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The Impact of Business Registration Reform on Urban Total Factor Productivity: Empirical Evidence from China

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Abstract: Optimizing the business environment exerts a positive influence on urban total factor productivity (TFP). Simplifying administrative approval processes and reducing the costs of business establishment and dissolution are crucial means of optimizing the business environment. This paper treats business registration reform as a quasi-natural experiment, collecting and organizing business registration reform data from 279 prefecture-level cities in China from 2010 to 2021. Using a difference-in-differences (DID) model, the study evaluates the policy effects of business registration reform on urban productivity. The results show that business registration reform significantly enhances urban productivity. This conclusion remains robust after a series of robustness checks, including parallel trend tests, PSM-DID, and placebo tests. Structural optimization effects, innovation-driven effects, and market competition effects are the primary channels through which business registration reform enhances urban TFP. The effectiveness of business registration reform in improving urban productivity requires the dual support of government efficiency and internet infrastructure. The higher the government efficiency and the more complete the internet infrastructure, the greater the impact of business registration reform on urban productivity. The findings provide empirical evidence and theoretical references for accelerating business registration reform and promoting urban economic development efficiency.

Keywords: Business Registration Reform; Urban Productivity; Institutional Environment; Urban Resource Endowment; Internet Infrastructure

1. Introduction

As's economy enters a new phase, it can China't old ways of growing, like rely on the using a lot of capital, labor, and land. To keep growing at to improve how it uses a good pace, China needs its resources. The systems and rules in place are crucial for the economy to work well. The costs of these systems can make So, China is or break the economy. Working on changing its institutions the balance to get right between the government and the market. Wants the It market to play how resources a bigger role in deciding are used. This is key to China's success in switching from an economy driven factors like by basic labor and capital by efficiency and innovation. to one driven China for developing its economy's plan the need to emphasizes modernize its governance systems, its administrative structures, and give simplify more power to local-makers. It also decision wants to combine and service functions regulatory to create a business environment that can compete globally. One important part of this plan is to simplify of getting approvals and licenses for businesses. This will the process reduce the costs and hassle dealing with the of government, make to start and grow, and create it easier for companies a market. By doing this, China hopes to unlock the potential of its economy and drive more vibrant high-quality growth is to create an The goal environment where and the economy can grow in a sustainable way. This requires a deep understanding of how the economy works and how to create the right conditions for growth. By focusing on efficiency, innovation, and market-driven growth, China can build a strong and competitive economy that benefits everyone. The institutional reforms are a critical step in this process, and their success will depend on the ability to implement them effectively and create businesses can thrive, a favorable. In the end, China's economic growth will depend on its ability to adapt to the new normal and create a

growth model that is driven by efficiency, innovation, and market forces. The government's role is to create the right conditions for this to happen, by putting in place the right institutions, rules, and regulations. By doing so, China can build a strong and sustainable economy that will drive growth and prosperity for years to come.

Enterprise registration reform has consistently served as a cornerstone of China's market-driven transformation initiatives and a catalyst for recalibrating the interaction between public and private sector actors [1,2]. In the early stages of reform and opening up, the enterprise registration system set market entry barriers, preventing certain high-pollution, high-energy-consumption enterprises from entering the market, thereby maintaining market order and promoting the government's provision of fair, effective, and high-quality public services [3]. However, as the socialist market economy system has been established and improved, the drawbacks of the enterprise registration system have become increasingly prominent, continuously hindering sustainable socioeconomic development. On the one hand, tedious enterprise registration and approval procedures weaken residents' entrepreneurial tendencies, inhibit "mass entrepreneurship," and restrict the market's role [4]. On the other hand, non-standardized administrative approval systems breed rent-seeking behavior, increase official corruption, and affect the fairness and efficiency of social resource allocation.

Since the nationwide rollout of business registration reform, business registration reform has entered an accelerated development stage. Regulatory reforms introduced in 2013 aimed to simplify business registration requirements. In the same year, cities like Shenzhen, Zhuhai, and Dongguan in Guangdong Province initiated business registration system reforms. The business registration system reform was launched nationwide in 2014, with the "three-in-one" and "one license, one code" systems actively promoted starting in 2015. Based on the effective implementation of the "three-in-one" reform, the "five-in-one" system was gradually promoted in 2016. Various provinces and cities have also carried out a series of reforms around enterprise registration, supervision, and deregistration, such as fully electronic reforms, "Internet + supervision," and one-certificate handling. Business registration reform, as a major reform measure in the current stage of streamlining administration and delegating power, continuously improves government operational efficiency, optimizes the economic environment for corporate sectors, and protects the innovative and entrepreneurial vitality of various market entities, thereby unleashing institutional dividends.

As a vital component of market economy modernization, business registration system overhaul represents a secondary institutional evolution emanating from the evolution of administrative licensing frameworks [4]. Existing scholarship preponderantly examines the economic impacts of these reforms through the lens of regulatory authorization. Streamlining administrative licensing frameworks contributes to lowering institutional transaction costs for firms, elevates market entry rates, invigorates corporate innovation dynamics, and improves total factor productivity, thereby augmenting enterprise profitability [5-9]. As the objectives and contents of commercial system reform become clearer, some scholars have begun to delve into this area, drawing insights from the literature on administrative approval reforms.

