

Figure A7: **Event Study - Land Price**



Notes: The dependent variable is the land price. The corresponding confidence interval is 95%.

Table A10: **DID Results on Land Prices**

	(1) Sample 02-07	(2) Sample 02-18
Post2003×East	0.513**	0.654**
	(0.220)	(0.261)
Province × Time Trend	Y	Y
GDP Per Capita × Time Trend	Y	Y
Industry Share × Time Trend	Y	Y
Year FE	Y	Y
Prefecture FE	Y	Y
Observations	189,619	1,421,487
R-squared	0.502	0.469

Notes: The dependent variable is land parcel prices. We also control for land parcel level selling categories. The standard errors are clustered at the prefecture level. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

A.7.3 Policy Effect on Wages and Housing Prices

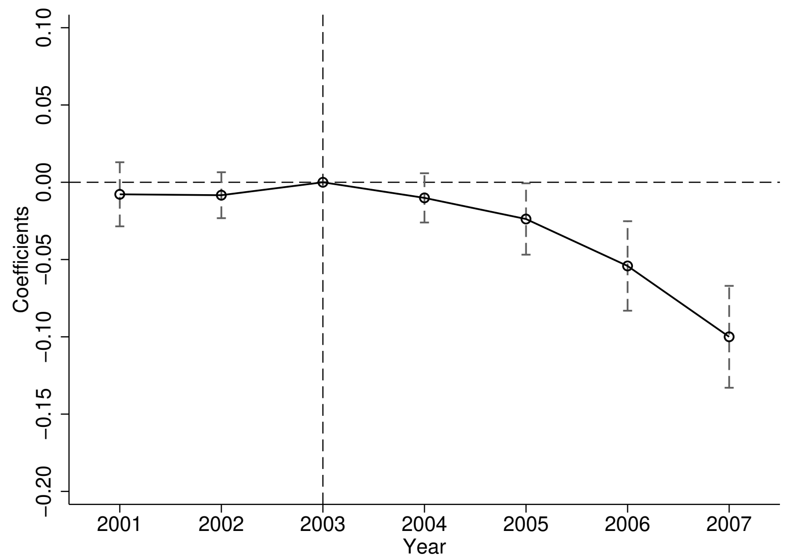
Furthermore, we examine the impact of the inland-favoring policy on wages and housing prices between eastern and inland regions. We employ prefecture-level data from City Statistical Yearbooks and conduct two simple DID regressions for wages and housing prices. The outcomes are presented in Table A11. Our findings show that the inland-favoring land policy reduced relative wages by two percentage points and increased relative housing prices by seven percentage points in eastern regions compared with inland regions. Figures A8 and A9 further illustrate the event study regression results for wages and housing prices. We find that there is no evident divergent pre-trend in wages or housing prices before the policy in 2003. After the policy was implemented, in eastern regions, relative wages fell and relative housing prices increased gradually and significantly.

Table A11: **DID Results on Wages and Housing Prices**

	(1) Wages	(2) Housing Prices
Post2003×East	-0.0210*	0.0673**
	(0.0122)	(0.0269)
Province × Time Trend	Y	Y
GDP per capita × Time Trend	Y	Y
Industry Share × Time Trend	Y	Y
Year FE	Y	Y
Prefecture FE	Y	Y
Observations	1,792	1,789
R-squared	0.9385	0.7421

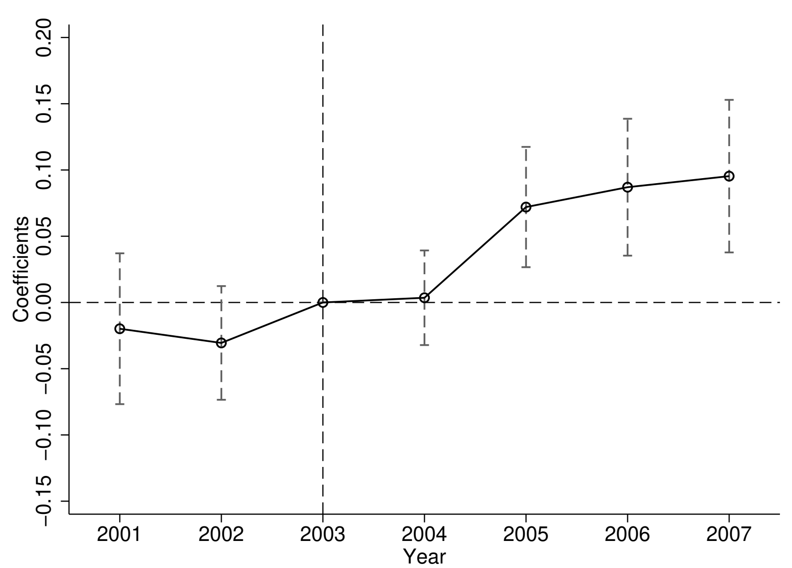
Notes: Prefecture-level average wages and housing prices are dependent variables. Standard errors are clustered at the prefecture level. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Figure A8: **Event Study - Wage**



Notes: The dependent variable is the prefecture-level wages. The corresponding confidence interval is 95%.

Figure A9: **Event Study - Housing Price**



Notes: The dependent variable is the prefecture-level housing prices. The corresponding confidence interval is 95%.

A.7.4 Policy Effect on Migration

We finally conduct a simple DID regression to investigate the policy effect on prefecture-level labor migration. We employ Census 2005 and 2010 to infer the scale of migration in each province from 2001 to 2010. Migration connects directly to our mechanism by investigating the location choices of workers. In the first column, we evaluate the effects on net migration. In the second column, we evaluate the effects on migration inflows. In the third column, we evaluate the effects on migration outflows. The units of the dependent variables are one thousand people. Table A12 shows that the 2003 policy reduced the eastern migration inflow and the net migration gap between eastern and inland regions.

Table A12: **DID Results on Migration**

	(1) Net Migration	(2) Migration Inflow	(3) Migration Outflow
Post2003×East	-7.81**	-6.94**	0.87
	(3.09)	(2.84)	(0.99)
Province × Time Trend	Y	Y	Y
GDP per capita × Time Trend	Y	Y	Y
Industry Share × Time Trend	Y	Y	Y
Year FE	Y	Y	Y
Prefecture FE	Y	Y	Y
Observations	2,181	2,181	2,181
R-squared	0.10	0.17	0.45

Notes: In the first column, we evaluate the effects on net migrations. In the second column, we evaluate the effects on migration inflows. In the third column, we evaluate the effects on migration outflows. The units of the dependent variables are 1 thousand people. The standard errors are clustered at the prefecture level. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

B Supplements to the Equilibrium Analysis

B.1 List of Cities by Productivity and Land Tightness

Table B1: List of Cities

City Name	GDP Per Capita (RMB)	Group	productivity 05	productivity 10	Land Abundance 2005	Land Abundance 2010
Beijing	38315	East, High	38.96	40.85	0.13	0.11
Tianjin	34170	East, Middle	38.95	41.63	0.03	0.14
Shijiazhuang	31850	East, Middle	36.53	39.25	0.12	0.04
Tangshan	27995	East, Middle	38.40	40.81	0.18	0.07
Qinhuangdao	39214	East, High	35.29	39.82	0.25	0.09
Handan	19687	East, Middle	36.95	40.24	0.14	0.05
Xingtai	18043	East, Middle	37.72	40.16	0.11	0.04
Baoding	23312	East, Middle	37.06	39.76	0.07	0.04
Zhangjiakou	24225	East, Middle	36.59	40.02	0.18	0.06
Chengde	20145	East, Middle	37.23	38.90	0.14	0.19
Taiyuan	20622	Non-east, Middle	37.54	40.04	0.10	0.12
Datong	16655	Non-east, Middle	37.03	40.82	0.08	0.12
Yangquan	16700	Non-east, Middle	38.45	40.95	0.06	0.10
Changzhi	20807	Non-east, Middle	37.74	40.84	0.04	0.07
Jincheng	20974	Non-east, Middle	38.14	40.37	0.03	0.06
Shuozhou	13665	Non-east, Low	36.58	40.20	0.07	0.08
Jinzhong	9873	Non-east, Low	36.57	39.42	0.02	0.04
Yuncheng	7584	Non-east, Low	36.67	38.36	0.03	0.06
Xinzhou	4795	Non-east, Low	36.13	37.49	0.02	0.05
Linfen	10588	Non-east, Low	37.72	39.22	0.03	0.03
Hohhot	31585	Non-east, Middle	35.87	38.45	0.27	0.17
Baotou	39561	Non-east, High	38.23	40.04	0.20	0.17
Wuhai	20081	Non-east, Middle	37.16	40.21	0.11	0.24
Chifeng	7547	Non-east, Low	36.56	39.00	0.19	0.09
Tongliao	13789	Non-east, Low	35.66	38.95	0.15	0.13
Ordos	35380	Non-east, Middle	38.46	42.13	0.05	0.13
Hulunbeir	13785	Non-east, Low	37.38	39.64	0.06	0.05
Shenyang	34345	East, Middle	37.80	39.89	0.18	0.12
Dalian	54183	East, High	38.29	41.01	0.18	0.15
Anshan	43816	East, High	38.41	39.73	0.21	0.13
Fushun	19635	East, Middle	37.73	39.89	0.24	0.18
Dandong	15440	East, Low	36.49	38.92	0.11	0.07
Fuxin	11242	East, Low	35.80	38.30	0.19	0.18
Tieling	11041	East, Low	36.14	39.66	0.12	0.08
Chaoyang	10781	East, Low	36.98	39.56	0.07	0.08
Changchun	37003	East, Middle	36.92	39.22	0.14	0.21
Jilin	23046	East, Middle	37.01	39.94	0.15	0.16
Siping	14560	East, Low	35.11	39.04	0.08	0.10
Liaoyuan	12097	East, Low	36.96	39.00	0.17	0.21
Tonghua	14717	East, Low	37.28	39.48	0.06	0.07
White City	9091	East, Low	33.83	37.96	0.06	0.11
Harbin	30534	East, Middle	37.11	39.33	0.19	0.13
Qiqihar	13431	East, Low	36.40	36.94	0.15	0.15
Jixi	8480	East, Low	36.59	37.15	0.18	0.16
Hegang	8432	East, Low	37.03	39.52	0.16	0.13
Shuangyashan	12678	East, Low	37.52	38.34	0.32	0.18
Yichun	8546	East, Low	35.63	39.11	0.66	0.53
Jiamusi	14080	East, Low	35.08	39.27	0.14	0.18
Shanghai	57423	East, High	40.22	41.11	0.04	0.06
Nanjing	35464	East, Middle	39.36	40.89	0.32	0.16
Wuxi	58976	East, High	39.07	41.34	0.12	0.06
Xuzhou	31592	East, Middle	37.94	40.37	0.13	0.10
Changzhou	36335	East, Middle	39.05	40.78	0.08	0.06

Table B2: List of Cities (Continued)

City Name	GDP Per Capita (RMB)	Group	productivity 05	productivity 10	Land Abundance 2005	Land Abundance 2010
Suzhou	60326	East, High	39.99	41.71	0.08	0.04
Nantong	35059	East, Middle	38.01	41.08	0.04	0.04
Lianyungang	29298	East, Middle	36.46	39.71	0.20	0.09
Huaian	11557	East, Low	36.99	41.05	0.17	0.08
Yancheng	15929	East, Middle	36.56	40.16	0.08	0.04
Zhenjiang	34988	East, Middle	39.62	40.62	0.13	0.08
Hangzhou	49055	East, High	39.86	41.30	0.16	0.07
Ningbo	60381	East, High	39.70	41.42	0.06	0.05
Wenzhou	45795	East, High	38.72	40.79	0.07	0.03
Jiaxing	30988	East, Middle	39.34	41.00	0.08	0.03
Huzhou	26260	East, Middle	39.55	40.52	0.14	0.05
Shaoxing	35753	East, Middle	39.24	40.82	0.08	0.04
Jinhua	19113	East, Middle	39.02	40.57	0.06	0.02
Zhoushan	21215	East, Middle	38.80	41.26	0.17	0.10
Taizhou	30647	East, Middle	39.47	40.88	0.09	0.04
Lishui	17653	East, Middle	37.03	40.59	0.07	0.05
Hefei	29058	Non-east, Middle	39.50	41.73	0.29	0.15
Wuhu	33544	Non-east, Middle	38.00	40.41	0.22	0.17
Bengbu	15456	Non-east, Low	35.64	39.48	0.29	0.20
Huainan	9784	Non-east, Low	37.74	40.82	0.23	0.18
Ma'anshan	29536	Non-east, Middle	38.84	41.11	0.24	0.17
Huaibei	15007	Non-east, Low	36.00	40.43	0.23	0.15
Anqing	19917	Non-east, Middle	35.27	39.24	0.11	0.08
Chuzhou	17353	Non-east, Middle	36.06	39.78	0.07	0.08
Fuyang	4229	Non-east, Low	35.92	38.71	0.26	0.07
Suzhou	4900	Non-east, Low	35.21	38.58	0.10	0.09
Lu'an	3039	Non-east, Low	36.15	39.55	0.18	0.08
Bozhou	6314	Non-east, Low	35.66	39.55	0.14	0.10
Chizhou	7290	Non-east, Low	37.11	39.74	0.10	0.12
Xuancheng	8989	Non-east, Low	37.80	40.78	0.11	0.07
Fuzhou	43600	East, High	38.27	40.70	0.12	0.07
Xiamen	40146	East, High	38.74	43.06	0.15	0.10
Sanming	25396	East, Middle	37.59	40.23	0.05	0.04
Quanzhou	28010	East, Middle	38.79	40.83	0.02	0.04
Zhangzhou	29056	East, Middle	38.24	40.88	0.05	0.04
Nanping	16169	East, Middle	37.09	39.83	0.04	0.03
Longyan	24690	East, Middle	38.21	40.37	0.07	0.04
Ningde	12408	East, Low	37.51	39.92	0.03	0.03
Nanchang	28388	Non-east, Middle	37.39	39.96	0.15	0.11
Jingdezhen	19486	Non-east, Middle	35.95	37.91	0.23	0.17
Pingxiang	13828	Non-east, Low	36.99	40.47	0.21	0.07
Jiujiang	29840	Non-east, Middle	35.78	39.43	0.07	0.07
Xinyu City	12046	Non-east, Low	36.69	39.94	0.24	0.15
Yingtan	11379	Non-east, Low	36.98	39.81	0.14	0.12
Ganzhou	12262	Non-east, Low	36.66	39.61	0.05	0.04
Ji'an	14198	Non-east, Low	35.89	38.41	0.06	0.04
Yichun	4600	Non-east, Low	36.68	39.29	0.05	0.04
Shangrao	12052	Non-east, Low	36.20	39.64	0.04	0.03
Jinan	36697	East, Middle	38.28	39.39	0.18	0.14
Qingdao	43327	East, High	39.24	41.10	0.10	0.07
Zibo	37104	East, Middle	38.15	39.66	0.19	0.14
Zaozhuang	13923	East, Low	36.38	38.87	0.18	0.12
Dongying	86523	East, High	39.20	41.20	0.26	0.15
Yantai	35583	East, Middle	38.74	40.47	0.13	0.13
Weifang	24267	East, Middle	37.26	40.44	0.09	0.06
Jining	18548	East, Middle	37.25	40.17	0.05	0.06
Tai'an	16938	East, Middle	37.15	39.71	0.14	0.08
Weihai	48100	East, High	38.20	39.94	0.15	0.14
Rizhao	16930	East, Middle	36.40	40.02	0.16	0.15
Laiwu	18042	East, Middle	37.55	40.45	0.32	0.14

Table B3: List of Cities (Continued)

