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Regional Economic Competition, Fiscal Subsidies, and Overcapacity

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ABSTRACT

Promotion tournaments theory and regional economic competition can be used to explain China's overcapacity. This study used the non-radial distance function to evaluate the overcapacity considering resource and environmental pollution, combined with Chinese industrial enterprise data, to evaluate the fiscal subsidies and their impact on regional industrial capacity. Empirical evidence based on provincial panel data shows that to strive for more foreign investment, local governments tend to increase fiscal subsidies to industrial enterprises and inhibit capacity utilization, but the technology diffusion and competitive effect of foreign investment can also weaken this adverse effect. The heterogeneity analysis based on geographical location shows that the fiscal subsidies to industrial enterprises weaken the improvement effect of economic competition on capacity utilization in coastal cities, but there is no such impact in inland cities. Reducing the government's excessive intervention and promoting orderly competition are essential to eliminating overcapacity.

KEYWORDS

Capacity Utilization, Economic Competition, Fiscal Subsidies, Industrial Enterprises, Non-Radial Distance Function, Overcapacity, Promotion Tournament

INTRODUCTION

China has entered a new phase of shifting economic growth and continuous structural adjustments in recent years, and the central government has emphasized speeding up supply-side structural reforms, advancing overcapacity management in key areas, and promoting high-quality development in the economy. However, according to statistics released by the China National Information Center, 19 manufacturing sub-sectors in China had severe overcapacity in 2020, and nine of these 19 sub-sectors had a capacity utilization rate below 75%. The central and local governments focus on the policy goal of "cut overcapacity, reduce excess inventory, deleverage, lower costs, and strengthen areas of weakness" by strengthening environmental inspections, limiting production and energy, and other means to resolve regional overcapacity. Nevertheless, the increase in production capacity in photovoltaics (PV), electrolytic aluminum, coal, and other industries remains obvious. Regarding the

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causes of overcapacity, researchers believed that overcapacity is a natural phenomenon under market economy conditions (Stiglitz, 1999). The mismatch between business investment growth and market demand during economic prosperity makes it difficult for production factors to function effectively; some companies use strategic overcapacity to signal a credible threat to potential market entrants (Spence, 1977). Political incentives for local governments to promote local economic development are a key component of China's economic growth (Gordon & Li, 2011; Xu, 2011). Owing to the economic competition in China's regional development, local officials enacted a *promotion tournament*, which is centered on economic development performance (Yao & Zhang, 2015; Landry et al., 2017). Simultaneously, the promotion tournament is embedded in external market competition beyond the control of the jurisdiction of the government. The close correlation and high integration of official and market competition have laid the institutional foundation for the rapid growth of China's economy (Zhou, 2018). Local governments tend to encourage foreign investment through more preferential land use policies (Xu, 2019), fiscal subsidies, and other means to increase local economic growth and fiscal and tax revenues, which demonstrates governance performance in the promotion tournament. However, fiscal subsidies in regional economic competition may cause serious efficiency distortions and resource misallocations, and it may aggravate the overcapacity of industrial enterprises in the jurisdiction. Hence, the following research questions were the focus of this study. What is the internal influence mechanism among regional economic competition, fiscal subsidies, and overcapacity? What kind of thinking should be adopted to assess the level of fiscal subsidies provided by local governments to enterprises in the jurisdiction and the level of industrial overcapacity in the region? Under the premise of considering spatial correlation characteristics, does economic competition have a dual impact on regional overcapacity? Are there spatial spillover effects between different regions?

The novelty of this study is to bring fiscal subsidies and industrial capacity utilization into the analysis framework of regional economic competition from the perspective of spatial correlation. It reveals how regional economic competition distorts capacity utilization through fiscal subsidies and the dual effects of improving capacity utilization through cost control and technological progress. In terms of data selection and methodology, this study addresses the limitations of previous studies on quantifying local government fiscal subsidies, evaluates regional industrial capacity utilization by using a non-radial distance function (NDDF) under the premise of considering resource and environmental constraints, and obtains relatively robust estimation results by combining with the spatial Durbin model (SDM).