The first type of research focuses on commercial system reform and its practical experiences. For instance, Branstetter [10] discovered that Portugal's "On the Spot Firm" one-stop service reduced waiting times and costs for businesses, encouraging more enterprises to enter the market. Zhong Ruidong and Liu Qiying [11] explored the innovative administrative measures in the context of commercial system reform from an administrative perspective. The second type of research examines the macro and micro performance of commercial system reform. Liu Cheng and Xia Jiechang [12], Deng Feng and Wu Xiaoyu [13], Huang Liangxiong [14], and Bi Qingmiao [15] found that commercial system reform can reduce market entry costs, improve governmental administrative efficiency, stimulate entrepreneurship, promote employment, and enhance societal innovation levels.

Despite extensive research, no scholars have yet examined the impact of commercial system reform on urban production efficiency. Enhancing urban production efficiency is crucial for sustainable urban development and a driving force for high-quality economic growth. Does business registration system innovation effectively enhance regional productivity

efficiency and promote sustainable economic progression? If so, what are the mechanisms and fundamental principles? Do urban features matter for the effect of commercial system reform on urban production efficiency? Tackling these queries will enable a rigorous evaluation of the policy impacts of business registration system modernization, unravel its nexus with urban productivity efficiency, and offer theoretical underpinnings for deepening commercial reforms and fostering sustainable economic modernization.

Marginal Contributions of This Paper:

Highlight Urban-Level Effects: This paper investigates the policy implications of business registration reform at the city level and applies a difference-in-differences (DID) method to assess its effect on urban productivity performance. The findings provide empirical evidence and theoretical references for accelerating commercial system reform and promoting high-quality economic development.

Comprehensive Analytical Framework: By constructing an analytical framework from the perspectives of structural optimization, innovation-driven effects, and market competition effects, this study considers the impact of urban characteristics on the reform effects. This method is helpful to understand deeply the mechanism and boundary condition of the reform of commercial system on promoting total factor productivity.

Robust Empirical Methods: By leveraging the "commercial system reform" pilot as an exogenous regulatory intervention, this research applies difference-in-differences (DID) frameworks, instrumental variable (IV) techniques, and propensity score matching (PSM) methods to estimate the causal impacts of business registration reforms on urban efficiency. This approach mitigates estimation bias and endogeneity issues caused by measurement errors, enriching the empirical methods on this topic.

2. Theoretical Foundation

Economic growth is a complex issue, and one key factor is total factor productivity, or TFP. This refers to the rate at which economies grow when things like capital and labor stay the same. To understand how to boost TFP, we need to look at how businesses are set up and run. This paper explores how making it easier for businesses to register and operate can affect productivity. It uses three main ideas to examine this: how businesses can be structured to work better, how new technology can drive innovation, and how competition in the market can push businesses to be more efficient. By looking at these factors, we can see how modernizing the business registration system can have a positive impact on productivity.

2.1 Structural Optimization Effects

Commercial system reform promotes industrial structural optimization and upgrading, providing a driving force for urban productivity improvement. It can curb government preferences for economies of scale, increase market entry rates, and boost industrial specialization and aggregation, thereby optimizing industrial structures and enhancing urban production efficiency [16].

Specifically, commercial system reform can drive industrial structural upgrading in two ways. Firstly, by curbing government preferences for large-scale industries, it promotes industrial specialization. Local governments prefer large high-tax industries, which distort the allocation of resources by the market and lead to a rapid expansion of large projects and enterprises, and affect urban production efficiency. Commercial system reform can suppress such government preferences, maintain a fair competitive environment, encourage enterprises to invest autonomously in highly efficient production areas, eliminate inefficient enterprises, optimize industrial structures, and improve urban resource allocation capabilities. When more businesses enter the market, it helps industries come together and work better, especially in the service sector. Since this sector doesn't need a lot of money to start and has a big impact when new businesses join, changing the way commerce works can make it easier for new companies to start, attract more businesses, and help the service sector grow and improve the overall industry.

Moreover, industrial structural optimization can improve overall resource allocation efficiency, boosting urban productivity. Higher levels of industrial specialization enhance the allocation efficiency of professional talents, capital, and technology, transferring resources to high-productivity, high-value-added industries, accelerating technological progress in advantageous industries, and improving urban productivity. Furthermore, as industrial

aggregation levels increase, market scale expansion facilitates economies of scale, enhances regional industrial chain completeness, and improves enterprise synergy and technological efficiency, thereby boosting urban production efficiency [17]. The positive effects of industrial aggregation on productivity are driven by mechanisms such as knowledge or technology spillovers and the diffusion of technological innovation, with the tertiary sector exhibiting stronger promotion effects than manufacturing.

2.2 Innovation-Driven Effect

Commercial system reform can stimulate enterprise innovation and inject vitality into urban productivity improvement. The reform helps reduce business costs, enhance innovation motivation and positivity, and promote technological advancements to optimize resource allocation, thereby improving urban productivity [18]. On one hand, commercial system reform can lower institutional costs for businesses, reduce government interference, and provide financial support and institutional guarantees for enterprise innovation development, thus boosting urban innovation capabilities. Firstly, by canceling and decentralizing investment approval authority, changing project investment from an approval system to a filing system, the reform significantly reduces the procedures for business registration and project investment approval, thereby lowering institutional costs in business operations [19-20]. Secondly, the reform can significantly alleviate the resource constraints and government intervention faced by enterprises, improve entrepreneurs' perception of the institutional environment and their social status, cultivating an enabling environment that combines internal managerial mechanisms and external policy support for enterprises to pursue technological innovation initiatives [21]. Thirdly, by relaxing the intensity of government regulation, the reform helps lower institutional costs for businesses, enabling them to invest more funds in R&D and production line upgrades, laying the foundation for product and technological innovation [4].