City Name	GDP Per Capita (RMB)	Group	productivity 05	productivity 10	Land Abundance 2005	Land Abundance 2010
Linyi	17479	East, Middle	36.98	40.25	0.13	0.08
Dezhou	24777	East, Middle	36.27	39.71	0.09	0.08
Liaocheng	8844	East, Low	36.58	39.03	0.13	0.08
Binzhou	19158	East, Middle	37.30	40.27	0.11	0.12
Zhengzhou	27261	Non-east, Middle	36.71	39.77	0.26	0.10
Kaifeng	11976	Non-east, Low	35.44	38.85	0.39	0.17
Luoyang	26555	Non-east, Middle	36.73	39.93	0.22	0.12
Pingdingshan	18337	Non-east, Middle	37.15	39.82	0.17	0.08
Anyang	19362	Non-east, Middle	36.74	39.54	0.18	0.07
Hebi	14703	Non-east, Low	34.47	39.15	0.39	0.16
Xuchang	14306	Non-east, Low	36.63	39.65	0.16	0.11
Luohe	23156	Non-east, Middle	35.12	38.29	0.53	0.14
Sanmenxia	15414	Non-east, Low	36.35	39.21	0.17	0.08
Nanyang	25615	Non-east, Middle	35.64	38.19	0.23	0.08
Shangqiu	14764	Non-east, Low	35.49	38.86	0.16	0.07
Zhoukou	13144	Non-east, Low	33.75	38.60	0.15	0.39
Wuhan	24963	Non-east, Middle	37.38	40.19	0.12	0.11
Shiyan	35874	Non-east, Middle	36.70	38.93	0.14	0.08
Yichang	26548	Non-east, Middle	36.03	38.15	0.09	0.10
Xiangfan	12493	Non-east, Low	36.02	38.84	0.15	0.10
Ezhou	13519	Non-east, Low	35.45	41.07	0.23	0.18
Jingmen	19907	Non-east, Middle	35.62	38.24	0.12	0.08
Xiaogan	6977	Non-east, Low	35.99	38.80	0.08	0.03
Jingzhou	10007	Non-east, Low	35.58	39.36	0.09	0.06
Huanggang	10270	Non-east, Low	34.97	38.78	0.05	0.06
Xianning	8278	Non-east, Low	35.60	38.93	0.08	0.12
Suizhou	8350	Non-east, Low	35.30	38.61	0.54	0.11
Changsha	34131	Non-east, Middle	37.89	40.15	0.10	0.10
Zhuzhou	24835	Non-east, Middle	38.31	40.75	0.12	0.09
Xiangtan	26112	Non-east, Middle	37.51	40.77	0.12	0.10
Hengyang	15457	Non-east, Low	37.17	40.47	0.15	0.08
Shaoyang	8988	Non-east, Low	36.07	39.96	0.07	0.05
Yueyang	28512	Non-east, Middle	37.32	39.85	0.12	0.08
Changde	18270	Non-east, Middle	37.19	39.62	0.10	0.08
Zhangjiajie	6514	Non-east, Low	38.52	39.86	0.19	0.13
Yiyang	8840	Non-east, Low	37.23	39.30	0.11	0.08
Chenzhou	14959	Non-east, Low	37.54	40.34	0.06	0.07
Yongzhou	8503	Non-east, Low	37.52	40.30	0.13	0.09
Huaihua	15795	Non-east, Middle	37.24	40.29	0.09	0.07
Guangzhou	63819	East, High	40.36	42.60	0.08	0.10
Shaoguan	19590	East, Middle	37.25	40.38	0.03	0.12
Shenzhen	59271	East, High	40.35	42.69	0.08	0.07
Zhuhai	64960	East, High	39.74	40.72	0.06	0.10
Shantou	12456	East, Low	36.43	39.54	0.06	0.11
Foshan	47500	East, High	38.99	40.83	0.03	0.03
Jiangmen	30791	East, Middle	37.57	40.37	0.04	0.08
Zhanjiang	24248	East, Middle	37.68	39.15	0.04	0.09
Maoming	20541	East, Middle	38.26	40.15	0.03	0.10
Zhaoqing	25943	East, Middle	38.09	40.02	0.03	0.11
Huizhou	37681	East, Middle	38.73	40.72	0.04	0.11
Meizhou	10984	East, Low	37.54	40.23	0.02	0.07
Shanwei	10193	East, Low	36.76	39.91	0.01	0.03
Heyuan	11453	East, Low	37.76	39.24	0.01	0.07
Yangjiang	18778	East, Middle	37.01	38.88	0.04	0.09
Qingyuan	12004	East, Low	38.13	40.27	0.03	0.10
Dongguan	71997	East, High	40.34	42.03	0.01	0.01
Zhongshan	44005	East, High	39.29	41.76	0.02	0.02
Yunfu	12543	East, Low	36.84	39.14	0.02	0.06

Table B4: List of Cities (Continued)

City Name	GDP Per Capita (RMB)	Group	productivity 05	productivity 10	Land Abundance 2005	Land Abundance 2010
Nanning	24296	Non-east, Middle	35.60	39.23	0.19	0.11
Liuzhou	23042	Non-east, Middle	37.31	40.60	0.21	0.12
Guilin	22192	Non-east, Middle	37.60	39.84	0.10	0.06
Beihai	18530	Non-east, Middle	36.92	39.25	0.23	0.16
Yulin	8573	Non-east, Low	37.22	39.63	0.10	0.07
Baise	12227	Non-east, Low	36.71	39.63	0.08	0.07
Hechi	9114	Non-east, Low	35.60	38.46	0.07	0.04
Laibin	5947	Non-east, Low	36.90	39.37	0.15	0.11
Chongzuo	6633	Non-east, Low	35.84	39.38	0.04	0.09
Haikou	17928	East, Middle	36.89	38.89	0.08	0.14
Sanya	9538	East, Low	37.76	39.96	0.10	0.12
Chongqing	13342	Non-east, Low	37.80	40.73	0.10	0.12
Chengdu	29463	Non-east, Middle	37.89	39.83	0.24	0.07
Zigong	14452	Non-east, Low	35.83	39.34	0.22	0.18
Panzhihua	20725	Non-east, Middle	36.92	40.26	0.42	0.15
Luzhou	10166	Non-east, Low	37.04	38.94	0.25	0.13
Deyang	15421	Non-east, Low	38.23	40.87	0.07	0.06
Mianyang	18200	Non-east, Middle	36.08	39.87	0.16	0.10
Guangyuan	6323	Non-east, Low	35.79	39.71	0.34	0.08
Suining	5207	Non-east, Low	36.71	39.23	0.25	0.08
Leshan	9887	Non-east, Low	36.45	38.76	0.19	0.07
Nanchong	6373	Non-east, Low	35.98	39.17	0.19	0.07
Meishan	8575	Non-east, Low	37.34	39.89	0.20	0.09
Yibin	16042	Non-east, Middle	36.45	39.78	0.09	0.08
Guang'an	4584	Non-east, Low	36.55	38.33	0.24	0.07
Ziyang	7540	Non-east, Low	36.70	39.07	0.10	0.09
Guiyang	18874	Non-east, Middle	36.68	39.57	0.16	0.11
Liupanshui	13504	Non-east, Low	38.03	40.34	0.16	0.08
Zunyi City	15180	Non-east, Low	37.43	39.81	0.08	0.05
Anshun	4921	Non-east, Low	36.04	39.52	0.14	0.11
Kunming	31780	Non-east, Middle	38.12	40.26	0.11	0.09
Qujing	17659	Non-east, Middle	37.59	39.80	0.23	0.06
Yuxi	52230	Non-east, High	37.71	39.08	0.03	0.05
Baoshan	4656	Non-east, Low	36.94	39.18	0.05	0.07
Zhaotong	6819	Non-east, Low	37.94	40.12	0.04	0.05
Lijiang	11223	Non-east, Low	35.71	39.13	0.12	0.10
Xi'an	17528	Non-east, Middle	37.07	39.49	0.09	0.08
Tongchuan	8160	Non-east, Low	35.13	39.29	0.12	0.18
Baoji	24210	Non-east, Middle	36.38	40.01	0.06	0.13
Xianyang	18391	Non-east, Middle	36.25	38.96	0.42	0.07
Weinan	5411	Non-east, Low	36.16	39.83	0.05	0.06
Yan'an	10092	Non-east, Low	36.47	40.21	0.03	0.06
Yulin	5932	Non-east, Low	36.01	40.99	0.12	0.06
Lan'Zhou	22470	Non-east, Middle	36.60	39.09	0.14	0.13
Jiayuguan	25206	Non-east, Middle	38.51	40.05	0.31	0.44
Jinchang	31236	Non-east, Middle	36.19	40.31	0.12	0.28
Baiyin	17406	Non-east, Middle	36.26	38.96	0.13	0.22
Tianshui	6311	Non-east, Low	35.16	38.21	0.10	0.11
Wuwei	7307	Non-east, Low	34.78	37.24	0.10	0.14
Zhangye	8654	Non-east, Low	35.62	37.02	0.05	0.17
Pingliang	7591	Non-east, Low	36.20	38.99	0.11	0.08
Xining	11160	Non-east, Low	37.04	38.95	0.05	0.08
Yinchuan	13956	Non-east, Low	36.32	39.50	0.10	0.12
Shizuishan	15503	Non-east, Low	36.39	40.43	0.16	0.31

Notes: This table displays the complete list of cities used in the quantitative model. The second column shows GDP per capita in 2005. The third column shows the city's category according to its location and GDP per capita. We divide cities into three levels of development by their GDP per capita. The fourth and fifth columns show productivity in 2005 and 2010, as calculated in the quantitative model. The sixth and the seventh columns show the land tightness in 2005 and 2010, as calculated in the quantitative model.

B.2 Computational Method of Solving the Model

Given the exogenous variables and parameters, we need to calculate the responses of endogenous variables resulting from model policy changes. As mentioned, we select the equilibrium that is the closest to the one observed in the real world. Thus, the initial values of the variables are set equal to the data in 2005 and 2010. Since we have a within-city land market between residential and production uses, we adopt a double-loop variation of the method in Fang and Huang (2022).

We first specify the exogenous variables and the model equation system. The exogenous variables are $\{H_i^s, \epsilon_j^s, \tau_{ij}^s, L_j, \phi_j, \eta_j\}$ where i indexes Hukou city, j indexes destination city, and s indexes skill. The equation system consists of three blocks: 1). Migration Block: worker income and gravity equations; 2). Production Block: production, wage, and floor space price equations; 3). Housing Block: construction equations and market clearing equations.

To calculate the counterfactuals following policy changes, we start with the block where the changes happen and then iterate block by block to update the endogenous variables until all endogenous variables converge within certain small thresholds. We present the process of calculating a counterfactual following an increase in land supply as an example below.

Suppose a land reallocation policy is $\hat{L_j} = \Delta_j \times L_j$ for every city j. We have the following process of updating variables $\{\hat{x_{jk}}\}^{OI}$, which indicates the OI^{th} iteration of variable x. Start with the housing block to initiate the process (there is no need to update $\{\hat{S_j}\}^*$ again):

Outer Loop: In the outer loop, we update the floor space distribution between residential and production uses according to the inner loop equilibrium unit prices of residential and production floor space. The outer loop converges when the prices satisfy the equilibrium price equation between both markets.

Step 1: Initiation (ensuring non-zero floor space supply)

$$\{\hat{S_{ju}}\}^* = \phi_j \hat{L_j} \tag{2}$$

$$\{\hat{S_{ju}^R}\}^1 = S_{ju}^R \times (\{\hat{S_{ju}}\}^* / S_{ju}) \tag{3}$$

$$\{\hat{S_{ju}^M}\}^1 = S_{ju}^M \times (\{\hat{S_{ju}}\}^* / S_{ju}) \tag{4}$$

Step 2: **Inner Loop** (feedback prices to Outer Loop, x^{1*} means Inner Loop for x converges)

$$\{\hat{Q_{ju}}\}^{\mathbf{1}^*} = \frac{1-\beta}{\beta} \frac{\{w_{ju}^l H_{ju}^l + w_{ju}^h H_{ju}^h\}^{\mathbf{1}^*}}{\{\hat{S_{ju}^R}\}^1} \tag{5}$$

$$\{\hat{q}_{ju}\}^{\mathbf{1}^*} = (1-\alpha)\left(\frac{\alpha}{\{\hat{W_{ju}}\}^{\mathbf{1}^*}}\right)^{\frac{\alpha}{1-\alpha}} \tag{6}$$

Step 3: Compare floor space prices and generate excess demand for residential space. The core idea is that if $\{\hat{Q_{ju}}\}^{\mathbf{1}^*} > \frac{\{\hat{q_{ju}}\}^{\mathbf{1}^*}}{\eta_j}$, residential floor space is smaller than equilibrium and production floor space is larger than equilibrium, so we need to redistribute more residential floor space to production floor space, until $\{\hat{Q_{ju}}\}^{\mathbf{1}^*} = \frac{\{\hat{q_{ju}}\}^{\mathbf{1}^*}}{\eta_j}$. We update partially with step size γ.

$$\{ED_j^R\}^1 = \gamma \left(\frac{\{\hat{Q_{ju}}\}^{\mathbf{1}^*} - \frac{\{\hat{q_{ju}}\}^{\mathbf{1}^*}}{\eta_j}}{\{\hat{Q_{ju}}\}^{\mathbf{1}^*} + \frac{\{\hat{q_{ju}}\}^{\mathbf{1}^*}}{\eta_j}} \right) \times \{\hat{S_{ju}^R}\}^1 \tag{7}$$

Step 4: Update floor space

$$\{\hat{S_{ju}^R}\}^2 = \{\hat{S_{ju}^R}\}^1 + \{ED_j^R\}^1 \tag{8}$$

$$\{\hat{S_{ju}^M}\}^2 = \{\hat{S_{ju}^M}\}^1 - \{ED_j^R\}^1 \tag{9}$$

Finally, we repeat Step 2 to Step 4 until the market clearing condition holds: $\{\hat{Q_{ju}}\}^{**} = \frac{\{\hat{q_{ju}}\}^{**}}{\eta_j}$.

Inner Loop: In the inner loop, we update the migration and production decisions given the residential and production floor space. This Inner Loop is almost identical to Fang and Huang (2022)'s method. Notation: for variable x^{OI}, O denotes the step in the Outer Loop, and I denotes the step in the Inner Loop. Here, we demonstrate with $O = 1$.

Step 2-1: Update the housing block

$$\{\hat{Q_{ju}}\}^{11} = \frac{1-\beta}{\beta} \frac{w_{ju}^l H_{ju}^l + w_{ju}^h H_{ju}^h}{\{\hat{S_{ju}^R}\}^1} \tag{10}$$

$$\{\hat{Q_{jr}}\}^{11} = \tau \{\hat{Q_{ju}}\}^{11} \tag{11}$$

$$\{S_{jr}^R\}^{11} = \frac{1-\beta}{\beta} \frac{w_{jr} H_{jr}}{\{\hat{Q_{jr}}\}^{11}} \tag{12}$$

Step 2-2: Update the migration block

$$\{\hat{v_{in,jk}^s}\}^{11} = w_{jk}^s + \frac{\{\hat{Q_{in}}\}^{11}\{\hat{S_{in}^R}\}^{11}}{H_{in}^R} \quad \text{from eq.(4)} \tag{13}$$

$$\{\hat{\pi_{in,jk}^s}\}^{11} = \frac{(\tau_{in,jk}^s \{\hat{Q_{jk}}\}^{11^{1-\beta}})^{-\epsilon} (\{\hat{v_{in,jk}^s}\}^{11})^{\epsilon}}{\sum_{j'k'=11}^{JK} (\tau_{in,jk}^s \{\hat{Q_{j'k'}}\}^{11^{1-\beta}})^{-\epsilon} (\{\hat{v_{in,j'k'}^s}\}^{11})^{\epsilon}} \text{ from eq.(6)} \tag{14}$$

Then, combining $\{\hat{\pi_{in,jk}^s}\}^{11}$ with $\{H_{in}^s\}$, we are able to calculate $\{\hat{H_{jk}^s}\}^{11}$.

Step 2-3: Update the production block

$$\{\hat{X_{ju}}\}^{11} = [(\{A_{ju}^h\}^{11}\{\hat{H_{ju}^h}\}^{11})^{\frac{\sigma-1}{\sigma}} + (\{A_{ju}^l\}^{11}\{\hat{H_{ju}^l}\}^{11})^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}} \text{ from eq.(7)} \tag{15}$$

$$\{\hat{w^l_{ju}}\}^{11} = \alpha(\{\hat{X_{ju}}\}^{11})^{\alpha-1}(\{\hat{S^M_{ju}}\}^{1})^{1-\alpha}(\{A^l_{ju}\}^{11})^{\frac{\sigma-1}{\sigma}}(\{\hat{X_{ju}}\}^{11})^{\frac{1}{\sigma}}(\{\hat{H^l_{ju}}\}^{11})^{-\frac{1}{\sigma}} \text{ from eq.(8)} \tag{16}$$

$$\{\hat{w^h_{ju}}\}^{11} = \alpha(\{\hat{X_{ju}}\}^{11})^{\alpha-1}(\{\hat{S^M_{ju}}\}^{1})^{1-\alpha}(\{A^h_{ju}\}^{11})^{\frac{\sigma-1}{\sigma}}(\{\hat{X_{ju}}\}^{11})^{\frac{1}{\sigma}}(\{\hat{H^h_{ju}}\}^{11})^{-\frac{1}{\sigma}} \text{ from eq.(9)} \tag{17}$$

Step 2-4: Update prices

$$\{\hat{Q_{ju}}\}^{12} = \frac{1-\beta}{\beta}\frac{\{w^l_{ju}H^l_{ju} + w^h_{ju}H^h_{ju}\}^{11}}{\{\hat{S^R_{ju}}\}^{1}} \tag{18}$$

We repeat Step 2-1 to Step 2-4 until residential floor space prices $\{\hat{Q_{ju}}\}^{1t}$ converge to $\{\hat{Q_{ju}}\}^{1*}$. We then output $\{\hat{Q_{ju}}\}^{1*}$ and $\{\hat{q}_{ju}\}^{1*}$ for the use in outer loop.

$$\{\hat{Q_{ju}}\}^{1*} = \frac{1-\beta}{\beta}\frac{\{w^l_{ju}H^l_{ju} + w^h_{ju}H^h_{ju}\}^{1*}}{\{\hat{S^R_{ju}}\}^{1}} \tag{19}$$

$$\{\hat{W_{ju}}\}^{11} = \frac{\{\hat{w^h_{ju}}\}^{11}\{\hat{H^h_{ju}}\}^{11} + \{\hat{w^l_{ju}}\}^{11}\{\hat{H^l_{ju}}\}^{11}}{\{\hat{X_{ju}}\}^{11}} \tag{20}$$

$$\{\hat{q}_{ju}\}^{1*} = (1-\alpha)\left(\frac{\alpha}{\{\hat{W_{ju}}\}^{1*}}\right)^{\frac{\alpha}{1-\alpha}} \tag{21}$$

Optimal Policy: To find the optimal policy, we first need to repeat the **Outer Loop** with modification in Step 3 to enforce $\eta_j = 1$ for any j and then add an additional Step 5 for updating the land distribution according to the price gap. The procedure of solving **Optimal Policy** is:

Step 1 to Step 4 from the **Outer Loop** with Step 3 modified as $\eta_j = 1$ for any j.