The structure of this article is as follows. A literature review is followed by the mechanism analysis, focusing on the relationship between local government fiscal subsidies and industrial overcapacity in regional economic competition, and presents relevant hypotheses accordingly. This is followed by an outline of the research design, explaining how to construct local fiscal subsidy indicators and capacity utilization indicators, as well as the empirical analysis and conclusion.

LITERATURE REVIEW

Regional Economic Competition and Local Fiscal Subsidies

In 1994, the "tax sharing system" reform in China established a framework for the taxes distribution between the central and local governments (Ding et al., 2019). Subsequently, the share of local government tax revenue decreased, and local "fiscal pressure" was created (Xu, 2019). Local governments engage in strong inter-regional competition to attract capital, and such inter-regional competition often takes the form of fiscal and tax competition (Jin et al., 2005; Fan et al., 2009). Some local governments in coastal areas even began to solve the gap of fiscal revenue and expenditure through land finance (Whiting, 2011). These local fiscal incentives significantly shape policy choices and local economic performance (Lv et al., 2020). In reality, China's local governments have strong incentives to subsidize enterprises to reduce costs and enhance market competitiveness. For example, industrial enterprises can receive direct fiscal subsidies or assistance through preferential land prices, development policies, credit facilities, or other means. Consequently, enterprises may blindly expand investment, and production, which leads to the problem of resource misallocation.

Fiscal Subsidies and Overcapacity

Overcapacity in China, especially in the manufacturing sector, exists in industries beyond the traditional industrial sectors of coal, steel, and electrolytic aluminum (Zhang et al., 2017; Wang et al., 2021). In recent years, overcapacity to varying degrees has existed in wind and solar energy, as well as other emerging industries (Wang et al., 2014; Zhang et al., 2016). Market failure caused by information asymmetry cannot explain the Chinese-style overcapacity "surge" feature. Many economists have attributed the root cause of China's overcapacity to government intervention or institutional defect (Zhang et al., 2017).

Several studies have reported that subsidies have an inhibitory effect on capacity utilization. Some regional governments increase fiscal subsidies on strategic emerging industries to win opportunities in future market competition (Zhang et al., 2018). However, government subsidies can distort enterprise investment behavior and lead to redundant construction (Zhang et al., 2016). Based on factors such as fiscal and tax sources, employment placement, and social stability, local governments have assisted traditional industries and maintained production and operations by increasing fiscal transfusion (Jiang & Cao, 2009). Further analysis finds that the fiscal subsidies from local governments may be used to support zombie enterprises (Cheng et al., 2021; Qiao & Fei, 2022), then these zombie firms will crowd out healthy enterprises and exacerbate overcapacity (Shen & Chen, 2017; Liu et al., 2019). On the contrary, some scholars believe that the impact of fiscal subsidies on enterprise capacity utilization is more complex. In different stages or regions of industrial development, the impact of subsidies on enterprises is different. Zhang et al. (2014) ascertained that government subsidies, in the long and short terms, have significant positive effects on the financial performance of wind energy manufacturing companies. Xiong and Yang (2016) found that the subsidies at the early exploratory stage could maximize the social and economic effects and have little effect on the turnover in the intermediate and mature stages, thereby exacerbating the overcapacity of PV supply.

Literature Summary

Despite increasing research on the relationship between regional economic competition and overcapacity, an in-depth discussion from the perspective of local government fiscal subsidies is lacking. In addition, previous studies have rarely discussed regional heterogeneity and spatial correlation. In particular, it is difficult to obtain fiscal subsidy data at the regional level, which restricts relevant empirical research. This study attempted to use local fiscal subsidy data based on the database of Chinese industrial enterprises, combined with data envelopment analysis and spatial econometric regression, to explore the internal relationship between economic competition, fiscal subsidies, and excess capacity.