On the other hand, innovation serves as the principal engine of economic growth, fostering sustainable development through technological breakthroughs and productivity enhancements, and enhancing urban innovation capabilities can promote total factor productivity improvement. Firstly, technological advancements brought about by innovation can optimize the allocation of production factors, improve industrial productivity, and thereby enhance urban productivity. Secondly, urban innovation mitigates the decline in factor allocation efficiency due to eroding structural dividends, facilitating the phasing out of energy-intensive, polluting, and inefficient firms from the market. This allows traditional industries to shift from low-value-added sectors to high-value-added industries, thereby optimizing factor allocation efficiency and boosting urban productivity. Lastly, urban innovation fosters the development of emerging industries, alleviating the supply-demand imbalance of factors and improving factor allocation efficiency. Through breakthrough and disruptive innovations, advanced technological achievements such as cloud services, quantum communication, artificial intelligence, and big data are transformed into real productivity, providing more allocation pathways for labor, capital, and technology, thereby improving urban productivity [22].

2.3 Market Competition Effect

Commercial system reform can effectively increase market competition intensity, providing intrinsic incentives for urban productivity improvement. The reform lowers market entry costs, helps create a fair competitive market environment, and enhances market competition intensity, thereby promoting urban productivity improvement [23]. On one hand, the reform notably boosts the degree of competition in the market. Firstly, as market entry barriers are lowered, a greater number of enterprises flock into the market, and these new entrants often have latecomer advantages such as lower costs, new technologies, and advanced equipment, posing a strong challenge to existing enterprises and thereby increasing market competition intensity. Based on Darwinian market selection effects, the reform increases the likelihood of low-R&D-level enterprises exiting the market, compelling incumbents to improve their competitiveness through R&D innovation to maintain their market position. The entry of new firms greatly stimulates incumbent companies' enthusiasm for technological innovation, pushing them to enhance their innovation levels to cope with potential threats and maintain their

leading positions, thereby increasing market competition intensity [24]. Secondly, the reform can significantly reduce the rent-seeking space of approval departments, directly lowering the entry costs for market entities, and strengthen the entry and exit of market entities through a survival of the fittest mechanism, thereby increasing market competition intensity.

On the other hand, intense market competition helps amplify the dominant function of market mechanisms in allocating factor resources, thereby enhancing urban productivity. From a macro perspective, market competition can significantly alleviate information asymmetry issues, diminish the frictional expenses tied to factor movement and the expenditures in market exchanges. To boost productivity, it's essential to encourage businesses to move resources from areas with outdated technology and low efficiency to those with advanced technology and high efficiency. This helps allocate resources in the best way possible. Market competition also plays a significant role in improving productivity. When companies compete, they share knowledge and ideas, and this can lead to better ways of doing things. In a competitive market, businesses are driven to attract investors, learn new technologies, and improve their management skills. This not only helps the businesses themselves but also makes the entire market more efficient. Competition pushes companies to govern themselves better, which can reduce problems that come from poor management and make executives more motivated to perform well. All these factors combined can significantly improve how well businesses operate. For instance, when companies are under pressure to perform, they're more likely to streamline their operations, cut unnecessary costs, and focus on innovation. This environment fosters an ecosystem where businesses are constantly looking for ways to improve, which in turn, boosts overall productivity. By promoting fair and fierce competition, we can create an economy where resources are used efficiently, and businesses are driven to innovate and grow. This ultimately leads to better economic outcomes and higher productivity across the board.

3. Model Specification, Variable Selection, and Data Description

3.1 Model Specification

This paper conceptualizes the commercial system reform as an exogenous policy shock, and uses a two-way fixed effects model to estimate the causal impacts on urban productivity to study the relationship between commercial system reforms and urban productivity:

$$TFP_{it} = \alpha_0 + \alpha_1 treat_{it} + \alpha_2 control_{it} + \mu_i + \eta_t + \varepsilon_i \quad (1)$$

where TFP represents the urban productivity, $treat$ reveals the policy implications of business registration system, and its estimated coefficient α_1 reflects the causal impact of the policy pilot on urban total factor productivity. $control$ represents a set of control factors to prevent the bias arising from omitted variables., while μ_i and η_t denote city fixed effects and time fixed effects, respectively. ε is the random disturbance term in the model, with subscripts i and t representing cities and years, respectively. To address potential issues of autocorrelation and heteroskedasticity, standard errors are aggregated at the city-level.

3.2 Variable Selection

3.2.1 Total factor productivity (TFP) of cities

In this study, urban total-factor productivity growth is measured using a super-efficiency SBM model with undesirable outputs and the Malmquist productivity index in a global reference data envelopment analysis context. The global reference approach establishes the optimal production frontier by utilizing the input-output information of all decision-making entities throughout the entire research duration. The SBM model then compares each decision maker to this global frontier, which resolves the non-feasibility and cross-period incommensurability problems. The super-efficiency SBM can be compared between efficient decision makers without the limitation that multiple units are not able to be compared. Therefore, this study uses the Malmquist productivity cumulative index calculated under the VRS assumption as the dependent variable.