Step 5: Update land distribution according to the updated prices $\{\hat{Q_{ju}}\}^{\mathbf{1^*}}$.

$$\hat{L_j}^{\mathbf{1^*}} = \hat{L_j} \times (1 + \gamma_o \times \frac{\{\hat{Q_{ju}}\}^{\mathbf{1^*}} - \overline{\{\hat{Q_{ju}}\}^{\mathbf{1^*}}}}{\overline{\{\hat{Q_{ju}}\}^{\mathbf{1^*}}}}) \tag{22}$$

$$\{\hat{L_j}\}^{\mathbf{1^*}} = \frac{\hat{L_j}^{\mathbf{1^*}}}{\sum \hat{L_j}^{\mathbf{1^*}}} \times \sum L_j \tag{23}$$

where γ_o is the tuning parameter for the spread of updating and $\overline{\{\hat{Q_{ju}}\}^{\mathbf{1^*}}}$ is the national average floor space price. The updating of construction land distribution in equation (22) is to distribute more construction land quota to the prefecture with a higher price. We then scale to satisfy the equation's total land constraint (23).

Finally, we repeat Step 1 to Step 5 until all prices are equal: $\{Q_{ju}\}^{**} = \overline{\{Q_{ju}\}^{**}}$.

B.3 Estimating the Agglomeration Parameters

Estimating the agglomeration parameters is not an easy task. A simple but naive way to identify these parameters is to log-linearize the agglomeration equation (12) and run a regression:

$$log(A^s_{ju}) = \gamma log(D_{ju}) + log(a^s_{ju})$$

However, the above regression suffers from a severe endogeneity issue. Fundamental productivity a^s_{ju} is absolutely correlated with D_{ju} since locations with higher fundamental productivity will naturally attract more workers. Usually, people choose instruments such as long population lags or soil fertility to estimate this regression (Ciccone and Hall, 1996; Rosenthal and Strange, 2008; Combes et al., 2010). Nevertheless, due to data limitations, there has been almost no successful attempt to estimate the prefecture-level agglomeration effect in China.

Fortunately, we can pin down the parameter with indirect inference. The basic idea is to find the parameter value that can reproduce the observed effect of the inland-favoring land policy within the model. We first execute a prefecture-level DID regression to obtain the real-world impact of the inland-favoring policy, which has been done in our empirical part. Next, we simulate the model to examine prefecture-level productivity if we eliminate the land supply policy. By employing these simulated data, we conduct the same regression and match the simulated regression coefficients with their corresponding ones in the empirical regression.

Measured Productivity We need a consistent comparison between productivity in the model and the empirical analysis. This requires us to calculate measured productivity in the model for two reasons. First, the labor productivities A^s_{ju} are inconsistent with the productivity used in our empirical analysis. Our measurements of productivity in the empirical analysis follow Olley and Pakes (1992), Levinsohn and Petrin (2003), and Ackerberg, Caves, and Frazer (2015), which do not consider land as one of the production inputs. Second, data on land input costs at the firm level is not available, nor are the fundamental skill-augmented labor productivities A^h_{ju} and A^l_{ju} distinguishable in the data. Thus, we calculate measured productivity in the model as output net of measured labor inputs:

$$ln(\widetilde{Prod}_{ju}) = ln\left(\frac{Y_{ju}}{(H^h_{ju} + H^l_{ju})^{\alpha}}\right) \tag{24}$$

With the measured productivity for each prefecture, we can estimate the production fundamentals (a^h_{ju} and a^l_{ju}) and the agglomeration elasticity (γ) jointly.

Method We now delve into the details in three steps. In the first step, we run a traditional DID regression for productivity using equation (5) to get $\hat{\delta}_1^*$.

In the second step, we construct a counterfactual 2005 equilibrium by guessing the agglomeration parameter γ^0 (and correspondingly, $a_j^{s,0}$) and derive simulated productivity. Given all the variables and parameters we have derived, we can solve for the 2005 equilibrium, except γ and a_j^s. For an initial guess of γ^0, we simulate the counterfactual case with no inland-favoring policy. We get this counterfactual equilibrium using the algorithm described in Appendix B.2 with the counterfactual labor productivity $A_j^{s,0}$. Then, given the counterfactual labor productivity $A_j^{s,0}$, we calculate the counterfactual measured productivity $\widetilde{Prod}_{ju}^0$ using equation (24).

In the third step, we run the same regression (5) using the simulated data from both the original equilibrium and the counterfactual equilibrium as $ln(\widetilde{Prod}_{ju}^0) = \alpha + \delta_1 Post2003 \times East_j + \phi_j + \gamma_t + \epsilon_{jut}$, where $Post2003 = 1$ indicates the original equilibrium and $Post2003 = 0$ indicates the counterfactual equilibrium without the inland-favoring land policy. This yields the estimate of $\hat{\delta}_1^0$. Finally, we calculate the absolute distance between $\hat{\delta}_1^0$ and the real-world estimate $\hat{\delta}_1^*$. We then repeat this process, say n times, until we find the γ^* that minimizes this distance between the simulated regression coefficient $\hat{\delta}_1^n$ and the real regression coefficient $\hat{\delta}_1^*$.

Results Table B5 shows the empirical prefecture-level regression estimate from data. We use two methods to measure firm productivity (OP and LP) and then calculate the average firm productivity in each prefecture, weighted by total firm employment. The 2003 inland-favoring policy led to a 5-7% decrease in eastern prefecture average productivity relative to the inland. This yields an estimate of $\hat{\delta}_1^*$ between -0.075 and -0.05. Figure B1 shows the relationship between the value of the agglomeration parameter γ and the regression estimate of $\hat{\delta}_1$ from the simulated data. We find a monotonic negative relationship: the stronger the agglomeration effect is, the larger the loss generated by the inland-favoring land policy in the model. Matching $\hat{\delta}_1^* \in [-0.075, -0.05]$ gives us a range of estimates $\gamma \in [0.13, 0.21]$.

Data Estimation of $\hat{\delta}_1$	(1) OP	(2) LP
Post2003×East	-0.0749***	-0.0516*
	(0.0241)	(0.0268)
Trend Variables	Y	Y
Year FE	Y	Y
Prefecture FE	Y	Y
Observations	1,788	1,788
R-squared	0.7537	0.6351

Table B5: Empirical DID Results

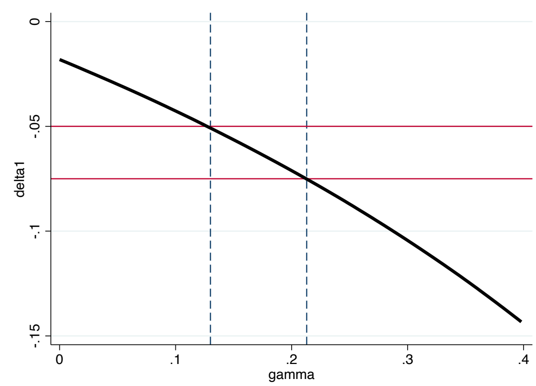


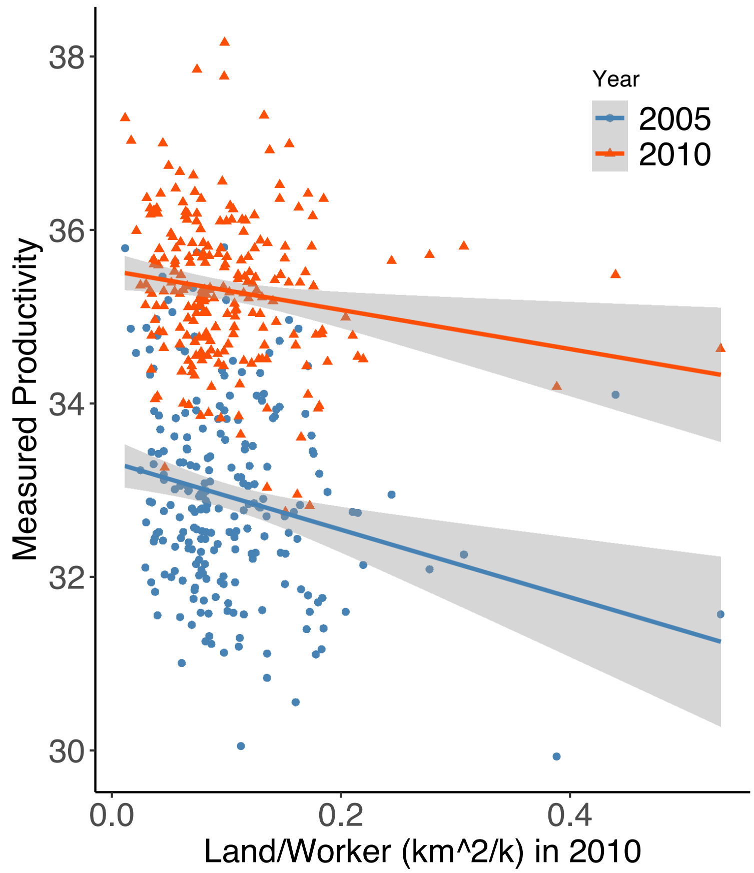
Figure B1: Relationship between γ and $\hat{\delta}_1$

Notes: In Table B5, the dependent variable is the prefecture average firm-level productivity measured by the OP and LP methods. The trend variables include province linear time trends, prefecture-level GDP per capita linear time trends, and prefecture-level industry share linear time trends. The standard errors are clustered at the prefecture level. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$. The regression results also hold from a firm-level regression; see Fang et al. (2024). Figure B1 plots how γ affects the estimation of $\hat{\delta}_1$ from the model simulated data. The regression result uses the data simulated by the model from both the original equilibrium and the counterfactual equilibrium from estimating $ln(\widetilde{Prod}_j^0) = \alpha + \delta_1 Post2003 \times East_j + \phi_j + \gamma_t + \epsilon_{jt}$, where $Post2003 = 1$ indicates the original equilibrium and $Post2003 = 0$ indicates the counterfactual equilibrium without the inland-favoring land policy. This yields an estimated coefficient $\hat{\delta}_1$ for a choice of the agglomeration elasticity γ. The range of the estimation in Table B5 $\hat{\delta}_1^* \in [-0.075, -0.05]$ (the red solid horizontal lines) gives us a range of estimates $\gamma \in [0.13, 0.21]$ (the blue dotted vertical lines).

B.4 Correlation between Productivity and Land Tightness

Figure B2 plots the correlation between productivity and land tightness in the model at the prefecture level, including the extreme values omitted in the main paper. We find a strong negative correlation between productivity and land tightness with the extreme values included.

Figure B2: Correlation between Productivity and Land Tightness By Individual Prefecture (Including Extreme Values)



Notes: This figure plots the correlation between productivity and land abundance in the model at the prefecture level, including the extreme values omitted in the main paper.

B.5 Additional Results of the Equilibrium Analysis

In this section, we show additional results of the quantitative analysis of the spatial distribution of economic development, income, and welfare that is left out of the main context.

Economic Development Table B6 shows the spatial distributions of total output, urban output, rural output, and urban population in 2005. Table B7 shows the spatial distributions of urban and rural workers by skill and floor space price in 2005. Table B8 and B9 show the above contents in 2010. Across these four tables, we have two observations consistent with our findings in the main context of the paper. First, more developed eastern cities have much higher output, especially urban output. Second, these cities are much more populated with higher floor space prices. These results supplement our main findings on the spatial misallocation created by the place-based land policy.

Table B6: 2005 Spatial Distribution of Economic Development Part I

Regions (loc., dev.)	No. of Cities	Total Output	Urban Output	Rural Output	Urban Pop.
		Units are Chinese Yuan and Person			
National	225	7.28E+12	5.07E+12	2.21E+12	2.38E+08
(east, high)	21	2.37E+12	2.22E+12	1.52E+11	7.56E+07
(east, mid)	51	1.95E+12	1.38E+12	5.67E+11	6.97E+07
(east, low)	25	4.62E+11	2.51E+11	2.11E+11	1.76E+07
(inland, high)	2	6.01E+10	2.67E+10	3.34E+10	1.33E+06
(inland, mid)	50	1.13E+12	6.55E+11	4.72E+11	3.68E+07
(inland, low)	76	1.31E+12	5.38E+11	7.70E+11	3.70E+07

Notes: This table displays a summary of economic development variables by city group (weighted by population) in 2005. Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

Table B7: 2005 Spatial Distribution of Economic Development Part II

Regions (loc., dev.)	No. of Cities	Urban Pop. High-skill	Urban Pop. Low-skill	Rural Pop. High-skill	Rural Pop. Low-skill	Floor Space Price
National	225	4.24E+07	1.96E+08	5.82E+05	2.20E+08	6.28E+01
(east, high)	21	1.42E+07	6.14E+07	6.31E+04	8.84E+06	1.24E+02
(east, mid)	51	1.07E+07	5.90E+07	1.34E+05	5.33E+07	4.81E+01
(east, low)	25	2.53E+06	1.51E+07	8.74E+04	2.40E+07	4.39E+01
(inland, high)	2	2.56E+05	1.07E+06	6.21E+03	1.96E+06	5.22E+01
(inland, mid)	50	8.05E+06	2.87E+07	1.25E+05	4.66E+07	4.71E+01
(inland, low)	76	6.70E+06	3.03E+07	1.67E+05	8.50E+07	3.83E+01

Notes: This table displays a summary of economic development variables by group (weighted by population) in 2005. Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

Table B8: 2010 Spatial Distribution of Economic Development Part I

Regions (loc., dev.)	No. of Cities	Total Output	Urban Output	Rural Output	Urban Pop.
		Units are Chinese Yuan and Person			
National	225	1.65E+13	1.28E+13	3.62E+12	3.40E+08
(east, high)	21	5.36E+12	5.12E+12	2.46E+11	1.08E+08
(east, mid)	51	4.50E+12	3.41E+12	1.09E+12	9.53E+07
(east, low)	25	6.43E+11	4.13E+11	2.30E+11	1.55E+07
(inland, high)	2	8.26E+10	5.87E+10	2.39E+10	1.59E+06
(inland, mid)	50	2.99E+12	2.21E+12	7.81E+11	6.52E+07
(inland, low)	76	2.88E+12	1.63E+12	1.25E+12	5.52E+07

Notes: This table displays a summary of economic development variables by city group (weighted by population) in 2010. Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, as in 5.

Table B9: 2010 Spatial Distribution of Economic Development Part II

Regions (loc., dev.)	No. of Cities	Urban Pop. High-skill	Urban Pop. Low-skill	Rural Pop. High-skill	Rural Pop. Low-skill	Floor Space Price
National	225	6.20E+07	2.78E+08	1.45E+06	1.83E+08	1.15E+02
(east, high)	21	1.97E+07	8.80E+07	1.31E+05	8.02E+06	1.76E+02
(east, mid)	51	1.62E+07	7.91E+07	4.44E+05	5.26E+07	9.64E+01
(east, low)	25	2.29E+06	1.32E+07	1.01E+05	1.36E+07	7.35E+01
(inland, high)	2	3.60E+05	1.23E+06	9.26E+03	9.23E+05	1.03E+02
(inland, mid)	50	1.42E+07	5.10E+07	3.46E+05	3.91E+07	1.08E+02
(inland, low)	76	9.28E+06	4.59E+07	4.18E+05	6.86E+07	7.84E+01

Notes: This table displays a summary of economic development variables by group (weighted by population) in 2010. Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

Income Table B10 shows the spatial distribution of total income, wage income, and non-wage income for Hukou workers in 2005 and 2010. Workers in more developed cities earn higher incomes (higher wages for all workers and higher non-wage incomes for Hukou workers). It supplements our main findings on the spatial misallocation created by the place-based land policy.

Table B10: Spatial Distribution of Hukou-based Income

Regions	No. of	Total Income		Wage Income		Non-Wage Income	
(loc., dev.)	Cities	2005	2010	2005	2010	2005	2010
National	225	1.90E+04	3.70E+04	1.46E+04	2.85E+04	4.35E+03	8.49E+03
(east, high)	21	3.74E+04	7.03E+04	2.47E+04	4.12E+04	1.27E+04	2.92E+04
(east, mid)	51	1.94E+04	3.72E+04	1.51E+04	2.89E+04	4.30E+03	8.26E+03
(east, low)	25	1.47E+04	2.93E+04	1.18E+04	2.43E+04	2.86E+03	5.06E+03
(inland, high)	2	2.26E+04	4.02E+04	1.74E+04	3.04E+04	5.21E+03	9.73E+03
(inland, mid)	50	1.71E+04	3.50E+04	1.37E+04	2.76E+04	3.45E+03	7.35E+03
(inland, low)	76	1.47E+04	3.05E+04	1.22E+04	2.61E+04	2.55E+03	4.45E+03

Notes: This table displays a summary of income variables by group (weighted by population) in 2005 and 2010. Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

C Supplements to the Counterfactual Analysis

C.1 Constructing the Counterfactual Policy

Table C1 and C2 provide additional summary statistics of the counterfactual land allocation policy when we redistribute the land supply according to equation (18). In general, if we maintain the pre-2003 land policy instead of adopting the inland-favoring policy, we would distribute more urban land to more developed cities and increase their land per worker, compared with the data. This increases the land tightness in more developed cities.

Table C1: Removing the Inland-favoring Policy: Spatial Distribution of Land Tightness

Regions (loc., dev.)	No. of Cities	Reality 2005	Reality 2010	Counterfactual $\widehat{2005}$	Counterfactual $\widehat{2010}$
National	225	0.093	0.083	0.092	0.082
(east, high)	21	0.077	0.068	0.082	0.090
(east, mid)	51	0.084	0.082	0.083	0.071
(east, low)	25	0.080	0.108	0.084	0.106
(inland, high)	2	0.127	0.130	0.127	0.107
(inland, mid)	50	0.140	0.101	0.126	0.079
(inland, low)	76	0.104	0.086	0.103	0.080

Notes: This table displays a summary of urban land supply relative to workers by city group (weighted by urban population) as well as the counterfactual migration-based land supply in 2005 and 2010 (unit: km^2/k). Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

Table C2: Removing the Inland-favoring Policy: Changes in Total Land Supply

Regions (loc., dev.)	No. of Cities	Changes 2005	Changes 2010
National	225	0%	0%
(east, high)	21	13%	51%
(east, mid)	51	-2%	-16%
(east, low)	25	4%	-5%
(inland, high)	2	0%	-18%
(inland, mid)	50	-12%	-27%
(inland, low)	76	-2%	-11%

Notes: This table displays changes in counterfactual total urban land supply by group (summations within the group) in 2005 and 2010. Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

C.2 A Sophisticated Rule of Regional Transfer

Without loss of generality, we design a direct regional transfer rule instead of the place-based land allocation policy. We need first to figure out who gains and who loses from removing the inland-favoring land policy and then design a direct regional transfer rule to reduce the income gap between workers from developed and underdeveloped regions.