MECHANISM ANALYSIS AND PROPOSITION

Regional Economic Competition and Local Fiscal Subsidies

The marketization process in China originated in the early 1980s. Prior to that, China was a highly centralized planned economy. The economic system was based on various plans, material incentives were completely suppressed, and local governments handed over the surplus of their jurisdiction to the central government. For a long time, the highly centralized planned economy hindered the enthusiasm of Chinese local governments to develop the economy and increase tax revenue. In 1994, the reform of China's fiscal decentralization system clarified the powers of the central and local governments for the first time and reasonably determined the scope of fiscal revenue and expenditure of governments at all levels. According to the principle of combining administrative power with fiscal power, the central and local tax system should be established, and the relatively standardized central local tax return and transfer payment system should be gradually implemented.

The reform of the "tax sharing system" is of great historical significance. It breaks many constraints of the planned economic system on regional economic growth. Under this reform, local budgets do not need to be approved by the central government, which greatly reduces the central government's control and constraints on local economic development. It also reduces the separation of administrative intervention on the regional market and is conducive to the establishment of a unified, open, competitive, and orderly modern market economy system. However, there are many drawbacks to the reform, especially the evaluation criteria for the political promotion of officials aiming at economic growth and tax increase. To meet the requirements of local budget and public goods provision, local governments in different regions have launched investment attraction and tax competition one after another, intensifying the vicious competition among some regions, which leads to redundant construction and market segmentation.

In reality, if the local industrial cost function and the initial income of fixed assets investment are exogenous and the income function of an enterprise in the industry for the local government is set as $R(Q_i)$, which usually includes more jobs and fiscal revenue, the first-order derivative is $R'(Q_i) > 0$, the second derivative is $R''(Q_i) < 0$. That is to say, the expansion of enterprise production scale will follow the development trend of marginal revenue increasing first and then decreasing. This implies that when the capacity of local industries is at a low level, the provision of fiscal subsidies will help reduce the uncertainty of investment and reduce production costs quickly to achieve short-term output increase and local government revenue increase.

For a long time, the issue of "fuzzy property rights" has prevailed with respect to China's land and environment. Local governments can lower the land price in their jurisdiction through administrative intervention, reduce the tax burden of enterprises, assist enterprises in obtaining bank financing, and attract industrial transfer and overseas investment from developed regions. Although the distorted land and environmental factor prices stimulate the development of local industries in the short term, their essence is still the provision of substantial subsidies to investment enterprises. In addition, the local government may choose to tolerate the serious environmental pollution caused by foreign investment while choosing economic growth goals, which also greatly reduces the actual production costs of enterprises, which is the specific performance of the disguised fiscal subsidies for foreign investment. If the environmental regulations of the above enterprises are stricter, they will have to pay higher pollution control costs.

Hypothesis 1: To stimulate local economic growth and industrial development, local governments usually tend to increase subsidies to enterprises to obtain higher subsidy returns.

Analysis and Factors Influencing China's Regional Overcapacity

From the perspective of the spatial distribution of overcapacity, there are obvious ladder distribution differences in industrial capacity utilization at the provincial level in China, and most provinces in the eastern region maintain a high-capacity utilization rate. The productivity utilization rates of Shanxi, Henan, Anhui, Hunan, and Hubei in the central region and Heilongjiang and Jilin in the northeastern region are relatively low. It is worth noting that Heilongjiang and Jilin are traditional heavy industrial areas in China. With the depletion of oil, coal, and other resources, resource-intensive industries are also showing a serious decline (Wang et al., 2022). In the industrial structure of Xinjiang, Gansu, Yunnan, Guizhou, and Guangxi in the western region, the proportion of nonferrous metals, oil, coal, and other resource extraction and processing industries is relatively high. With the loss of resource dividends, the adjustment of industrial structure (Jing et al., 2022), and the saturation of domestic market demand, its capacity utilization has declined significantly. Jiangxi in the central region and

Inner Mongolia in the western region show obvious overcapacity in the development of emerging strategic industries. The photovoltaic industry and wind and solar energy industry are typical cases of overcapacity.