For the input side of urban total factor productivity, we select capital input, labor input, and energy resource input. For the output side, we choose both desirable and undesirable outputs. Specifically, physical capital input is operationalized as the fixed capital stock of each city. Since statistical data does not report city-level capital stock, this study estimates it

using total fixed asset investment data, setting the depreciation rate at 10.96%. Fixed asset investment data for each city is adjusted to real values based on the year 2000 using the fixed asset investment price index of its province. Labor input is gauged by the aggregate number of workers engaged in the secondary and tertiary sectors. Energy resource input is assessed based on the total electricity usage and total water provision of the city. Desirable output is measured from two aspects: economic output and residents' quality of life output. Economic output is represented by real GDP, indicating the city's capability to create economic wealth.

Residents' quality of life output is the greening rate of cities. Other undesirable outputs, which reflect pollution from the activities of economy, include industrial wastewater, SO2, industrial dust and PM2.5. Input-output information comes from the "China Urban Statistical Yearbook" and the annual statistics from different provinces. For each city's PM2.5 concentration information, it is extracted from the satellite remote sensing data of NASA and then processed using the 1:4,000,000 scale basic geographical information data provided by the National Geomatics Center of China to calculate the yearly average PM2.5 concentration for each city.

3.2.2 Commercial system reform (treat)

Currently, there are three methods to measure commercial system reforms in academia. The first is to construct an evaluation index system, but the results are susceptible to the influence of the index system. The second is to measure the reform by the establishment of market supervision bureaus, but using only the reform implementation time as the dividing variable cannot observe the specific content and measures of the reform, making it unable to effectively evaluate the reform's effects. The third method measures the degree of implementation of commercial system reforms based on the duration of the reforms [4]. Drawing on prior scholarship, this research employs the concurrent adoption of the "subscription-based registered capital system" and "multi-certificate integration" as the key identifier for commercial regulatory reforms. Given that the nationwide rollout of these two policies occurred in March 2014 and October 2015 respectively, mid-year (June) is selected as the temporal demarcation point to account for inter-city implementation disparities. Specifically, if a city introduced both reforms during the first half of a given year, that year is designated as the reform implementation year. Conversely, reforms introduced in the latter half of a year would have their effective implementation year deferred to the subsequent calendar year. Municipalities undergoing these commercial system reforms during the study period are coded as 1, while non-reforming cities are assigned a value of 0.

3.2.3 Control variables

To avoid estimation errors due to missing factors we consider the following controlled variables: GDP (pGDP) as the log value of the per capita gross domestic product; Human capital stock (Hum) as a log value for the number of students in formal tertiary education; Fin, as the percent of the financial credit volume from region GDP; market globalization (FDI) as its log value at the level of the foreign direct investment flows; government regulatory intensity (Gov), as the ratio of public budgets outlays to regional economic output; and infrastructure capacity (Inf) as per capita urban road network area.

3.3 Data Description

This research employs a balanced panel dataset covering 279 prefecture-level municipalities across the 2010–2021 timeframe to examine the policy impacts of commercial regulatory reforms on urban productivity. The data on commercial system reforms, including the timing and specific content of the reforms (such as the registration capital system reform, licensing before certification, multi-certificate integration, and unified social credit codes), were manually collected from the websites of local industrial and commercial bureaus. Urban total factor productivity measures and control variables were obtained from the annual "China City Statistical Yearbook," with missing observations imputed via the mean imputation approach. Summary statistics for all variables are presented in Table 1.

Table 1. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
TFP	3348	1.067	0.282	0.462	4.185
Treat	3348	0.176	0.381	0	1
pGDP	3348	10.654	0.595	8.576	13.056
Hum	3348	10.49	1.37	5.086	13.871
Fin	3348	0.973	0.616	0.118	9.622
FDI	3348	7.844	2.249	0	14.323
Gov	3348	0.196	0.104	0.044	1.485
Inf	3348	4.585	4.024	0.242	42.505

4. Empirical Results and Analysis

4.1 Baseline Regression Analysis

In this test, a DID estimation framework is employed to study the causal effects of commercial regulatory policies on city-level productivity efficiency. The results are presented in Table 2. Column (1) includes the business system reform variable while controlling for time effects. Column (2) adds various control variables on this basis. Columns (3) and (4) further control for city-specific fixed effects. Empirical results demonstrate that the coefficient estimates for commercial system reforms remain statistically significant and positive, irrespective of the inclusion of city-fixed effects and control covariates. This suggests that business system reforms effectively enhance urban total factor productivity (TFP). For example, in column (4), the estimated coefficient of business system reforms on urban TFP is 0.202 and is significant at the 5% level. This indicates that municipalities with "subscription based registered capital system" and "multi-certificate integration" reforms are more TFP-decreasing than non-adopting cities. This indicates that business system reforms can optimize market services, relax market entry standards, reduce transaction costs for enterprises, stimulate entrepreneurial and innovative activities, and significantly improve resource misallocation in the market, thereby enhancing urban production efficiency.