Who Gains and Who Losses We first discuss workers in four subgroups without considering cross-city migration. Firstly, developed regions experience direct gains. Urban workers in developed cities benefit from higher local wages, lower local housing prices, and increased land income. Rural workers in developed cities benefit from higher wages and lower housing prices in the nearby urban sector. Secondly, underdeveloped regions face direct losses. Urban workers in underdeveloped cities suffer from lower local wages, higher local housing prices, and decreased land income. Rural workers in underdeveloped cities suffer from two components: lower wages and higher housing prices in the nearby urban sector.

We then discuss workers in four subgroups, taking into account cross-city migration. All workers in underdeveloped cities enjoy more indirect gains from higher wages and lower housing prices in developed cities, especially rural workers in underdeveloped cities. Meanwhile, rural workers in developed cities also experience indirect gains, although they may not be as significant as those for workers in underdeveloped cities. Urban workers in developed cities have minimal indirect gains. Lastly, the government directly benefits from higher production floor space returns.

The Regional Transfer Rule Based on the above qualitative analysis, we could design a regional transfer rule to replace the place-based land policy. The rule does not targeting on optimal policy design but demonstrates that there could be a better policy design. The rule could directly aim at transferring the direct gains. First, define the national gains in land income as follows:

$$\Delta\Pi_L^R = \sum_i \left(\hat{Q}_{iu}\hat{S}_{iu}^R - Q_{iu}S_{iu}^R\right) \tag{25}$$

$$\Delta\Pi_L^M = \sum_i \left(\hat{q}_{iu}\hat{S}_{iu}^M - q_{iu}S_{iu}^M\right) \tag{26}$$

where $\hat{Q}_{iu}\hat{S}_{iu}^R$ and $\hat{q}_{iu}\hat{S}_{iu}^M$ are regional land income in the counterfactual and $Q_{iu}S_{iu}^R$ and $q_{iu}S_{iu}^M$ are regional land income in the original equilibrium. The regional transfers $\{\widehat{DT_{iu}}, \widehat{DT_{ir}}\}$ must satisfy the following balance of budgets:

$$\sum_i \left(\widehat{DT_{iu}} + \widehat{DT_{ir}}\right) = \Delta\Pi_L^R + \Delta\Pi_L^M \tag{27}$$

We assume the following rule for each city i:

$$\widehat{DT_{iu}} = \underbrace{-\left(\hat{Q}_{iu}\hat{S}^R_{iu} - Q_{iu}S^R_{iu}\right)}_{\text{restore urban land income}} + \underbrace{\left.\frac{\frac{\hat{Q}_{iu}-Q_{iu}}{Q_{iu}}Q_{iu}S^R_{iu}}{\sum_i \frac{|\hat{Q}_{iu}-Q_{iu}|}{Q_{iu}}Q_{iu}S^R_{iu}} \times \gamma^1_u \times \Delta\Pi^R_L\right|_{\hat{Q}_{iu}-Q_{iu}>0}}_{\text{adjust for housing price }\uparrow} + \underbrace{\left.\frac{\frac{\hat{Q}_{iu}-Q_{iu}}{Q_{iu}}Q_{iu}S^R_{iu}}{\sum_i \frac{|\hat{Q}_{iu}-Q_{iu}|}{Q_{iu}}Q_{iu}S^R_{iu}} \times \gamma^2_u \times \Delta\Pi^R_L\right|_{\hat{Q}_{iu}-Q_{iu}<0}}_{\text{adjust for housing price }\downarrow} \tag{28}$$

$$\widehat{DT_{ir}} = \underbrace{\frac{\Delta\Pi^M_L H_{ir}}{\sum_i H_{ir}}}_{\text{urban-rural transfer}} + \underbrace{\left.\frac{\frac{\hat{Q}_{ir}-Q_{ir}}{Q_{ir}}Q_{ir}S^R_{ir}}{\sum_i \frac{|\hat{Q}_{ir}-Q_{ir}|}{Q_{ir}}Q_{ir}S^R_{ir}} \times \gamma^1_r \times \Delta\Pi^R_L\right|_{\hat{Q}_{ir}-Q_{ir}>0}}_{\text{adjust for housing price }\uparrow} + \underbrace{\left.\frac{\frac{\hat{Q}_{ir}-Q_{ir}}{Q_{ir}}Q_{ir}S^R_{ir}}{\sum_i \frac{|\hat{Q}_{ir}-Q_{ir}|}{Q_{ir}}Q_{ir}S^R_{ir}} \times \gamma^2_r \times \Delta\Pi^R_L\right|_{\hat{Q}_{ir}-Q_{ir}<0}}_{\text{adjust for housing price }\downarrow} \tag{29}$$

where $\{\gamma^1_u, \gamma^2_u, \gamma^1_r, \gamma^2_r\}$ are tunning parameters for housing price transfer adjustments. The weights reflect the importance of the local housing market in the country in terms of housing prices. To satisfy the balanced budget condition (27), the following equation $\gamma^1_u + \gamma^1_r = \gamma^2_u + \gamma^2_r + 2$ must hold. The first part of $\widehat{DT_{iu}}$ is to restore gains and losses in direct land income, and the second and third parts adjust for gains and losses in floor space prices. The first part of $\widehat{DT_{ir}}$ is to redistribute additional urban production land income to rural households, and the second and third parts adjust for gains and losses in floor space prices.

This counterfactual is feasible to implement and still fulfills the central government's goal of balancing regional development. This mechanism mimics a "land quota market" policy recommended by previous literature such as Lu and Xiang (2016). The basic idea is that the central government can balance the development of different regions by transferring revenues from developed cities to underdeveloped cities rather than allocating the land supply directly. Since land and wage incomes in land-gaining cities are higher than in land-losing cities, and the total land supply is unchanged, this redistribution is feasible, and the central government generates an additional financial surplus.

Turning the Redistribution Parameters Since the distribution of gains is mainly between housing price drops in developed urban regions and housing price increases in underdeveloped rural regions because it is more costly to move to nearby urban regions. We could mainly focus on γ^1_r and γ^2_u. Currently, we choose $\gamma^1_r = 20$ and $\gamma^2_u = 18$ to satisfy significant redistribution. We choose $\gamma^1_u = 0.2$ and $\gamma^2_r = 0.2$ to make non-zero adjustments in the other directions.

C.3 A Simple Rule of Regional Transfer

We could also design a very simple direct regional transfer rule without considering the changes from the new equilibrium to the original equilibrium. There are certainly more efficient regional transfer rules. The simple rule is as follows for each city i:

$$\widehat{DT_{iu}} = \underbrace{\hat{Q}_{iu}\hat{S}_{iu}^{R} \times \gamma_u^l \times \frac{-\Delta L_i}{L_i}}_{\text{urban land income transfer}} + \underbrace{(\hat{w}_{iu}^l H_{iu}^l + \hat{w}_{iu}^h H_{iu}^h) \times \gamma_u^w \times \frac{-\Delta L_j}{L_j}}_{\text{urban wage income transfer}}$$

$$\widehat{DT}_{ir} = \underbrace{(\hat{w}_{ir} H_{ir}) \times \gamma_r \times \frac{-\Delta L_j}{L_j}}_{\text{rural wage income transfer}}$$

where $\widehat{DT}_{iu}$ stands for direct transfer to urban workers and $\widehat{DT}_{ir}$ stands for direct transfer to rural workers. For a city losing $\frac{\Delta L_i}{L_i}$ (<0) of its land, urban workers will be compensated with a fraction γ_u^l of their floor space income $\hat{Q}_{iu}\hat{S}_{iu}^R$, and a fraction γ_u^w of their wage income $(\hat{w}_{iu}^l H_{iu}^l + \hat{w}_{iu}^h H_{iu}^h)$. Since rural workers also face losses in their wage for losing access to their closest urban sector (the urban sector in their own city), they will be compensated with a fraction γ_r of their indirect wage income $\hat{w}_{ir} H_{ir}$. These direct transfers are feasible to implement because land-gaining cities ($\frac{\Delta L_i}{L_i} > 0$) have much higher floor space prices and wages.

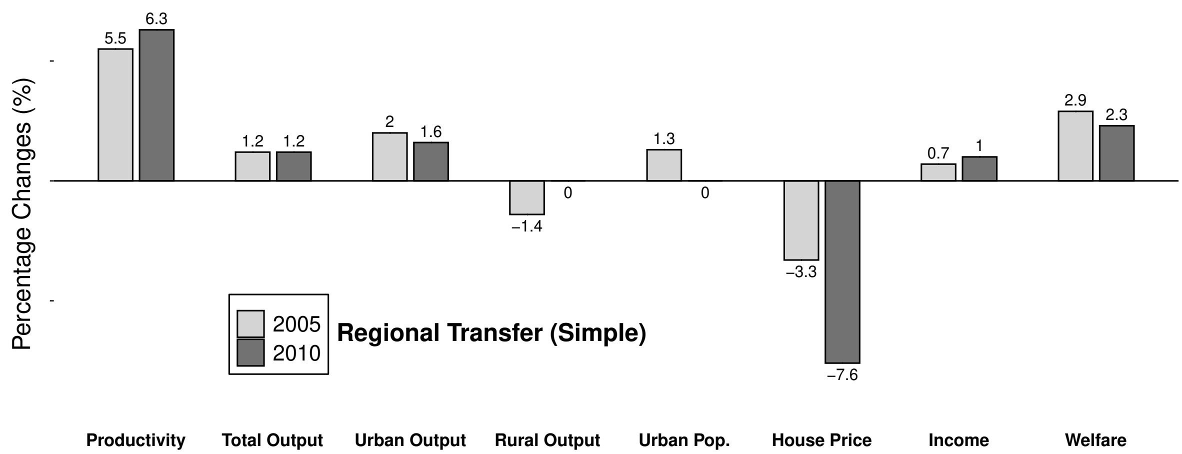
The transfer scale depends on the tuning parameters $\{\gamma_u^l, \gamma_u^w, \gamma_r\}$. As we mentioned, we cannot discuss the design of optimal redistribution policy in this paper. We show the results from one set of tuning parameters $\{\gamma_u^l, \gamma_u^w, \gamma_r\} = \{0.5, 0.1, 0.5\}$ for 2010 and $\{\gamma_u^l, \gamma_u^w, \gamma_r\} = \{0.75, 0.1, 0.5\}$ for 2005 which are sufficient to generate substantial redistribution and clarify the key mechanisms of the transfer results. We tested other sets of parameters, and the results were similar.

One thing to note is that the simple rule does not utilize the additional income from the more productive production land, and the government keeps the surplus.

C.4 Aggregate Effects with the Simple Rule of Regional Transfer

We show the aggregate effects of replacing the inland-favoring land policy with the simple rule of regional transfer on national productivity, urban output, rural output, urban population, and national average income and welfare. The results are plotted in Figure C1. Removing the place-based land policy significantly increased productivity, urban output, income, and welfare in 2005 and 2010. It also helps to increase the urban population due to lower residential floor space prices in more developed cities. Rural output falls due to worker emigration.

Figure C1: Aggregate Effects with the Simple Rule of Regional Transfer



Notes: This figure shows the aggregate effects of replacing the inland-favoring policy with the regional transfer on the Chinese economy in 2005 and 2010. We find substantial national gains in TFP, total output, urban output, urban population, income, and welfare.

One thing to note is that the simple rule does not utilize the additional income from the more productive production land, and the government keeps the surplus. Therefore, the aggregate incomes in both years are much lower than the sophisticated rule of regional transfer.

C.5 Aggregate Effects Decomposition

Construction To show the decomposition of the aggregate effects into three channels, we need to construct two intermediate equilibrium counterfactuals to separate the direct, the indirect, and the agglomeration effects. The idea is to follow the transmission path sequentially: (1) the direct effect from production floor space changes, (2) the indirect effect from induced labor demand and supply changes, and (3) the agglomeration effect from induced population density changes.

Suppose the initial equilibrium is a collection of variables X_{ini} and the final counterfactual equilibrium with the policy change is a collection of variables X_{fin}. We must construct two equilibrium collections of variables X_{de} and X_{die}.

In the direct effect equilibrium X_{de}, we would only consider how the policy change affects each prefecture's production floor space. We start with the production land supply equation (13) and then end with the production function (7). We assume workers do not move during the process, agglomeration effects do not change, and residential floor space and corresponding prices are unchanged. As a result, measured productivity, urban output, income, and welfare would change, but other variables would remain the same as in X_{ini}.

We would only shut down the agglomeration effects in the direct and indirect effects equilibrium X_{die}. The idea is that we allow the counterfactual policy change to move workers across prefectures and regions. Still, we assume the agglomeration component $(D_{ju})^{\gamma}$ in equation (12) to be the same as X_{ini}. Alternatively, we solve the counterfactual policy change with the agglomeration elasticity $\gamma = 0$ to generate the equilibrium X_{die}.

Finally, we could calculate the percentage changes of specific variable $x \in X$ in the direct, indirect, and agglomeration effects following the chain rule:

$$\underbrace{\frac{x_{fin} - x_{ini}}{x_{ini}}}_{total} = \underbrace{\frac{x_{de} - x_{ini}}{x_{ini}}}_{direct} + \underbrace{\frac{x_{die} - x_{de}}{x_{ini}}}_{indirect} + \underbrace{\frac{x_{fin} - x_{die}}{x_{ini}}}_{agglomeration} \tag{30}$$

Table C3: Aggregate Effects Decomposition

Decomp.	Δ Productivity		Δ Total Output		Δ Urban Output		Δ Rural Output		Δ Urban Pop.		Δ House Price		Δ Income		Δ Welfare	
	$\widehat{2005}$	$\widehat{2010}$	$\widehat{2005}$	$\widehat{2010}$	$\widehat{2005}$	$\widehat{2010}$	$\widehat{2005}$	$\widehat{2010}$	$\widehat{2005}$	$\widehat{2010}$	$\widehat{2005}$	$\widehat{2010}$	$\widehat{2005}$	$\widehat{2010}$	$\widehat{2005}$	$\widehat{2010}$
(a) Without Transfer																
Total	5.9%	8.1%	1.5%	1.8%	3.0%	3.1%	-1.4%	-1.9%	1.3%	1.5%	-3.0%	-6.2%	1.5%	1.7%	3.8%	4.1%
Direct	0.3%	-0.8%	0.2%	-0.6%	0.3%	-0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	-0.4%	0.2%	-0.4%
Indirect	3.2%	5.8%	0.7%	1.2%	1.6%	3.2%	-1.4%	-1.7%	1.3%	1.2%	-3.8%	-7.3%	0.7%	1.3%	3.2%	3.9%
Agglomeration	2.4%	3.1%	0.5%	1.2%	1.0%	0.8%	0.0%	-0.3%	0.0%	0.3%	0.8%	1.1%	0.6%	0.8%	0.4%	0.6%
(b) Regional Transfer																
Total	5.1%	6.8%	1.2%	1.2%	2.0%	1.6%	-0.9%	-0.3%	0.4%	0.3%	-3.8%	-7.4%	3.2%	3.3%	4.8%	2.9%
Direct	0.3%	-0.8%	0.2%	-0.6%	0.3%	-0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	-0.3%	0.3%	-0.3%
Indirect	2.9%	5.3%	0.5%	1.2%	1.1%	2.4%	-0.9%	-0.6%	0.4%	0.3%	-4.4%	-8.0%	1.8%	1.7%	3.9%	2.1%
Agglomeration	1.9%	2.3%	0.5%	0.6%	0.6%	0.0%	0.0%	0.3%	0.0%	0.0%	0.6%	0.6%	1.1%	1.9%	0.6%	1.1%
(c) Regional Transfer (Simple Rule)																
Total	5.5%	6.3%	1.4%	0.6%	2.6%	1.6%	-1.4%	0.0%	1.3%	0.0%	-3.3%	-7.6%	0.7%	1.0%	2.9%	2.3%
Direct	0.3%	-0.8%	0.2%	-0.6%	0.3%	-0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	-0.3%	0.3%	-0.3%
Indirect	3.0%	4.9%	0.6%	1.2%	1.4%	3.2%	-0.9%	-1.7%	0.8%	1.2%	-4.1%	-7.3%	0.0%	1.2%	2.1%	2.1%
Agglomeration	2.2%	2.2%	0.5%	0.0%	0.8%	-0.8%	-0.5%	1.7%	0.4%	-1.2%	0.8%	-0.3%	0.4%	0.1%	0.5%	0.5%

Notes: This table summarizes the decomposition of the aggregate effects into three components in 2005 and 2010. All numbers are relative changes from the observed data to the counterfactual results without the inland-favoring policy. The three channels are (1) the direct effect from production floor space changes, (2) the indirect effect from induced labor demand and supply changes, and (3) the agglomeration effect from induced population density changes. All three channels of the inland-favoring land policy lead to spatial misallocation of production and labor towards less productive regions and cause national productivity to stay relatively low.

C.6 Spatial Effects on Measured Productivity

Table C4, C5, and C6 below provide additional summary statistics of the spatial effects on measured productivity when the inland-favoring land policy was removed. The effects on measured productivity are similar whether there are regional transfers.