From the perspective of the causes of overcapacity, there are great differences in economic foundation and resource endowment in different regions of China. The economic competition and local government fiscal subsidies caused by political promotion incentives will lead to the convergence of development planning in neighboring regions, while the vicious competition in neighboring provinces will eventually lead to the convergence of industries and the surge of homogeneous products. Taking China's urban agglomeration in the middle reaches of the Yangtze River as an example, the Wuhan Urban Agglomeration in Hubei Province, the Greater Changsha Metropolitan Region in Hunan Province, and the Poyang Lake urban agglomeration in Jiangxi Province have been mutually closed markets for a long time. Automobile, iron and steel, nonferrous metals, and other industries occupy a dominant position in the above three industrial structures. It is worth noting that the above regions are characterized by overcapacity to varying degrees. In recent years, the government industrial planning of the above provinces has been emphasizing the development of the automobile industry. Through the implementation of fiscal subsidies, tax incentives, and other investment policies, positive industrial policies are formulated to attract external automobile enterprises to invest in the province, which leads to obvious overcapacity in the automobile industry. Wuhan and Changsha both put forward the goal of becoming the central car city. Wuhan of Hubei Province is a famous city of automobile production in China. Changsha of Hunan Province has introduced auto manufacturers such as BAIC Foton and GAC, and the automobile industry in both these places has exceeded 100 billion yuan. The output value of Jiangling Automobile in Nanchang of Jiangxi Province is close to 100 billion yuan. However, from the perspective of resource allocation, although excessive fiscal subsidies reduce the actual cost of enterprises, they also distort the normal investment behavior of enterprises and induce the subsidized enterprises to blindly expand their production capacity. When all enterprises in the region take expanding production capacity as the production decision, it is bound to lead to the fallacy of composition of the whole industry.

Hypothesis 2: In regional economic competition, local governments provide fiscal subsidies to enterprises, which leads to overcapacity by distorting the allocation of resources.

The local government subsidies can explain the formation mechanism of overcapacity to a certain extent. However, in reality, economic competition may have both positive and negative effects on the capacity utilization of enterprises. On the one hand, local governments participating in economic competition increase subsidies to enterprises, resulting in resource misallocation and excess capacity of enterprises; on the other hand, production enterprises participating in the economic competition will compete with other enterprises in production technology and product quality, thus creating a certain inhibition on overcapacity.

Hypothesis 3: Economic competition will also bring technology diffusion and competitive effect, which has a certain inhibitory effect on overcapacity.

Analysis of Spatial Correlation of Regional Overcapacity

The development of regional industry is affected by the administrative intervention of local government, and the development trend of local protection and economic integration simultaneously exists in many regions, which indicates that it is not feasible to analyze the problem of regional overcapacity from the perspective of separation. When the local government of a region implements fiscal subsidies for the development of local industries, the neighboring regions will adopt similar subsidy policies to ensure that the relative competitiveness of local enterprises is not weakened. This kind of competitive subsidization not only makes the industrial structure of different regions converge but also leads to the spatial correlation of overcapacity. Therefore, from the perspective of the spatial distribution of overcapacity, the more likely the two adjacent regions will show the characteristics of overcapacity. This also means that the future upgrading of regional industrial structure should consider the characteristics of regional spatial dependence, formulate targeted industrial policies according to the regional reality, and strive to avoid industrial isomorphism and its derived overcapacity.