Table 2. Baseline Regression Results

	(1)	(2)	(3)	(4)
Treat	0.275**	0.232***	0.215**	0.202**
	(2.257)	(2.945)	(2.141)	(2.372)
pGDP		0.318***		0.384***
		(23.289)		(22.063)
Hum		0.017***		0.022**
		(2.672)		(2.128)
Fin		0.043***		0.019***
		(6.287)		(2.630)
FDI		-0.165		-0.199
		(-1.262)		(-1.726)
Gov		0.420***		0.324***
		(11.368)		(8.275)
Inf		0.007***		0.004***
		(4.939)		(2.839)
Constant	2.008***	1.239***	2.008***	1.691***
	(121.772)	(7.670)	(252.400)	(7.868)
Time Fixed Effects	YES	YES	YES	YES
City Fixed Effects	NO	NO	YES	YES
Observations	3348	3348	3348	3348
R^2		0.386	0.360	

Note: The values in parentheses are t-statistics. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

4.2 Robustness Checks

4.2.1 Parallel trend test

Following the method of Beck [25], to validate the parallel trends assumption, this research formulates an econometric dynamic model using an event-based analytical framework:

$$TFP_{it} = \alpha + \sum_{j=-4}^{j=6} \beta_t treat_{it}^{\ j} + \phi control_{it} + \mu_i + \eta_t + \varepsilon_{it} \quad (2)$$

Where $treat_{it}^{\ j}$ are policy dummy variables denoting the business system reforms four years before, three years before, two years before, one year before, and the first to sixth years after implementationβ are the corresponding estimated coefficients. All control variables are held constant with the base specification to ensure model consistency.

Figure 1 presents the estimated coefficients β along with their 95% confidence intervals, showing how urban production efficiency changed before and after the business system reforms. Before the reforms were put into place,

there wasn't any statistically meaningful difference in productivity levels between pilot and non-pilot cities. But after the reform implementation, the productivity gap between the treatment and control groups widened significantly—and this divergence is statistically significant. These findings not only support the parallel trends assumption but also confirm that the difference-in-differences (DID) framework is appropriate for identifying the causal impact of business system reforms on city-level production efficiency.

4.2.2 Placebo test

To rule out the influence of other unobservable factors on urban production efficiency, this paper adopts the counterfactual method used by Li Xiaoping and Yu Dongsheng [4]. The policy variable for business system reforms is constructed by advancing the reform implementation by one, two, and three years, respectively. The regression results are shown in Table 3. After adjusting the timing of commercial system reform pilots, coefficient estimates for the policy variable on city-level productivity efficiency ceased to be statistically significant, suggesting that the positive effects identified in the baseline regression are unlikely to be confounded by extraneous factors, thus validating the robustness of our empirical findings.

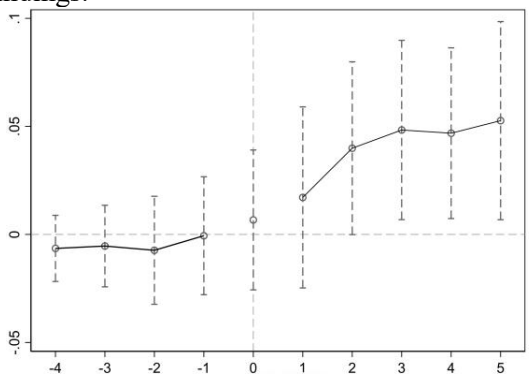

Figure 1. Parallel Trend Test

Table 3. Placebo Test

	Advanced by 1 Year	Advanced by 2 Years	Advanced by 3 Years
Treat	0.123	0.137	0.146
	(1.527)	(0.915)	(1.441)
Control Variables	YES	YES	YES
Fixed Effects	YES	YES	YES
Observations	3348	3348	3348
R^2	0.264	0.256	0.219

4.2.3 Estimation based on PSM-DID method

The non-random selection of business system reform pilots may introduce endogenous selection bias. To get around this issue, we turn to a PSM-DID estimator — that is, propensity score matching combined with a difference-in-differences approach. Three matching algorithms-nearest neighbor, kernel, and caliper matching-are utilized to pair treatment and control cities. On the basis of matched samples, the DID framework is re-applied to estimate the causal effects of business system reforms on city-level total factor productivity. The regression results presented in Columns (1)-(3) of Table 4 demonstrate that policy coefficients remain statistically significant at the 5% confidence level, indicating the robustness of the positive TFP effects identified in the baseline analysis.

4.2.4 Instrumental variable approach

Table 4. PSM-DID and Endogeneity Tests

	Nearest Neighbor	Kernel Matching	Caliper Matching	First Stage	Second Stage
Treat	0.219**	0.220**	0.225**		0.240**
	(2.190)	(2.098)	(2.420)		(2.576)
IV				0.239**	
				(2.58)	
LM statistic				46.12***	
Wald F statistic				46.61	
Control Variables	YES	YES	YES	YES	YES
Fixed Effects	YES	YES	YES	YES	YES
Observations	3348	3348	3348	3348	3348
R^2	0.416	0.360	0.360		0.441

There may be reverse causality between business system reform pilots and urban production efficiency. To address this, following the method of Liu Cheng and Xia Jiezhang [12], this paper

uses the average market of "registered capital subscription system" in non-neighboring cities within the same province as an instrumental variable for business system reforms to tackle endogeneity problems and isolate the pure impact of the policy on production efficiency. Only the business system reform of the city itself affects its production efficiency while controlling for other variables, thus largely satisfying the excludability requirement. Empirical results indicate that the Kleibergen-Paap rank LM statistic exhibits statistical significance at the 1% confidence level, while the Cragg-Donald Wald F statistic for weak instrument bias tests at 46.61, surpassing the 10% Stock-Yogo critical value threshold of 16.38. This confirms the absence of weak instrument issues in the selected instrumental variable and validates the 2SLS estimation results. The regression findings further demonstrate that the positive policy effect persists even after accounting for endogeneity.