The decomposition further reveals that most of the national productivity gains are driven by increased fundamental productivity. The reform encourages more workers to migrate to developed regions with higher productivity, raising the weighted national productivity. The influx of migrant workers also amplifies the agglomeration effect on local productivity in developed regions. The changes in productivity are uneven across regions. In 2005, productivity in eastern cities with high productivity increased, while there was almost no change in productivity in other cities. In 2010, although we observed a larger productivity increase in developed cities, there was also a significant productivity decrease in underdeveloped cities due to land losses. For instance, productivity in inland cities with medium and low productivity declines, respectively. This result demonstrates that although national productivity and output would be higher with the pre-2003 land allocation policy, regional productivity gaps would also increase.

Table C4: Spatial Effects on Measured Productivity (Without Transfer)

		Measured Productivity									
Regions (loc., dev.)	No. of Cities	2005 Total	LSP	SP	Fund	Agg	2010 Total	LSP	SP	Fund	Agg
National	225	5.9%	0.9%	-0.8%	4.5%	1.2%	8.1%	0.5%	-0.6%	5.4%	2.6%
(east, high)	21	7.4%	2.9%	-3.0%	4.7%	2.7%	14.9%	4.8%	-2.6%	5.1%	7.2%
(east, mid)	51	-0.3%	-0.3%	0.1%	0.1%	-0.1%	-2.3%	-2.1%	0.4%	0.6%	-1.2%
(east, low)	25	-0.6%	0.4%	0.1%	-0.6%	-0.5%	-2.7%	-0.9%	-0.1%	-0.2%	-1.5%
(inland, high)	2	-0.1%	-0.2%	0.0%	0.1%	0.0%	-2.6%	-2.4%	0.0%	0.2%	-0.4%
(inland, mid)	50	-0.7%	-1.0%	0.0%	1.2%	-0.9%	-7.8%	-3.6%	-0.2%	-1.3%	-2.8%
(inland, low)	76	-0.4%	-0.3%	0.1%	0.3%	-0.6%	-4.9%	-2.1%	0.2%	-0.7%	-2.5%

Notes: This table displays a summary of the spatial effects on measured productivity $ln(\widetilde{Prod}_{ju})$ in the model by group (weighted by population) in 2005 and 2010, as well as the decomposition of measured productivity. *LSP* stands for land scale premium, *SP* stands for skill premium, *Fund* stands for fundamental, and *Agg* stands for agglomeration. Land tightness is measured by km^2/thousand workers. Regions are classified by the location of the prefecture (east or inland) and the level of development (GDP per capita) in 2005, as in the data. For the level of development, we divide all cities into three categories {high, mid, and low} to capture {10%, 45%, 45%} of the distribution of GDP per capita. Each region has the same cities in 2005 and 2010 for consistent comparisons.

Table C5: Spatial Effects on Measured Productivity (Regional Transfer)

		Measured Productivity									
Regions	No. of			2005					2010		
(loc., dev.)	Cities	Total	LSP	SP	Fund	Agg	Total	LSP	SP	Fund	Agg
National	225	5.1%	0.8%	-0.7%	4.2%	0.8%	6.8%	0.4%	-0.6%	4.9%	1.9%
(east, high)	21	6.7%	2.9%	-2.7%	4.3%	2.2%	13.6%	4.7%	-2.5%	4.8%	6.2%
(east, mid)	51	-0.6%	-0.3%	0.1%	0.0%	-0.4%	-2.7%	-2.1%	0.3%	0.6%	-1.6%
(east, low)	25	-1.3%	0.3%	0.2%	-0.4%	-1.3%	-3.2%	-0.9%	-0.1%	-0.4%	-1.8%
(inland, high)	2	-0.2%	-0.2%	0.0%	0.0%	0.0%	-3.0%	-2.4%	0.0%	-0.1%	-0.5%
(inland, mid)	50	-1.2%	-1.0%	0.0%	1.0%	-1.1%	-8.3%	-3.6%	-0.3%	-1.4%	-3.3%
(inland, low)	76	-0.7%	-0.3%	0.1%	0.2%	-0.8%	-5.2%	-2.1%	0.2%	-1.0%	-2.4%

Notes: This table displays a summary of the spatial effects on measured productivity $ln(\widetilde{Prod}_{ju})$ in the model by group (weighted by population) in 2005 and 2010, as well as the decomposition of measured productivity. *LSP* stands for land scale premium, *SP* stands for skill premium, *Fund* stands for fundamental, and *Agg* stands for agglomeration. Land tightness is measured by km^2/thousand workers. Regions are classified by the location of the prefecture (east or inland) and the level of development (GDP per capita) in 2005, as in the data. For the level of development, we divide all cities into three categories {high, mid, and low} to capture {10%, 45%, 45%} of the distribution of GDP per capita. Each region has the same cities in 2005 and 2010 for consistent comparisons.

Table C6: Spatial Effects on Measured Productivity (Regional Transfer with Simple Rule)

		Measured Productivity									
Regions	No. of			2005					2010		
(loc., dev.)	Cities	Total	LSP	SP	Fund	Agg	Total	LSP	SP	Fund	Agg
National	225	5.5%	0.8%	-0.7%	4.3%	1.0%	6.3%	0.4%	-0.5%	4.6%	1.7%
(east, high)	21	7.1%	2.9%	-2.8%	4.5%	2.5%	12.9%	4.7%	-2.2%	4.2%	5.8%
(east, mid)	51	-0.4%	-0.3%	0.1%	0.1%	-0.3%	-2.7%	-2.1%	0.4%	0.7%	-1.7%
(east, low)	25	-0.8%	0.3%	0.1%	-0.4%	-0.8%	-2.9%	-0.9%	-0.1%	-0.3%	-1.6%
(inland, high)	2	-0.2%	-0.2%	0.0%	0.0%	0.0%	-2.9%	-2.4%	0.0%	0.0%	-0.5%
(inland, mid)	50	-1.0%	-1.1%	-0.1%	1.0%	-0.9%	-8.4%	-3.6%	-0.3%	-1.4%	-3.4%
(inland, low)	76	-0.4%	-0.3%	0.1%	0.3%	-0.6%	-5.2%	-2.1%	0.2%	-1.0%	-2.4%

Notes: This table displays a summary of the spatial effects on measured productivity $ln(\widetilde{Prod}_{ju})$ in the model by group (weighted by population) in 2005 and 2010, as well as the decomposition of measured productivity. *LSP* stands for land scale premium, *SP* stands for skill premium, *Fund* stands for fundamental, and *Agg* stands for agglomeration. Land tightness is measured by km^2/thousand workers. Regions are classified by the location of the prefecture (east or inland) and the level of development (GDP per capita) in 2005, as in the data. For the level of development, we divide all cities into three categories {high, mid, and low} to capture {10%, 45%, 45%} of the distribution of GDP per capita. Each region has the same cities in 2005 and 2010 for consistent comparisons.

C.7 Spatial Effects on Migration

Table C7: Spatial Effects on Migration in 2005 (Without Transfer)

Regions (loc., dev.)	No. of Cities	Urban Pop. High-skill	Urban Pop. Low-skill	Rural Pop. High-skill	Rural Pop. Low-skill
National	225	0.0%	1.5%	-1.2%	-1.8%
(east, high)	21	1.4%	8.1%	-0.2%	-0.2%
(east, mid)	51	-0.9%	-0.7%	-1.4%	-0.8%
(east, low)	25	-0.5%	-0.7%	-2.3%	-1.3%
(inland, high)	2	-0.1%	0.1%	-0.2%	0.1%
(inland, mid)	50	-1.6%	-2.1%	-1.3%	-1.9%
(inland, low)	76	-1.1%	-2.0%	-0.7%	-2.1%

Notes: This table displays a summary of economic development variables by city group (weighted by population) in 2005. Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

Table C8: Spatial Effects on Migration in 2010 (Without Transfer)

Regions (loc., dev.)	No. of Cities	Urban Pop. High-skill	Urban Pop. Low-skill	Rural Pop. High-skill	Rural Pop. Low-skill
National	225	0.0%	1.8%	-1.4%	-2.2%
(east, high)	21	8.6%	14.8%	5.1%	2.7%
(east, mid)	51	-2.5%	-3.0%	-1.8%	-0.8%
(east, low)	25	-3.8%	-3.0%	-0.8%	-2.2%
(inland, high)	2	-1.0%	-1.0%	3.5%	1.9%
(inland, mid)	50	-6.3%	-7.6%	-2.3%	-3.1%
(inland, low)	76	-3.2%	-5.2%	-2.6%	-3.8%

Notes: This table displays a summary of economic development variables by city group (weighted by population) in 2005. Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

Table C9: Spatial Effects on Migration in 2005 (Regional Transfer)

Regions (loc., dev.)	No. of Cities	Urban Pop. High-skill	Urban Pop. Low-skill	Rural Pop. High-skill	Rural Pop. Low-skill
National	225	0.0%	0.5%	-3.7%	-0.9%
(east, high)	21	2.1%	6.5%	-5.9%	-1.1%
(east, mid)	51	-0.9%	-1.4%	-8.6%	-0.2%
(east, low)	25	-1.4%	-2.0%	-3.6%	-0.4%
(inland, high)	2	-0.2%	-0.1%	-0.2%	0.0%
(inland, mid)	50	-1.8%	-2.4%	-1.0%	-0.6%
(inland, low)	76	-1.8%	-2.3%	-1.0%	-0.9%

Notes: This table displays a summary of economic development variables by city group (weighted by population) in 2005. Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

Table C10: Spatial Effects on Migration in 2010 (Regional Transfer)

Regions (loc., dev.)	No. of Cities	Urban Pop. High-skill	Urban Pop. Low-skill	Rural Pop. High-skill	Rural Pop. Low-skill
National	225	-0.2%	0.4%	3.3%	-0.5%
(east, high)	21	8.6%	12.6%	2.6%	1.3%
(east, mid)	51	-2.5%	-4.0%	3.9%	1.0%
(east, low)	25	-4.2%	-3.0%	4.6%	-0.7%
(inland, high)	2	-1.4%	-1.3%	6.4%	1.9%
(inland, mid)	50	-7.0%	-8.4%	2.8%	-0.5%
(inland, low)	76	-3.3%	-5.4%	2.9%	-1.5%

Notes: This table displays a summary of economic development variables by city group (weighted by population) in 2005. Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

Table C11: Spatial Effects on Migration in 2005 (Regional Transfer with Simple Rule)

Regions (loc., dev.)	No. of Cities	Urban Pop. High-skill	Urban Pop. Low-skill	Rural Pop. High-skill	Rural Pop. Low-skill
National	225	0.0%	1.0%	-4.5%	-1.4%
(east, high)	21	2.1%	7.3%	-4.6%	-0.9%
(east, mid)	51	-0.9%	-1.0%	-7.1%	-0.8%
(east, low)	25	-1.1%	-1.3%	-7.4%	-1.3%
(inland, high)	2	-0.2%	0.0%	-2.0%	0.1%
(inland, mid)	50	-1.7%	-2.1%	-3.2%	-1.3%
(inland, low)	76	-1.6%	-1.7%	-2.1%	-1.6%

Notes: This table displays a summary of economic development variables by city group (weighted by population) in 2005. Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

Table C12: Spatial Effects on Migration in 2010 (Regional Transfer with Simple Rule)

Regions (loc., dev.)	No. of Cities	Urban Pop. High-skill	Urban Pop. Low-skill	Rural Pop. High-skill	Rural Pop. Low-skill
National	225	0.0%	0.0%	1.3%	0.0%
(east, high)	21	9.1%	11.6%	1.9%	0.6%
(east, mid)	51	-3.1%	-4.0%	0.6%	1.5%
(east, low)	25	-4.5%	-3.0%	0.6%	-0.7%
(inland, high)	2	-1.3%	-1.3%	3.2%	2.0%
(inland, mid)	50	-7.0%	-8.6%	1.8%	0.5%
(inland, low)	76	-3.8%	-5.4%	1.6%	-0.9%

Notes: This table displays a summary of economic development variables by city group (weighted by population) in 2005. Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

C.8 Spatial Effects on Economic Development

Table C13: Spatial Effects on Economic Development (Regional Transfer)

Regions (loc., dev.)	No. of prefectures	Δ Productivity $\widehat{2005}$	Δ Productivity $\widehat{2010}$	Δ Urban Output $\widehat{2005}$	Δ Urban Output $\widehat{2010}$	Δ Rural Output $\widehat{2005}$	Δ Rural Output $\widehat{2010}$	Δ Urban Pop. $\widehat{2005}$	Δ Urban Pop. $\widehat{2010}$	Δ House Price $\widehat{2005}$	Δ House Price $\widehat{2010}$
National	225	5.1%	6.8%	2.0%	1.6%	-0.9%	-0.3%	0.4%	0.3%	-3.8%	-7.4%
(east, high)	21	6.7%	13.6%	7.2%	15.4%	-1.3%	1.2%	5.7%	11.1%	-18.2%	-33.7%
(east, mid)	51	-0.6%	-2.7%	-1.4%	-5.3%	0.0%	0.9%	-1.3%	-3.8%	0.7%	10.9%
(east, low)	25	-1.3%	-3.2%	-1.6%	-5.1%	-0.9%	-2.2%	-1.7%	-3.2%	-4.3%	2.4%
(inland, high)	2	-0.2%	-3.0%	0.0%	-3.6%	0.0%	2.1%	-0.1%	-1.3%	1.5%	18.1%
(inland, mid)	50	-1.2%	-8.3%	-3.2%	-12.2%	-0.4%	-0.8%	-2.4%	-8.1%	1.0%	8.8%
(inland, low)	76	-0.7%	-5.2%	-2.2%	-7.4%	-0.9%	-1.6%	-2.2%	-5.1%	-4.3%	-1.9%

Notes: This table displays a summary of changes in core economic development variables by prefecture group (weighted by population) in 2005 and 2010. All numbers are relative changes from the observed data to the counterfactual results without the inland-favoring policy. For each variable, we show the changes in 2005 and 2010. Regions are classified by prefecture location (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

Table C14: Spatial Effects on Economic Development (Regional Transfer with Simple Rule)

Regions (loc., dev.)	No. of prefectures	Δ Productivity $\widehat{2005}$	Δ Productivity $\widehat{2010}$	Δ Urban Output $\widehat{2005}$	Δ Urban Output $\widehat{2010}$	Δ Rural Output $\widehat{2005}$	Δ Rural Output $\widehat{2010}$	Δ Urban Pop. $\widehat{2005}$	Δ Urban Pop. $\widehat{2010}$	Δ House Price $\widehat{2005}$	Δ House Price $\widehat{2010}$
National	225	5.5%	6.3%	3.1%	2.6%	-1.9%	-1.4%	1.5%	1.3%	-6.2%	-3.3%
(east, high)	21	7.1%	12.9%	17.8%	8.1%	3.3%	-0.7%	13.9%	6.3%	-32.4%	-17.7%
(east, mid)	51	-0.4%	-2.7%	-4.4%	-1.4%	0.0%	-0.4%	-3.0%	-1.0%	11.9%	1.1%
(east, low)	25	-0.8%	-2.9%	-4.6%	-1.2%	-3.5%	-1.4%	-3.2%	-1.1%	2.8%	-3.8%
(inland, high)	2	-0.2%	-2.9%	-3.2%	0.0%	1.7%	0.0%	-1.0%	0.0%	18.5%	1.5%
(inland, mid)	50	-1.0%	-8.4%	-11.8%	-2.7%	-2.9%	-0.8%	-7.5%	-2.2%	9.6%	1.3%
(inland, low)	76	-0.4%	-5.2%	-6.7%	-1.7%	-3.2%	-1.6%	-5.1%	-1.6%	-1.7%	-3.9%

Notes: This table displays a summary of changes in core economic development variables by prefecture group (weighted by population) in 2005 and 2010. All numbers are relative changes from the observed data to the counterfactual results without the inland-favoring policy. For each variable, we show the changes in 2005 and 2010. Regions are classified by prefecture location (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

C.9 Spatial Effects on Income and Welfare

Table C15: Spatial Effects on Income (Without Transfer)

Regions (loc., dev.)	No. of Cities	Δ Income $\widehat{2005}$	Δ Income $\widehat{2010}$	Δ Wage Income $\widehat{2005}$	Δ Wage Income $\widehat{2010}$	Δ Non-wage Income $\widehat{2005}$	Δ Non-wage Income $\widehat{2010}$
National	225	1.46%	1.74%	1.46%	1.74%	1.47%	1.76%
(east, high)	21	2.69%	7.43%	0.21%	0.60%	7.52%	17.08%
(east, mid)	51	0.28%	-0.08%	0.54%	0.82%	-0.64%	-3.22%
(east, low)	25	1.10%	1.92%	1.67%	3.21%	-1.24%	-4.28%
(inland, high)	2	0.01%	-1.61%	0.00%	-1.58%	0.03%	-1.68%
(inland, mid)	50	0.95%	-0.91%	1.71%	1.26%	-2.06%	-9.07%
(inland, low)	76	2.24%	1.92%	3.09%	3.15%	-1.80%	-5.31%

Notes: This table displays a summary of income by city group (summations within the group) in 2005 and 2010. Regions are classified by the location of the prefecture/city (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

Table C16: Spatial Effects on Income (Regional Transfer)

Regions (loc., dev.)	No. of Cities	Δ Income $\widehat{2005}$	Δ Income $\widehat{2010}$	Δ Wage Income $\widehat{2005}$	Δ Wage Income $\widehat{2010}$	Δ Non-wage Income $\widehat{2005}$	Δ Non-wage Income $\widehat{2010}$
National	225	3.18%	3.26%	1.09%	1.12%	10.20%	10.42%
(east, high)	21	-10.32%	-10.89%	0.29%	0.89%	-31.03%	-27.53%
(east, mid)	51	0.49%	5.03%	0.37%	0.15%	0.90%	22.10%
(east, low)	25	0.72%	6.49%	1.64%	2.72%	-3.10%	24.58%
(inland, high)	2	2.30%	5.63%	-0.01%	-1.77%	10.01%	28.79%
(inland, mid)	50	20.00%	6.94%	1.02%	0.36%	95.33%	31.66%
(inland, low)	76	6.49%	7.05%	2.34%	2.36%	26.27%	34.55%