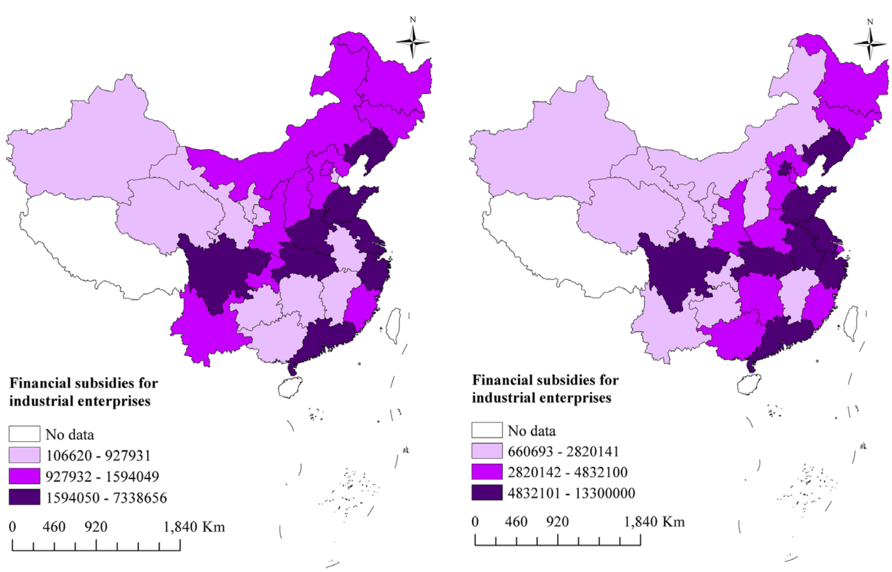
RESEARCH DESIGN

Local Fiscal Subsidy Index and Preliminary Statistical Analysis

Research on corporate subsidy income is usually conducted at the enterprise level, but it seldom involves the impact of regional heterogeneity on corporate subsidy income. The reason is that the national statistics department has not released regional fiscal and tax subsidy indicators for industrial enterprises at the regional level. As one of the most used data sources in academic research, the China Industrial Enterprise Database provides important indicators, including subsidy income, fixed asset investment, number of employees, main business income, and income tax payable of industrial enterprises. Therefore, this study used 2003–2013 data from China's industrial enterprise database to obtain subsidy income indicators. Regarding the sample time, owing to the lack of corporate subsidy income indicators in 2009 and 2010, this study excluded those years. Regarding regional samples, the study did not include Tibet, Hainan, Hong Kong, Macao, Taiwan, and other regions with many missing indicators. In this study, the subsidy income of all industrial enterprises above the designated size in 29 provinces was aggregated separately. ArcGIS 10.3 software was used to draw a spatial distribution map of local government fiscal subsidies in various provinces in China, which is shown in Figure 1.

There are obvious spatial distribution differences in the intensity of local government fiscal subsidies, which is evident in the subsidy amount of enterprises above the designated size. In 2003, the fiscal subsidies of Liaoning, Shandong, Jiangsu, Zhejiang, Shanghai, and Guangdong (provinces with relatively developed economies) maintained a high level. The above regions are important equipment

Figure 1. Fiscal subsidies for industrial enterprises in China's 29 provinces (a) Year 2003 (b) Year 2013



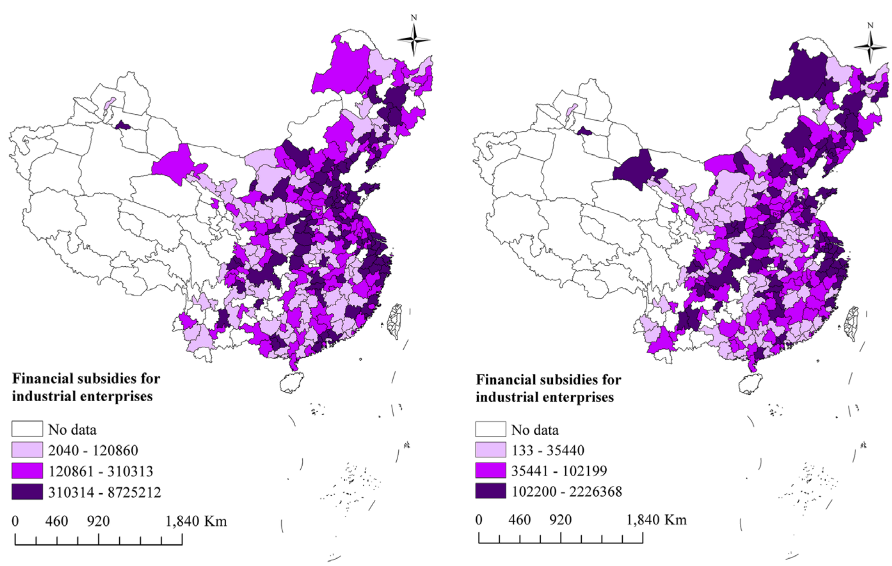
(a) (b)