4.2.5 Other robustness tests

To ensure the robustness of the core conclusions, the following methods were adopted for further testing: (1) Substitute Explained Variables: The city's production efficiency is calculated using the approximate total factor productivity method. (2) Change Core Explanatory Variables Measurement Scheme: The study uses the establishment of Market Regulatory Bureaus and the reform duration, along with alternative key explanatory variables, to validate the robustness of the analysis. From 2009 to 2016, 45 cities established Market Regulatory Bureaus, meeting the conditions for a quasi-natural experiment. The reform duration measures the months of reform implementation by mid-year (June) for each year. (3) Modify the Sample Interval: The research period was shortened from 2010–2021 to 2012–2019 to guarantee that the choice of the study interval has no impact on the regression outcomes. (4) Control for Sample Bias: Considering the significant heterogeneity in resource acquisition abilities among cities of different administrative levels, the study re-estimates the empirical results after excluding municipalities and provincial capital cities. (5) Exclude Outliers: To avoid estimation bias due to extreme values, the explained variables were subject to 1% level winsorization. (6) Incorporate Joint Fixed Effects: To account for time-varying policy impacts and other random elements at the provincial level, this research integrates province-year joint fixed effects into the model. This step aims to alleviate the influence of macro-systematic alterations resulting from the business system reform. The regression outcomes, presented in Table 5, suggest that the study's conclusions maintain their robustness when multiple factors are taken into comprehensive consideration.

Table 5. Robustness Tests

Alternative Explanatory Variables	Change Core Explanatory Variables	Alter Sample Interval	Control for Sample Bias	Exclude Outliers	Add Joint Fixed Effects
	Market Regulatory Bureaus	Reform Duration	"Multiple Certificates in One" Duration		
(1)	(2)	(3)	(4)	(5)	(6)
Treat	0.234***		0.237***	0.226***	0.224***
	(5.658)		(3.313)	(3.178)	(2.792)
Treat2		0.227*			
		(1.845)			
Treat3			0.233***	0.223**	
			(3.232)	(2.238)	
Control Variables	YES	YES	YES	YES	YES
Fixed Effects	YES	YES	YES	YES	YES
Observations	3348	3348	3348	3348	2232
R^2	0.449	0.404	0.361	0.360	0.195

5. Further Extended Analysis

Our study shows that changes to the business system can actually improve how well cities produce goods and services. We used a special method to compare the differences in cities that made these changes and those that didn't, and the results were clear. But what we really want to know is how these changes are making a difference. Does it work the same way for all cities, or are there some that it helps more than others? Answering these questions will help us

understand how and why business system changes can make cities more productive. So, this research aims to dig deeper into how business system changes affect the overall productivity of cities, and whether it works differently depending on the type of city.

5.1 Mechanism Test

To how changes to the business system impact the efficiency of production in cities, we've set up some models to test the middle steps that make this happen:

$$TFP_{it} = \alpha_0 + \alpha_1 treat_{it} + \alpha_2 control_{it} + \mu_i + \eta_t + \varepsilon_{it} \quad (3)$$

$$Media_{it} = \beta_0 + \beta_1 treat_{it} + \beta_2 control_{it} + \mu_i + \eta_t + \varepsilon_{it} \quad (4)$$

$$TFP_{it} = \gamma_0 + \gamma_1 treat_{it} + \gamma_2 Media_{it} + \gamma_3 control_{it} + \mu_i + \eta_t + \varepsilon_{it} \quad (5)$$

where $Media$ is the mediating variable, and other variables have the same meanings as previously explained. Based on theoretical analysis, the study tests the impact channels of business system reform on urban production efficiency through three paths: structural optimization effect (IND), innovation-driven effect (INNO), and market competition effect (MARKET).To measure the structural optimization effect, we take a weighted ratio — specifically, one that combines the shares of the three industries and the labor productivity within each industry. The innovation-driven effect is quantified by the number of authorized invention patents per 10,000 urban residents. The market competition effect is measured by the ratio of the city's average enterprise output value to the national average enterprise output value. If $\alpha 1$, $\beta 1$, and $\gamma 2$ are all significant, and $\gamma 2$ is smaller or less significant than $\alpha 1$. Empirical results suggest the existence of a mediating effect, as demonstrated by the regression findings presented in Table 6.