Notes: This table displays a summary of income by city group (summations within the group) in 2005 and 2010. Regions are classified by the location of the prefecture/city (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

Table C17: Spatial Effects on Income (Regional Transfer with Simple Rule)

Regions (loc., dev.)	No. of Cities	Δ Income $\widehat{2005}$	Δ Income $\widehat{2010}$	Δ Wage Income $\widehat{2005}$	Δ Wage Income $\widehat{2010}$	Δ Non-wage Income $\widehat{2005}$	Δ Non-wage Income $\widehat{2010}$
National	225	0.72%	1.34%	1.30%	1.00%	-1.23%	2.46%
(east, high)	21	-6.97%	-14.48%	0.28%	0.61%	-21.13%	-35.80%
(east, mid)	51	-2.12%	1.34%	0.55%	0.11%	-11.45%	5.65%
(east, low)	25	-0.85%	5.90%	1.83%	2.75%	-11.89%	21.02%
(inland, high)	2	-1.34%	-2.30%	0.02%	-1.64%	-5.87%	-4.37%
(inland, mid)	50	11.43%	6.61%	1.29%	0.20%	51.67%	30.72%
(inland, low)	76	3.34%	6.68%	2.69%	2.23%	6.48%	32.72%

Notes: This table displays a summary of income by city group (summations within the group) in 2005 and 2010. Regions are classified by the location of the prefecture/city (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

Table C18: Spatial Effects on Welfare

Regions (loc., dev.)	No. of Cities	Without Transfer (Year 2005)				
		Welfare	(Urban, High)	(Urban, Low)	(Rural, High)	(Rural, Low)
National	225	3.8%	2.5%	1.7%	5.3%	1.0%
(east, high)	21	10.8%	7.3%	6.9%	16.0%	2.4%
(east, mid)	51	-0.2%	-0.5%	-0.6%	-0.1%	-0.5%
(east, low)	25	-1.5%	0.5%	0.8%	-2.7%	1.5%
(inland, high)	2	-0.6%	-0.3%	-0.2%	0.3%	-0.7%
(inland, mid)	50	-0.1%	-2.3%	-1.7%	0.5%	-2.2%
(inland, low)	76	2.7%	-0.1%	0.5%	3.4%	0.7%

Notes: This table displays a summary of welfare by city group (summations within the group) in 2005. Regions are classified by the location of the prefecture/city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

Table C19: Spatial Effects on Welfare

Regions (loc., dev.)	No. of Cities	Without Transfer (Year 2010)				
		Welfare	(Urban, High)	(Urban, Low)	(Rural, High)	(Rural, Low)
National	225	4.1%	3.4%	0.2%	7.2%	3.8%
(east, high)	21	14.5%	19.4%	16.7%	15.9%	14.0%
(east, mid)	51	-4.0%	-4.6%	-5.7%	-3.2%	-3.6%
(east, low)	25	1.2%	-2.6%	-2.5%	7.2%	1.3%
(inland, high)	2	-5.3%	-5.7%	-6.8%	-5.1%	-4.7%
(inland, mid)	50	-5.1%	-10.3%	-9.0%	-4.4%	-3.2%
(inland, low)	76	-3.5%	-5.1%	-3.9%	-9.6%	-0.4%

Notes: This table displays a summary of welfare by city group (summations within the group) in 2010. Regions are classified by the location of the prefecture/city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

Table C20: Spatial Effects on Welfare

Regions (loc., dev.)	No. of Cities	Regional Transfer (Year 2005)				
		Welfare	(Urban, High)	(Urban, Low)	(Rural, High)	(Rural, Low)
National	225	4.8%	-10.2%	-8.8%	6.3%	5.2%
(east, high)	21	7.7%	-18.0%	-16.2%	14.9%	0.3%
(east, mid)	51	1.2%	-4.4%	-4.3%	1.4%	3.1%
(east, low)	25	1.9%	-7.2%	-8.8%	2.0%	6.1%
(inland, high)	2	2.0%	-0.5%	-0.4%	2.0%	2.8%
(inland, mid)	50	5.8%	-4.9%	-5.5%	3.3%	23.7%
(inland, low)	76	5.0%	-7.1%	-8.3%	4.8%	8.8%

Notes: This table displays a summary of welfare by city group (summations within the group) in 2005. Regions are classified by the location of the prefecture/city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

Table C21: Spatial Effects on Welfare

Regions (loc., dev.)	No. of Cities	Regional Transfer (Year 2010)				
		Welfare	(Urban, High)	(Urban, Low)	(Rural, High)	(Rural, Low)
National	225	2.9%	-14.3%	-11.4%	5.6%	4.6%
(east, high)	21	2.5%	-25.2%	-22.9%	8.0%	3.2%
(east, mid)	51	2.1%	-7.4%	-7.4%	1.1%	6.3%
(east, low)	25	6.3%	-6.0%	-6.8%	7.6%	10.9%
(inland, high)	2	3.1%	-4.6%	-5.3%	3.3%	8.1%
(inland, mid)	50	4.2%	-8.4%	-7.7%	5.1%	9.7%
(inland, low)	76	4.0%	-7.4%	-7.0%	0.7%	8.3%

Notes: This table displays a summary of welfare by city group (summations within the group) in 2010. Regions are classified by the location of the prefecture/city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

Table C22: Spatial Effects on Welfare

Regions (loc., dev.)	No. of Cities	Regional Transfer with Simple Rule (Year 2005)				
		Welfare	(Urban, High)	(Urban, Low)	(Rural, High)	(Rural, Low)
National	225	2.9%	-8.5%	-8.9%	5.0%	0.9%
(east, high)	21	5.1%	-11.7%	-12.3%	11.8%	-3.1%
(east, mid)	51	0.6%	-7.8%	-8.9%	1.4%	1.7%
(east, low)	25	0.7%	-6.0%	-7.0%	1.4%	1.5%
(inland, high)	2	-1.3%	-7.4%	-7.9%	0.9%	0.7%
(inland, mid)	50	3.2%	-5.5%	-6.0%	2.3%	12.2%
(inland, low)	76	2.8%	-5.8%	-6.6%	3.2%	3.6%

Notes: This table displays a summary of welfare by city group (summations within the group) in 2005. Regions are classified by the location of the prefecture/city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

Table C23: Spatial Effects on Welfare

Regions (loc., dev.)	No. of Cities	Regional Transfer with Simple Rule (Year 2010)				
		Welfare	(Urban, High)	(Urban, Low)	(Rural, High)	(Rural, Low)
National	225	2.3%	-20.9%	-20.8%	7.9%	4.5%
(east, high)	21	1.0%	-28.4%	-30.9%	6.6%	2.0%
(east, mid)	51	0.3%	-18.0%	-20.0%	2.6%	8.4%
(east, low)	25	6.9%	-12.1%	-14.1%	6.7%	14.7%
(inland, high)	2	-3.6%	-16.1%	-18.7%	1.5%	4.6%
(inland, mid)	50	5.1%	-15.6%	-16.2%	6.2%	14.8%
(inland, low)	76	7.8%	-14.6%	-15.0%	13.0%	10.7%

Notes: This table displays a summary of welfare by city group (summations within the group) in 2010. Regions are classified by the location of the prefecture/city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

D Supplements to Eliminating All Land Frictions

D.1 Land Distribution Across Prefectures

Table D1: Counterfactual Total Land Supply (km^2)

Regions (loc., dev.)	No. of prefectures	Reality 2005	Reality 2010	Counterfactual $\widehat{2005}$	Counterfactual $\widehat{2010}$
National	225	22268	28336	22268	28336
(east, high)	21	5838	7272	15674	17002
(east, mid)	51	5875	7832	2648	4270
(east, low)	25	1418	1681	520	761
(inland, high)	2	169	206	115	85
(inland, mid)	50	5131	6578	2407	4565
(inland, low)	76	3837	4767	904	1655

Notes: This table displays a summary of total urban land supply data by prefecture group (summations within the group) in 2005 and 2010, as well as the counterfactual land supply in 2010 (unit: km. Regions are classified by prefecture location (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

Table D2: Spatial Distribution of Land Tightness

Regions (loc., dev.)	No. of Cities	Reality 2005	Reality 2010	Counterfactual $\widehat{2005}$	Counterfactual $\widehat{2010}$
National	225	0.093	0.083	0.090	0.082
(east, high)	21	0.077	0.068	0.137	0.114
(east, mid)	51	0.084	0.082	0.044	0.053
(east, low)	25	0.080	0.108	0.038	0.061
(inland, high)	2	0.127	0.130	0.094	0.062
(inland, mid)	50	0.140	0.101	0.078	0.074
(inland, low)	76	0.104	0.086	0.033	0.040

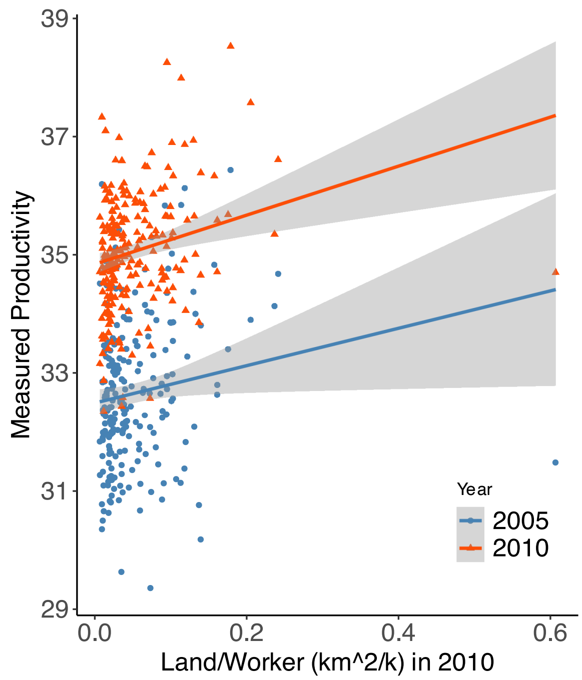
Notes: This table displays a summary of urban land supply relative to workers by city group (weighted by urban population) as well as the counterfactual migration-based land supply in 2005 and 2010 (unit: km^2/k). Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

Table D3: Changes in Total Land Supply

Regions (loc., dev.)	No. of Cities	Changes 2005	Changes 2010
National	225	0%	0%
(east, high)	21	168%	134%
(east, mid)	51	-55%	-45%
(east, low)	25	-63%	-55%
(inland, high)	2	-32%	-59%
(inland, mid)	50	-53%	-31%
(inland, low)	76	-76%	-65%

Notes: This table displays changes in counterfactual total urban land supply by group (summations within the group) in 2005 and 2010. Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

Figure D1: Correlation between Productivity and Land Tightness By Individual Prefecture (Including Extreme Values)



Notes: This figure plots the correlation between productivity and land abundance in the model at the prefecture level, including the extreme values omitted in the main paper.

D.2 Spatial Effects on Measured Productivity

Table D4: Spatial Distribution of Measured Productivity

Regions (loc., dev.)	No. of prefectures	Measured Productivity 2005 Total	LSP	SP	Fund	Agg	2010 Total	LSP	SP	Fund	Agg
National	225	34.27	2.19	0.62	31.33	0.13	36.09	2.21	0.66	33.04	0.19
(east, high)	21	35.68	2.40	0.68	32.13	0.48	37.15	2.39	0.71	33.55	0.51
(east, mid)	51	33.69	2.11	0.50	31.10	-0.01	35.57	2.12	0.60	32.75	0.10
(east, low)	25	32.29	1.93	0.52	30.01	-0.17	34.61	1.93	0.51	32.57	-0.40
(inland, high)	2	33.59	1.97	0.60	31.48	-0.45	35.04	2.00	0.77	32.66	-0.39
(inland, mid)	50	32.84	1.99	0.70	30.37	-0.22	35.32	2.11	0.71	32.41	0.09
(inland, low)	76	32.26	1.91	0.58	30.23	-0.47	34.90	1.98	0.53	32.82	-0.43

Notes: This table displays a summary of measured productivity $ln(\widetilde{Prod}_{ju})$ and land tightness in the model by group (weighted by population) in 2005 and 2010, as well as the decomposition of measured productivity. *LSP* stands for land scale premium, *SP* stands for skill premium, *Fund* stands for fundamental, and *Agg* stands for agglomeration. Land tightness is measured by km^2/thousand workers. Regions are classified by the location of the prefecture (east or inland) and the level of development (GDP per capita) in 2005, as in the data. For the level of development, we divide all prefectures into three categories {high, mid, and low} to capture {10%, 45%, 45%} of the distribution of GDP per capita. Each region has the same prefectures in 2005 and 2010 for consistent comparisons.

Table D5: Spatial Effects on Measured Productivity

Regions (loc., dev.)	No. of prefectures	Measured Productivity 2005 Total	LSP	SP	Fund	Agg	2010 Total	LSP	SP	Fund	Agg
National	225	54.7%	0.2%	2.8%	31.3%	14.5%	26.4%	-1.1%	4.0%	12.7%	9.0%
(east, high)	21	61.3%	16.4%	0.8%	5.8%	30.0%	41.0%	9.8%	3.2%	4.3%	19.3%
(east, mid)	51	-13.3%	-13.4%	0.4%	4.7%	-4.9%	-15.9%	-11.6%	2.8%	-0.9%	-6.6%
(east, low)	25	-27.8%	-18.0%	1.7%	0.7%	-14.0%	-20.1%	-12.6%	1.0%	-0.3%	-9.2%
(inland, high)	2	-8.9%	-8.7%	0.9%	4.0%	-5.0%	-17.4%	-12.9%	0.0%	0.9%	-6.0%
(inland, mid)	50	-12.0%	-11.5%	1.6%	3.3%	-5.3%	-3.0%	-5.6%	2.3%	0.5%	0.0%
(inland, low)	76	-20.8%	-16.7%	2.4%	2.1%	-9.1%	-18.4%	-15.3%	1.3%	8.3%	-12.2%

Notes: This table displays a summary of the spatial effects on measured productivity $ln(\widetilde{Prod}_{ju})$ in the model by group (weighted by population) in 2005 and 2010, as well as the decomposition of measured productivity. *LSP* stands for land scale premium, *SP* stands for skill premium, *Fund* stands for fundamental, and *Agg* stands for agglomeration. Land tightness is measured by km^2/thousand workers. Regions are classified by the location of the prefecture (east or inland) and the level of development (GDP per capita) in 2005, as in the data. For the level of development, we divide all cities into three categories {high, mid, and low} to capture {10%, 45%, 45%} of the distribution of GDP per capita. Each region has the same cities in 2005 and 2010 for consistent comparisons.

D.3 Spatial Effects on Migration

Table D6: Spatial Effects on Migration in 2005

Regions (loc., dev.)	No. of Cities	Urban Pop. High-skill	Urban Pop. Low-skill	Rural Pop. High-skill	Rural Pop. Low-skill
National	225	0.0%	5.1%	-12.6%	-4.5%
(east, high)	21	35.2%	55.7%	-0.7%	3.9%
(east, mid)	51	-14.5%	-13.4%	-9.7%	0.6%
(east, low)	25	-21.4%	-23.2%	-18.3%	-2.5%
(inland, high)	2	-4.4%	-9.4%	14.1%	3.5%
(inland, mid)	50	-17.1%	-15.7%	-22.4%	-5.2%
(inland, low)	76	-22.9%	-27.1%	-10.0%	-8.9%

Notes: This table displays a summary of economic development variables by city group (weighted by population) in 2005. Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

Table D7: Spatial Effects on Migration in 2010

Regions (loc., dev.)	No. of Cities	Urban Pop. High-skill	Urban Pop. Low-skill	Rural Pop. High-skill	Rural Pop. Low-skill
National	225	0.2%	2.2%	-12.0%	-3.3%
(east, high)	21	31.5%	39.8%	12.4%	11.0%
(east, mid)	51	-14.2%	-15.2%	-9.8%	1.9%
(east, low)	25	-21.5%	-19.7%	-14.6%	-3.7%
(inland, high)	2	-16.0%	-13.7%	-3.2%	3.5%
(inland, mid)	50	-6.3%	-5.5%	-14.1%	-4.1%
(inland, low)	76	-24.4%	-26.1%	-19.7%	-8.0%

Notes: This table displays a summary of economic development variables by city group (weighted by population) in 2005. Regions are classified by the location of the city (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

D.4 Spatial Effects on Economic Development

Table D8: Spatial Effects on Economic Development in 2005

Regions (loc., dev.)	No. of prefectures	Δ Total Output	Δ Urban Output	Δ Rural Output	Δ Urban Pop.	Δ House Price
National	225	14.3%	21.7%	-2.7%	4.2%	60.7%
(east, high)	21	78.9%	83.8%	4.6%	52.1%	-18.5%
(east, mid)	51	-15.9%	-23.9%	2.6%	-13.5%	109.6%
(east, low)	25	-20.1%	-35.1%	-2.8%	-22.7%	129.7%
(inland, high)	2	-4.2%	-13.9%	3.6%	-8.4%	93.1%
(inland, mid)	50	-15.2%	-23.2%	-3.8%	-16.3%	113.9%
(inland, low)	76	-19.8%	-36.1%	-7.7%	-26.5%	163.1%

Notes: This table displays a summary of changes in core economic development variables by prefecture group (weighted by population). All numbers are relative changes from the observed data to the counterfactual results without the inland-favoring policy. Regions are classified by prefecture location (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

Table D9: Spatial Effects on Economic Development in 2010

Regions (loc., dev.)	No. of prefectures	Δ Total Output	Δ Urban Output	Δ Rural Output	Δ Urban Pop.	Δ House Price
National	225	7.9%	10.9%	-1.9%	1.8%	47.0%
(east, high)	21	57.6%	59.6%	11.4%	38.0%	-4.3%
(east, mid)	51	-16.2%	-22.3%	2.8%	-15.0%	74.8%
(east, low)	25	-20.2%	-29.1%	-4.8%	-20.0%	129.1%
(inland, high)	2	-16.9%	-25.2%	3.3%	-14.2%	63.7%
(inland, mid)	50	-7.4%	-8.6%	-3.6%	-5.8%	56.2%
(inland, low)	76	-22.9%	-35.0%	-7.2%	-25.9%	114.8%

Notes: This table displays a summary of changes in core economic development variables by prefecture group (weighted by population). All numbers are relative changes from the observed data to the counterfactual results without the inland-favoring policy. Regions are classified by prefecture location (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

D.5 Spatial Effects on Income and Welfare

Table D10: Spatial Effects on Income

Regions (loc., dev.)	No. of Cities	Δ Income $\widehat{2005}$	Δ Income $\widehat{2010}$	Δ Wage Income $\widehat{2005}$	Δ Wage Income $\widehat{2010}$	Δ Non-wage Income $\widehat{2005}$	Δ Non-wage Income $\widehat{2010}$
National	225	13.44%	7.72%	13.40%	7.69%	13.57%	7.81%
(east, high)	21	35.90%	28.62%	14.38%	8.36%	77.89%	57.25%
(east, mid)	51	-0.55%	-1.00%	3.62%	3.18%	-15.19%	-15.64%
(east, low)	25	8.78%	5.77%	15.56%	11.06%	-19.23%	-19.60%
(inland, high)	2	-1.98%	-5.45%	-1.49%	-2.03%	-3.63%	-16.14%
(inland, mid)	50	8.47%	4.38%	14.24%	7.46%	-14.42%	-7.22%
(inland, low)	76	15.17%	6.37%	22.24%	11.20%	-18.49%	-21.96%

Notes: This table displays a summary of income by city group (summations within the group) in 2005 and 2010. Regions are classified by the location of the prefecture/city (east or inland) and the level of development (GDP per capita) in 2005, as in Table 5.