manufacturing, raw material production bases, and export processing industry clusters in China. For example, the proportion of the secondary industry in Liaoning Province is as high as 48.3%, and the proportion of heavy industry is significantly higher than that of light industry. Regardless of the perspective of economic growth, the number of jobs, or tax revenue, these areas rely on industrial development, and the subsidy and incentive for industrial enterprises are obvious. The mining and smelting industries of coal, steel, nonferrous metals, and other resources in inland provinces such as Hubei, Sichuan, Inner Mongolia, and Yunnan are relatively developed. Resource-intensive industries are not only highly dependent on resources but also have high price elasticity of their products, which are vulnerable to macroeconomic uncertainty. The increase of local government subsidies to industrial enterprises will help enterprises expand production investment, reduce production costs, and resist potential financial risks caused by market uncertainty.

From 2003 to 2013, fiscal subsidies from Chinese provinces for industrial enterprises have a clear spatial distribution trend. On the one hand, most provinces in the western region have more fiscal subsidies than other regions of the country. On the other hand, the spatial distribution of fiscal subsidies shows a rising trend along the Yangtze River Economic Belt to inland areas. The spatial distribution characteristics are related to the transfer of industries from east to west between regions and that of potential economic growth rates from coastal to inland areas. While accepting the transfer of industrial enterprises from developed regions, the central and western regions need government fiscal subsidies to assist industrial enterprises moving from outside to increase investment in fixed assets and construction of supporting infrastructure.

To investigate the spatial differences of local government fiscal subsidies from a more micro perspective, this study used the Chinese industrial enterprise database to calculate the fiscal subsidies of 270 cities in China in 2003 and 2008. Similar to Figure 1, Figure 2 shows that the subsidy activities of China's industrial enterprises in 2003 were concentrated in the eastern coastal areas and provincial capitals, because the economies of the eastern regions and provincial capitals are relatively developed, as these cities have a high concentration of industries, especially high-end manufacturing industry. Compared with other cities, cities located in the provincial capital have more advantages in obtaining subsidy information and coordinating government enterprise relations. By 2008, the number of fiscal

Figure 2. Fiscal subsidies for industrial enterprises in China's 270 cities (a) Year 2003 (b) Year 2008



(a) (b)

subsidies for industrial enterprises in the eastern coastal areas showed a downward trend, while the central and western regions showed an upward trend, which may be related to the adjustment direction of industrial structure in different cities.

Capacity Utilization Index Considering Resource and Environmental Constraints

As the constraints of sustainable development are becoming increasingly prominent, various regions in China are facing serious resource consumption and environmental pollution (Shen et al., 2022; Yu et al., 2022). Environmental pollution has a serious impact on people's health and welfare. Complaints about environmental pollution have a significant impact on regional industrial site selection and industrial production. The inclusion of resource and environmental factors in the overcapacity evaluation system will align the measurement indicators with development reality. Considering Jiang et al. (2017) and NDDF, economic benefits as the expected output and environmental pollution as the undesired output are included, and the capacity utilization rate of the regional industry is measured according to the model.