Table 6. Mechanism Test

	Structural Optimization Effect	Innovation Driven Effect		Market Competition Effect		Structural Optimization Effect	
	TFP	IND	TFP	INNO	TFP	MARKET	TFP
	1	2	3	4	5	6	7
Baseline Regression	0.022**	0.066***	0.019**	0.047**	0.020**	0.047***	0.014**
TFP	(2.372)	(5.282)	(2.100)	(2.214)	(2.074)	(2.593)	(2.156)
1			0.125***				
Treat			(10.251)				
					0.591***		
IND					(15.368)		
							0.012*
INNO							(1.845)
	YES	YES	YES	YES	YES	YES	YES
MARKET	YES	YES	YES	YES	YES	YES	YES
	3348	3348	3348	3348	3348	3348	3348
Control Variables	0.360	0.378	0.360	0.685	0.360	0.330	0.367

The findings from the analysis show that changing the way businesses operate can help cities use their resources more effectively. This happens when cities improve their industrial structure, become more innovative, and increase competition in the market. As a result, cities become more productive. To be more specific, the numbers from the analysis indicate that business reforms have a positive impact on upgrading industries, creating new inventions, and promoting competition. Even when we consider other factors that might influence this relationship, the impact of business reforms remains significant. This suggests that improving industrial structures, enhancing innovation, and fostering competition all play a role in how business reforms lead to greater productivity in cities. What this means is that business reforms can have a two-fold effect. On the one hand, they can help certain industries grow faster, encourage companies to invest more in research and development, and make it easier for new businesses to enter the market. On the other hand, these changes can also help cities use their resources more efficiently. This can happen through various means, such as companies taking advantage of economies of scale, sharing skilled workers, specializing in specific tasks, and exchanging knowledge and technology. Ultimately, this leads to increased productivity in cities.

5.2 Heterogeneity Tests

5.2.1 Government efficiency heterogeneity

For a country economy to really's work well, the government needs to be organized and efficient. This is especially when it comes to making big changes to important the systems business and trade that control. The strength of government governance and efficiency directly impacts the effectiveness of commercial system reforms. Accordingly, this study categorizes cities into low and high government efficiency groups and constructs an interaction term between a government efficiency dummy variable and the business system reform variable to investigate the differential effects of business system reforms on total factor productivity (TFP) across cities with varying levels of government efficiency.

Specifically, based on the "2016 China Local Government Management Efficiency Ranking," cities in the upper-half of the ranking are labeled as high-efficiency cities, and those in the lower-half are labeled as low-efficiency cities. A dummy variable is created where high-efficiency cities are assigned a value of 1 and low-efficiency cities a value of 0. As presented in Column (1) of Table 7, the regression coefficient of the interaction term is statistically significant and positive at the 10% significance level, suggesting that in regions implementing business system reforms, higher government efficiency results in more substantial enhancements in regional productivity. The advancement of commercial system reforms requires local governments to adjust their organizational structures, enhance service and regulatory philosophies, and tailor strategies to local conditions. Improvements in government efficiency facilitate the implementation of commercial system reforms and enhance regional productivity.

5.2.2 Information network infrastructure heterogeneity

Internet infrastructure plays a key supporting role in making commercial system reforms work effectively. Looking at the actual rollout of these reforms, it's clear that the internet and other information platforms serve as crucial technical foundations—they help shorten the time it takes to register an enterprise and also improve the efficiency of market supervision. Dongguan, as one of the first cities to pilot commercial system reforms nationwide, has leveraged its early reform advantages to establish a comprehensive market supervision system based on judiciary, centered on credit, and supported by information technology. This system uses big data and smart regulation methods for market supervision, providing a reference for diversified market governance.

Thus, this study categorizes cities into high and low internet infrastructure groups and constructs an interaction term between an internet infrastructure dummy variable and the business system reform variable to analyze the differential effects of business system reforms on TFP across cities with varying levels of internet infrastructure. Specifically, cities designated as "Broadband China" pilot cities in three batches by the Ministry of Industry and Information Technology (MIIT) and National Development and Reform Commission (NDRC) during 2014–2016 are labeled as high-internet infrastructure cities (coded 1), while others are classified as low-internet infrastructure cities (coded 0). Empirical results presented in Column (2) of Table 7 reveal that the interaction term coefficient is statistically significant and positive at the 1% significance level, indicating that regions with higher internet infrastructure undergoing business system reforms experience more pronounced productivity improvements. Internet infrastructure development serves as a foundational pillar for commercial system reforms and resource allocation. On one hand, internet advancements facilitate the establishment of integrated information platforms and enhance government market supervision efficiency; on the other hand, they expedite the allocation of knowledge, information, and technology resources, thereby boosting urban productivity.

5.2.3 Resource endowment heterogeneity

Resource-based cities are characterized by a high concentration of resource-intensive industries and exhibit an excessive reliance on the resource sector. Cheng Liu and Jidong Yang (2020) found that commercial system reforms promote industrial specialization, which may potentially increase the number of resource-based enterprises in a region, thereby giving rise to problems such as industrial homogeneity, redundant construction, and overcapacity. Therefore, this study categorizes cities into resource-based and non-resource-based groups according to the National List of Resource-Based Cities (2013) and constructs an interaction term between a

resource endowment dummy variable and the business system reform variable to analyze the differential effects of business system reforms on TFP across cities with heterogeneous resource endowments.

Specifically, based on the "National Plan for Sustainable Development of Resource-based Cities (2013-2020)", the sample cities are categorized into resource-based and non-resource-based groups. A dummy variable is created where resource-based cities are coded as 1 and non-resource-based cities as 0. As presented in Column (3) of Table 7, the regression coefficient of the interaction term is statistically significant and negative at the 10% significance level. This implies that commercial system reforms have a more substantial positive impact on urban productivity in non-resource-based cities compared to resource-based ones. Resource-based cities mainly concentrate on industries associated with resource extraction, processing, and transportation, which typically feature lower technological intensity. Resource-based enterprises tend to use the transaction cost savings from commercial system reforms to expand production scale rather than promote technological research and development, resulting in a lower positive impact on urban productivity compared to non-resource-based cities.