Table D11: Spatial Effects on Welfare

Regions (loc., dev.)	No. of Cities	Welfare	(Urban, High)	(Urban, Low)	(Rural, High)	(Rural, Low)
				Year 2005		
National	225	8.8%	14.2%	-6.5%	8.5%	12.8%
(east, high)	21	32.9%	67.4%	44.6%	23.0%	45.5%
(east, mid)	51	-7.4%	-20.9%	-27.1%	-3.7%	-16.6%
(east, low)	25	1.4%	-24.1%	-26.7%	10.0%	-16.4%
(inland, high)	2	-17.9%	-20.1%	-17.2%	-11.3%	-17.9%
(inland, mid)	50	-1.0%	-14.9%	-25.2%	3.4%	-14.1%
(inland, low)	76	2.3%	-25.2%	-29.7%	9.2%	-15.3%
				Year 2010		
National	225	7.5%	10.5%	-9.2%	14.3%	7.2%
(east, high)	21	17.1%	51.5%	29.0%	22.0%	14.8%
(east, mid)	51	-16.3%	-14.6%	-23.2%	-10.3%	-15.6%
(east, low)	25	-12.4%	-18.7%	-25.0%	5.2%	-12.5%
(inland, high)	2	-16.8%	-19.1%	-23.8%	-7.6%	-14.5%
(inland, mid)	50	-10.0%	-7.3%	-16.8%	5.4%	-11.5%
(inland, low)	76	-10.0%	-23.1%	-28.2%	3.5%	-12.7%

Notes: This table displays a summary of welfare by city group (summations within the group) in 2005. Regions are classified by the location of the prefecture/city (east or inland) and the level of development (GDP per capita) in 2005, consistently as in Table 5.

E Supplements to the Sensitivity Analysis

We have tested the model sensitivity in many checks. However, we intend not to dump redundant results. If particular sensitivity checks interest you, please get in touch with the authors to request them.

E.1 Parameter Sensitivity Check 1: Migration Elasticity

We show here (1) the correlation between productivity and land tightness and (2) the gains in removing the inland-favoring policy with a lower bound of migration elasticity $\epsilon = 1$.

Figure E1: Correlation between Productivity and Land Tightness ($\epsilon = 1$)

(a) By Prefecture Group (b) By Individual Prefecture

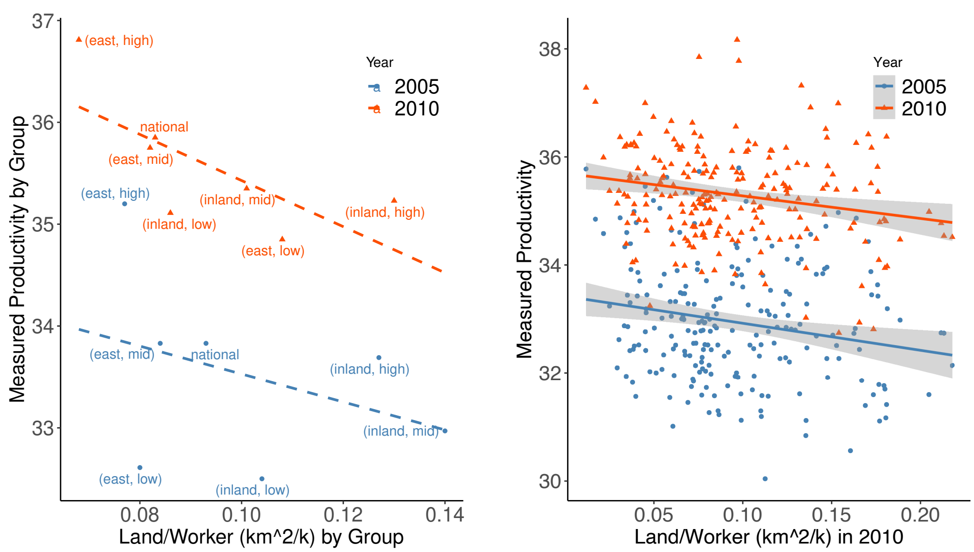
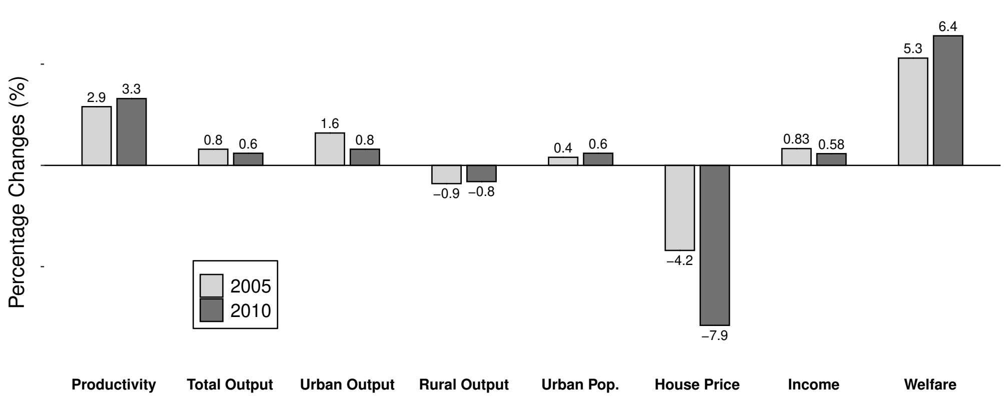


Figure E2: Aggregate Effects of Removing Inland-favoring Land Policy ($\epsilon = 1$)

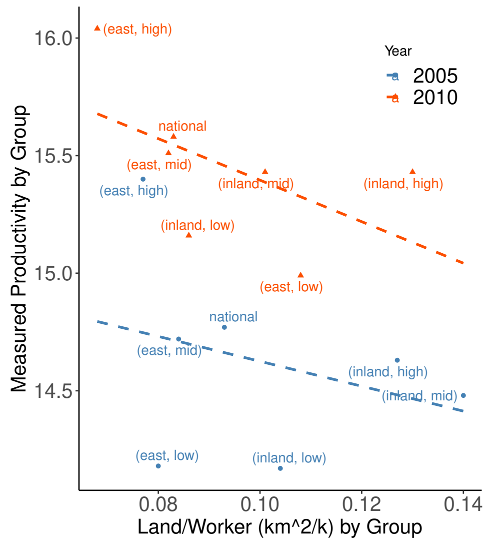


E.2 Parameter Sensitivity Check 2: Skill Substitution Elasticity

We show here (1) the correlation between productivity and land tightness and (2) the gains in removing the inland-favoring policy with an upper bound of elasticity of substitution between H/L-skills $\sigma = 4$ as suggested by Bils, Kaymak, and Wu (2022).

Figure E3: Correlation between Productivity and Land Tightness ($\sigma = 4$)

(a) By Prefecture Group



(b) By Individual Prefecture

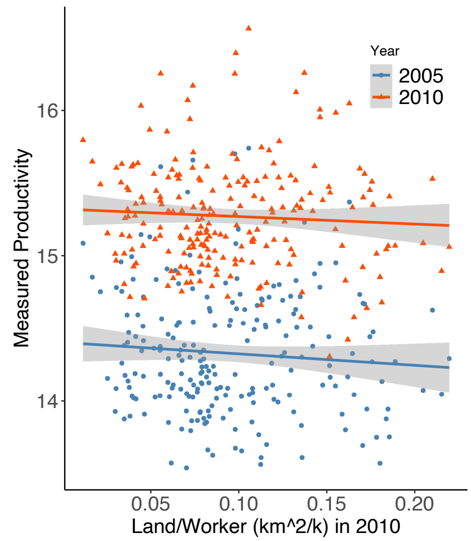
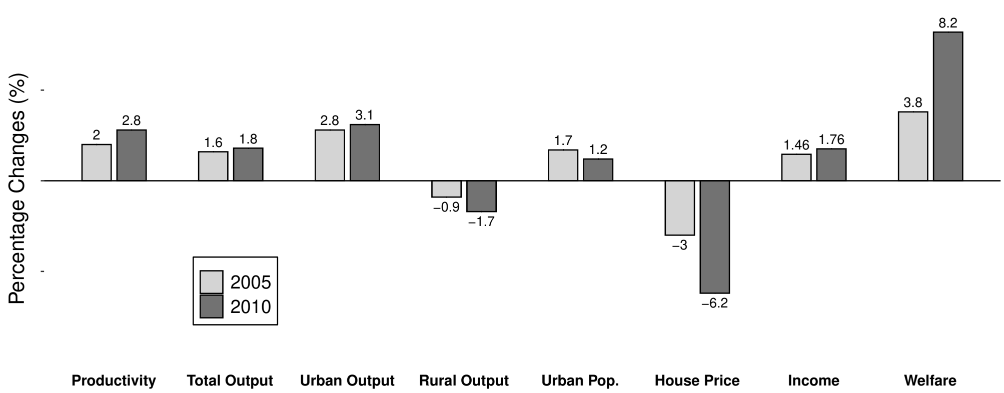


Figure E4: Aggregate Effects of Removing Inland-favoring Land Policy ($\sigma = 4$)



E.3 Parameter Sensitivity Check 3: Agglomeration Elasticity

We show here (1) the correlation between productivity and land tightness and (2) the gains in removing the inland-favoring policy with no agglomeration effect $\gamma = 0$.

Figure E5: Correlation between Productivity and Land Tightness ($\gamma = 0$)

(a) By Prefecture Group (b) By Individual Prefecture

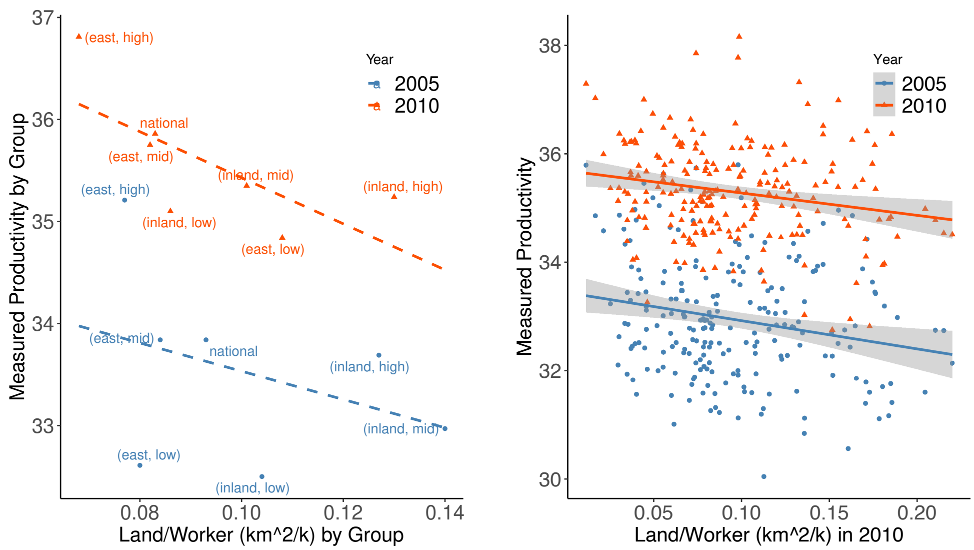
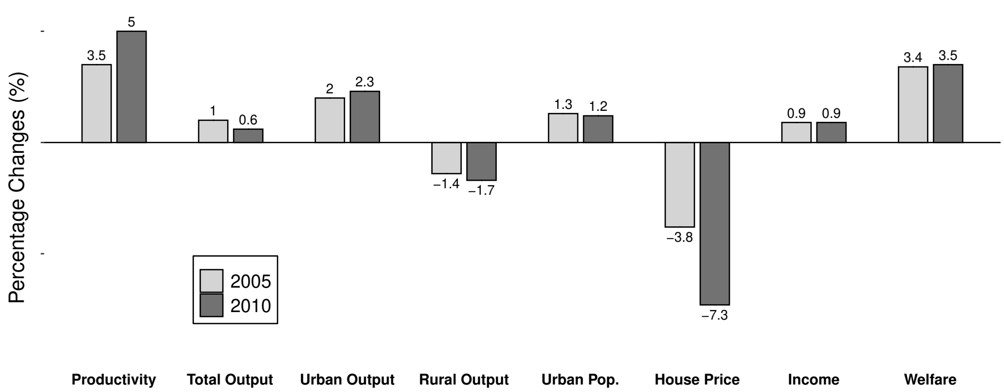


Figure E6: Aggregate Effects of Removing Inland-favoring Land Policy ($\gamma = 0$)



E.4 Data Inputs Sensitivity Check 1: Purged Wage Measures

We show here (1) the correlation between productivity and land tightness and (2) the gains in removing the inland-favoring policy with the purged wage following Fajgelbaum and Gaubert (2020) as our wage data inputs for both years.

Figure E7: Correlation between Productivity and Land Tightness (Purged Wage)

(a) By Prefecture Group (b) By Individual Prefecture

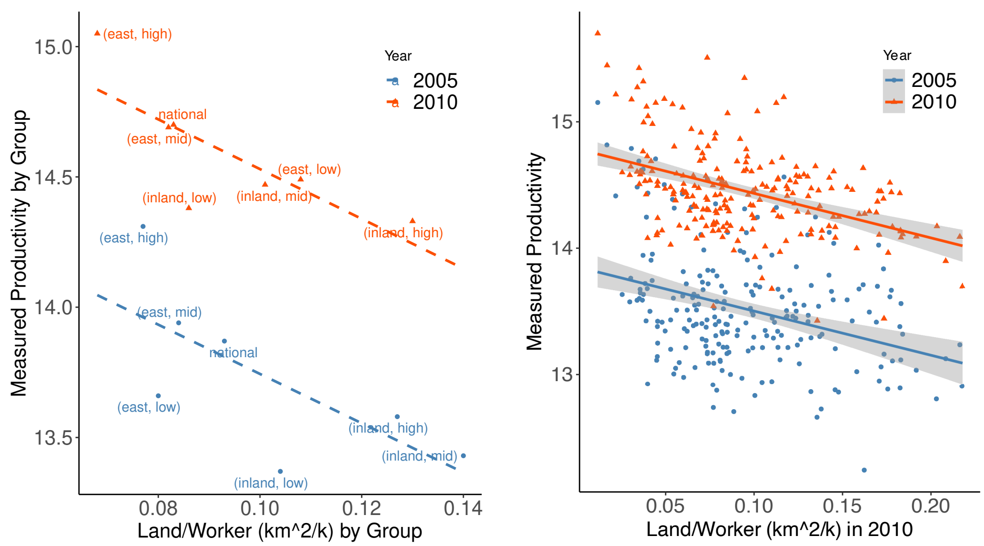
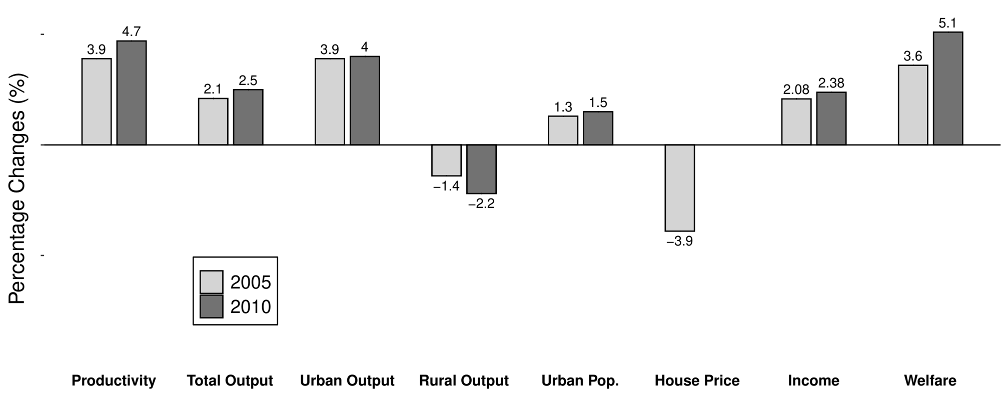


Figure E8: Aggregate Effects of Removing Inland-favoring Land Policy (Purged Wage)



E.5 Data Inputs Sensitivity Check 2: Imputed Land Quotas

We show here (1) the correlation between productivity and land tightness and (2) the gains in removing the inland-favoring policy with the prefecture-level land quotas (imputed from the province-level land quotas) as the construction land supply in the model.

The effects of removing inland-favoring land policy are huge if we use the imputed prefecture-level land quotas since these unused land quotas are now used as actual land usage in the more productive East. These findings are consistent with Figure 3.

Figure E9: Correlation between Productivity and Land Tightness (Imputed Land Quotas)

(a) By Prefecture Group (b) By Individual Prefecture

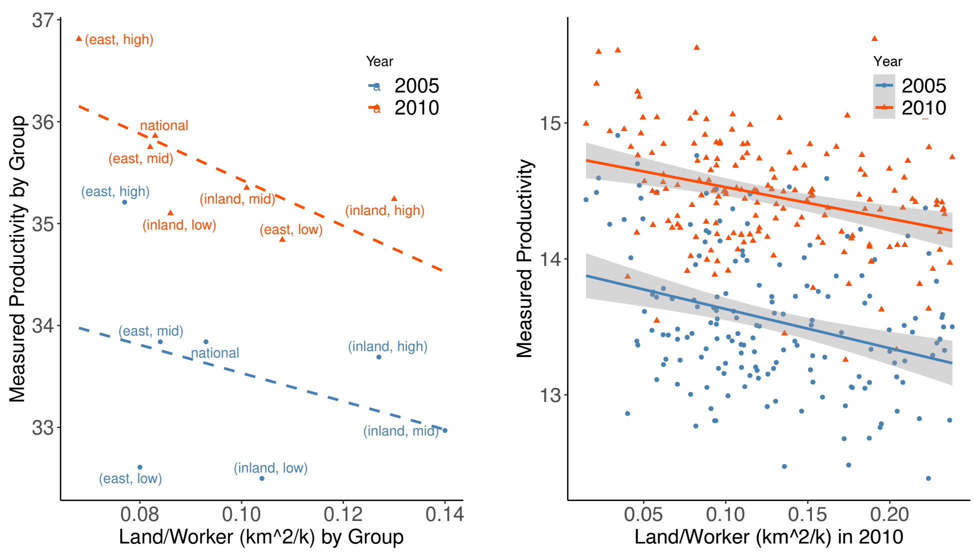
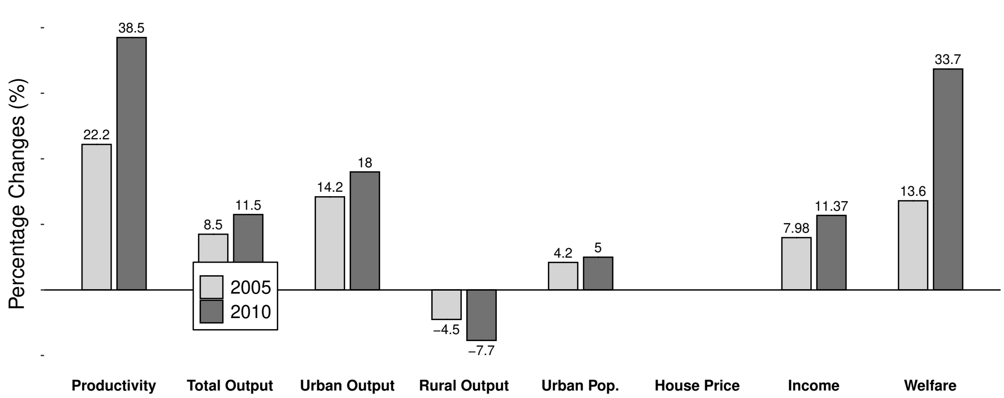


Figure E10: Aggregate Effects of Removing Inland-favoring Land Policy (Imputed Land Quotas)

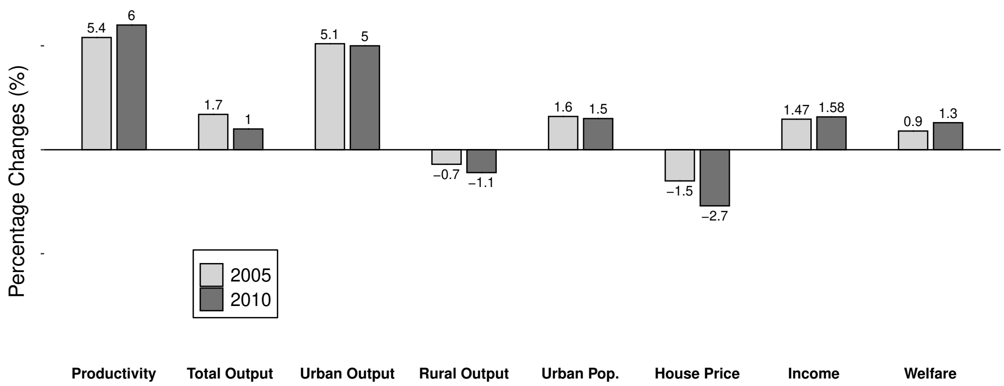


E.6 Counterfactual Sensitivity Check 1: Pre-2003 GDP Growth Trend

Here, we show the gains in removing the inland-favoring policy with the pre-2003 prefecture-level GDP growth (2003-2000) as g_{Lj} in the counterfactual land policy equation (18).

Figure E11: Aggregate Effects of Removing Inland-favoring Land Policy

(Pre-2003 GDP Growth Trend)

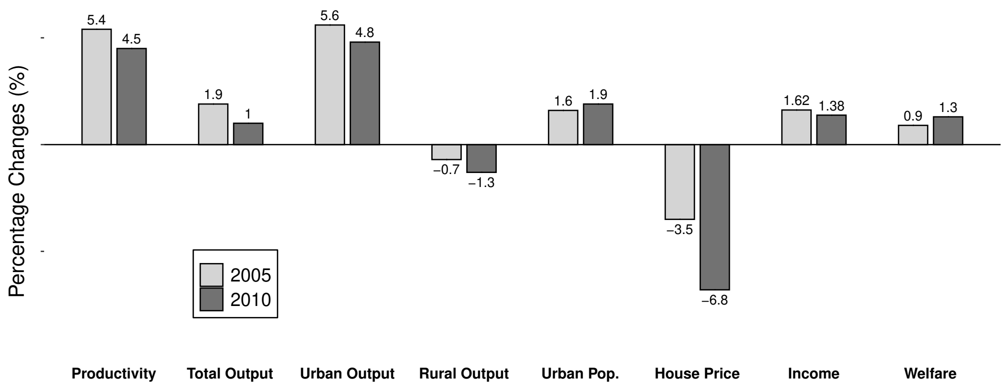


E.7 Counterfactual Sensitivity Check 2: Pre-2003 Migration Growth Trend

Here, we show the gains in removing the inland-favoring policy with pre-2003 prefecture-level migration inflow growth (2003-2000) as g_{Lj} in the counterfactual land policy equation (18).

Figure E12: Aggregate Effects of Removing Inland-favoring Land Policy

(Pre-2003 Migration Growth Trend)



E.8 Functional Sensitivity Check 1: Partially Elastic Floor Space Supply

Here, we show (1) the correlation between productivity and land tightness and (2) the gains in removing the inland-favoring policy when the construction intensity (plot ratio) is partially elastic to population density, which is

$$\phi_{ju} = \bar{\phi}_{ju} \times (D_{ju})^{\gamma_\phi} \tag{31}$$

where D_{ju} is the same urban density definition as in the agglomeration equation, and γ_ϕ is the elasticity. We try a range of γ_ϕ up to 0.10, and the effects of removing inland favoring policy get stronger with larger γ_ϕ.

Figure E13: Correlation between Productivity and Land Tightness ($\gamma_\phi = 0.10$)

(a) By Prefecture Group (b) By Individual Prefecture

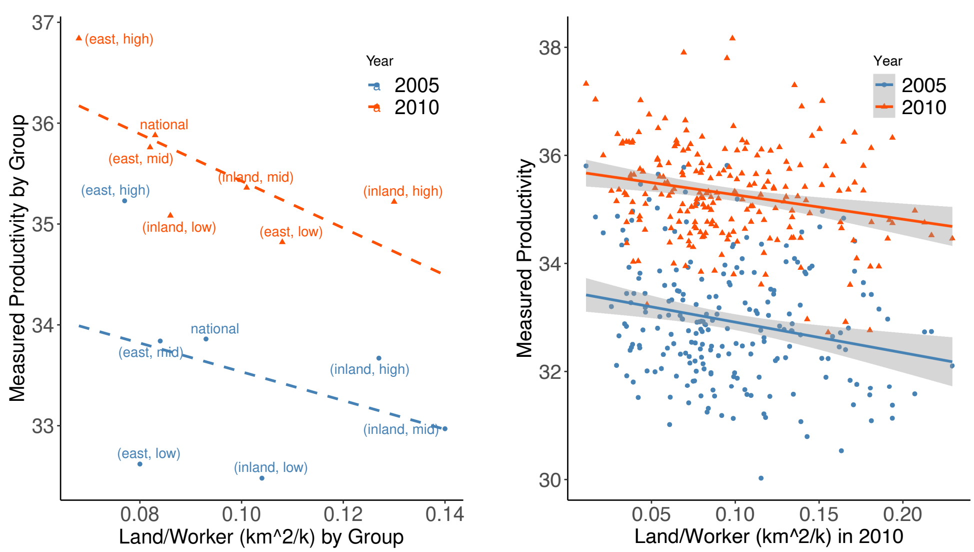
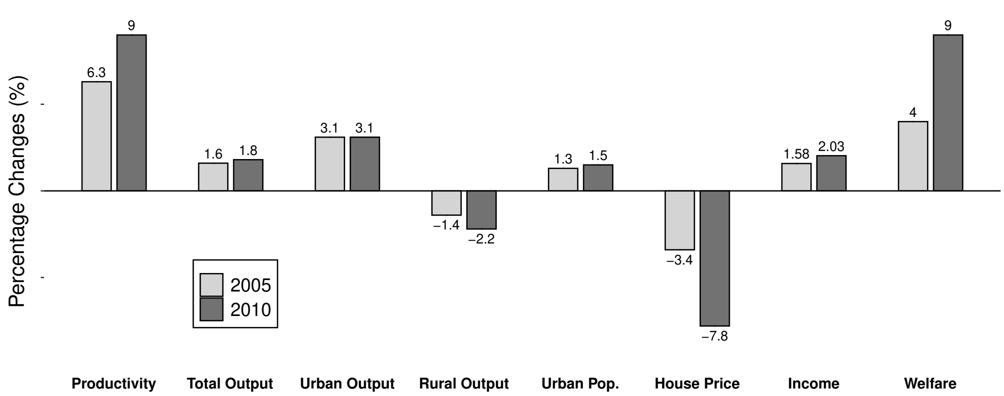


Figure E14: Aggregate Effects of Removing Inland-favoring Land Policy ($\gamma_\phi = 0.10$)



E.9 Functional Sensitivity Check 2: Additional Congestion Effects

Here, we show (1) the correlation between productivity and land tightness and (2) the gains in removing the inland-favoring policy when there are additional congestion effects in migration costs to population density, which is

$$\tau^s_{in,ju} = \bar{\tau}^s_{in,ju} \times (D_{ju})^{\gamma_\tau} \tag{32}$$

where D_{ju} is the same urban density definition as in the agglomeration equation, and γ_τ is the elasticity. We try a range of γ_τ up to 0.15 as in Allen and Donaldson (2020).

Figure E15: Correlation between Productivity and Land Tightness ($\gamma_\tau = 0.15$)

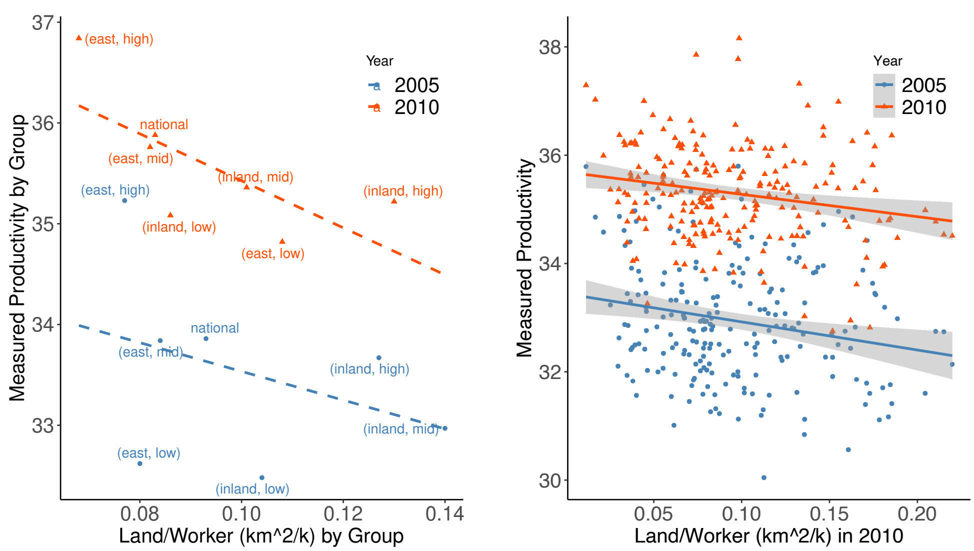
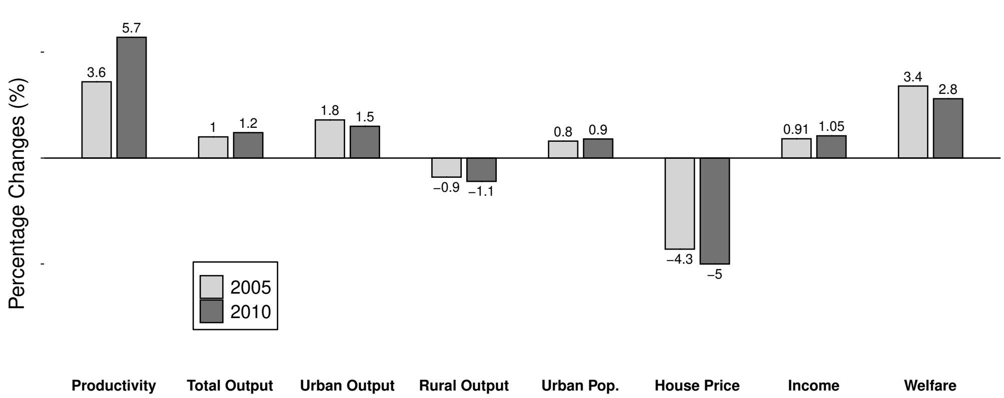


Figure E16: Aggregate Effects of Removing Inland-favoring Land Policy ($\gamma_\tau = 0.15$)



References

Ackerberg, Daniel A, Kevin Caves, and Garth Frazer. 2015. “Identification Properties of Recent Production Function Estimators.” *Econometrica* 83 (6):2411–2451.

Allen, Treb and Dave Donaldson. 2020. “Persistence and Path Dependence in the Spatial Economy.” Tech. rep., National Bureau of Economic Research.

Bils, Mark, Bariş Kaymak, and Kai-Jie Wu. 2022. “Labor Substitutability among Schooling Groups.” Tech. rep., National Bureau of Economic Research.

Chari, Amalavoyal, Elaine M Liu, Shing-Yi Wang, and Yongxiang Wang. 2021. “Property Rights, Land Misallocation, and Agricultural Efficiency in China.” *The Review of Economic Studies* 88 (4):1831–1862.

Ciccone, Antonio and Robert E Hall. 1996. “Productivity and the Density of Economic Activity.” *The American Economic Review* :54–70.

Combes, Pierre-Philippe, Gilles Duranton, Laurent Gobillon, and Sébastien Roux. 2010. “Estimating Agglomeration Economies with History, Geology, and Worker Effects.” In *Agglomeration Economics*. University of Chicago Press, 15–66.

Fajgelbaum, Pablo D and Cecile Gaubert. 2020. “Optimal Spatial Policies, Geography, and Sorting.” *The Quarterly Journal of Economics* 135 (2):959–1036.

Fang, Min, Libin Han, Zibin Huang, Ming Lu, and Li Zhang. 2022. “Place-based Land Policy and Spatial Misallocation: Theory and Evidence from China.” *Available at SSRN 3846313* .

———. 2024. “Place-based Land Policy and Firm Productivity: Evidence from China’s Coastal-Inland Regional Border.” *Available at SSRN 4695879* .

Fang, Min and Zibin Huang. 2022. “Migration, Housing Constraints, and Inequality: A Quantitative Analysis of China.” *Labour Economics* 78:102200.

Levinsohn, James and Amil Petrin. 2003. “Estimating Production Functions Using Inputs to Control for Unobservables.” *The Review of Economic Studies* 70 (2):317–341.

Lu, Ming and Kuanhu Xiang. 2016. “Great Turning: How Has the Chinese Economy Been Trapped in an Efficiency-and-Balance Tradeoff?” *Asian Economic Papers* 15 (1):25–50.

Olley, G Steven and Ariel Pakes. 1992. “The Dynamics of Productivity in the Telecommunications Equipment Industry.” Tech. rep., National Bureau of Economic Research.

Rosenthal, Stuart S and William C Strange. 2008. “The Attenuation of Human Capital Spillovers.” *Journal of Urban Economics* 64 (2):373–389.

Wang, Xiaxin and Yan Shen. 2014. “The Effect of China’s Agricultural Tax Abolition on Rural Families’ Incomes and Production.” *China Economic Review* 29:185–199.