Table 7. Heterogeneity Tests

	Government Efficiency Heterogeneity	Information Network Infrastructure Heterogeneity	Resource Endowment Heterogeneity
	(1)	(2)	(3)
Treat*efficiency	0.195*		
	(1.790)		
Treat*information		0.384***	
		(2.862)	
Treat*resource			-0.242*
			(-1.847)
Control Variables	YES	YES	YES
Fixed Effects	YES	YES	YES
Observations	3348	3348	3348
R^2	0.359	0.361	0.359

6. Conclusion and Recommendations

6.1 Research Findings

This study treats the business system reform as a “quasi - natural experiment” and explores its influence on urban production efficiency and the underlying mechanisms. It draws on balanced panel data encompassing 279 prefecture - level cities spanning from 2010 to 2019. The analysis makes use of methodologies such as difference - in - differences (DID), instrumental variables, and event study. The findings indicate:

Making cities work better is a big deal. We can make a real difference by changing the way businesses operate. For example, when cities use a "registered capital subscription registration system" and "multi-certificate integration", they can produce more with less. Our research shows that cities that use these systems are about 0.022 units more efficient than those that don't. We checked our results many times to make sure they're accurate, using different methods like parallel trend assumption validation, Propensity Score Matching, and placebo tests. The results stayed the same, which means we can be confident that these reforms really do make a difference. By streamlining the way businesses work, we can make cities more productive and efficient, which is good for everyone. This is especially important for cities, where resources are often limited and every little bit counts. So, it's worth taking a closer look at how we can make our cities work better, and how we can use these kinds of reforms to make a real impact.

When it comes to the mechanisms at work, the reforms boost urban total factor productivity (TFP) through several channels. These include optimizing the industrial structure, raising the level of urban innovation, and intensifying market competition.

Heterogeneous Effects: The impact of commercial system reforms on urban production efficiency varies. Regions with higher government efficiency and better internet infrastructure see stronger effects from the

reforms. Moreover, the reforms promote production efficiency more in non-resource-based cities compared to resource-based ones.

6.2 Policy Implications

This study theoretically and empirically investigates the impact of commercial system reforms on urban productivity, offering policy support for systematically improving the business environment and fostering high-quality urban development. Drawing on these findings, the following policy recommendations are advanced:

We should aim to raise the quality of commercial system reforms. That means continuing to push forward with the "streamline administration and delegate power, improve regulation, and upgrade services" agenda. Transform government functions, strengthen government service capabilities, reduce institutional costs for enterprises, and increase market entry rates. Harness policy guidance and market forces to optimize industrial structure, strengthen market regulation, cultivate a modern government-business relationship, and establish a fair and competitive market environment-thereby enhancing urban resource allocation efficiency and productivity.

Improve Government Efficiency and Internet Infrastructure: Government efficiency is crucial for the effective implementation of commercial system reforms. We need to set up diversified jurisdictional mechanisms and interest distribution mechanisms inside administrative departments, spell out responsibilities and powers clearly, and build a form of competitive administration that runs on appeal and reward mechanisms - all with the goal of making government more efficient. Additionally, robust internet infrastructure is essential for the effective execution of these reforms. Strengthen support for internet infrastructure development, improve planning for internet facilities, expand coverage, and increase internet penetration and household network access capabilities.

One way forward is to adopt what you might call a “top-level design” approach. In practice, this means enhancing commercial system reforms through a mix of top-down and bottom-up strategies. As local areas design their systems based on actual conditions, the lack of unified design leads to varying standards and resource wastage. With commercial system reforms entering a deeper phase, it is necessary to establish unified and standardized commercial systems supported by legal frameworks, reflecting a "people-centered" development philosophy.

6.3 Research Limitations and Future Directions

Despite the rigorous empirical analysis exploring the impact and mechanisms of commercial system reforms on urban production efficiency, several limitations exist:

(1) Data Limitations: The study is based on balanced panel data from 2010-2019. Longer-term data might better reveal the long-term impacts of commercial system reforms on production efficiency.

(2) The study sheds some light on the mechanisms involved, highlighting a few key channels such as streamlining industry structures, driving innovation, and increasing competition. However, to get a clearer picture of the specific pathways and underlying mechanisms that are at play, we need to dive deeper with more in-depth analysis and real-world case studies. This will help us better understand how these mechanisms actually work and interact with each other.

(3) Dynamic Nature of Reforms: Commercial system reforms are dynamic processes with different policy focuses and impacts at different stages. The study may not fully capture this dynamic nature.

Future research can enhance this study by:

(4) On the data side, as more information becomes available, future work can extend the sample period. That would give us a more complete picture of the long-run impacts of commercial system reforms.

(5) When it comes to digging deeper into the mechanisms, future research could rely on mixed methods - for instance, combining case studies, field surveys, and other approaches - to better understand the causal pathways through which commercial system reforms affect urban production efficiency.

(6) To really understand how policies work, we need to look at how they change and affect things over time. So, future studies should focus on how commercial systems are reformed and how these changes impact how efficiently cities produce things. By doing this, we can get a better idea of how different parts of a policy affect things and how they change, which can help us make better policies and adjust them as

needed. This will give us more precise guidance on how to create and adjust policies to get the best results.

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