There is a set of production possibilities $P\left(x,y,b\right)$, where *x, y*, and *b* are input elements, expected outputs, and undesired outputs, respectively. The NDDF is $\vec{D}\left(x,y,b;g\right)= \sup\{w^T\beta : (x,y,b)+g\cdot d\left(\beta\right)\in P\}$, where d and g are the diagonal matrix and the direction vector, respectively. Further, $w^T = (w_k, w_l, w_e, w_{gdp}, w_{SO_2}, w_{NOx}, w_{ws})^T$ representing capital k, labor l, energy e, industrial economic output value gdp, industrial sulfur dioxide SO_2, industrial nitrogen oxide compound NOx, and industrial solid waste ws; and $\beta^T = (\beta_k, \beta_l, \beta_e, \beta_{gdp}, \beta_{SO_2}, \beta_{NOx}, \beta_{ws})^T \geq 0$ characterizes the inefficiency level of input and output. According to Zhang and Choi (2013), input factors, such as labor and capital, directly affect economic output, but they do not directly affect pollutant emission. Therefore, this study sets $g = \left(0,0,-g_e, g_{\text{gdp}}, -g_{SO_2}, -g_{NOx}, -g_{ws}\right)$, sets w^T to $w^T = (0,0,1/5,1/5,1/5,1/5,1/5)^T$, and constructs the linear programming equation as follows:

$$\vec{D}\left(x,y,b;g\right)= \max\left(w_e\beta_e + w_{gdp}\beta_{gdp} + w_{SO_2}\beta_{SO_2} + w_{NOx}\beta_{NOx} + w_{ws}\beta_{ws}\right)$$

$$\sum_{n=1}^{N}\lambda_n k_n \leq k_{n'}$$

$$\sum_{n=1}^{N}\lambda_n l_n \leq l_{n'}$$

$$\sum_{n=1}^{N}\lambda_n e_n \leq e_{n'} - \beta_e g_e$$

$$\sum_{n=1}^{N}\lambda_n gdp_n \geq gdp_{n'} + \beta_{gdp} g_{gdp}$$

$$\sum_{n=1}^{N}\lambda_n SO_{2n} = SO_{2n'} - \beta_{SO_2} g_{SO_2}$$

$$\sum_{n=1}^{N}\lambda_n NOx_n = NOx_{n'} - \beta_{NOx} g_{NOx}$$

$$\sum_{n=1}^{N}\lambda_n ws_n = ws_{n'} - \beta_{ws} g_{ws}$$

$$\lambda_n \geq 0, n = 1, 2, \cdots, N; \beta_e, \beta_{gdp}, \beta_{SO_2}, \beta_{NOx}, \beta_{ws} \geq 0$$

When $\vec{D}\left(x, y, b; g\right) = 0$, it means that the efficiency value of the decision-making unit (DMU) is optimal, this study obtains the following capacity utilization indicators:

$$CU = \left(gdp_{n'} - \beta^*_{gdp} gdp_{n'}\right) / \, gdp_{n'} = 1 - \beta^*_{gdp}$$

This study used Maxdea 6.4 to calculate the ratio of the actual output of each province to the ideal output, which is the level of industrial capacity utilization in each province.

RESULTS AND ANALYSIS

This section discusses the relationship between regional economic competition and fiscal subsidies. Subsequently, it combines the spatial measurement model and considers the interaction between regional economic competition and fiscal subsidies. Finally, it explores the impact of the two on regional industrial capacity utilization.

Test of Regional Economic Competition on Subsidies

Firstly, this study uses the panel fixed effect model to investigate the relationship between regional economic competition and fiscal subsidies of industrial enterprises. The model form is as follows:

$$Sub_{i,t} = a + \beta_1 EC_{i,t} + \beta_2 Gov_{i,t} + \beta_3 OS_{i,t} + \beta_4 RIS_{i,t} + \beta_5 Tax_{i,t} + \beta_6 Net + \beta_7 OC_{i,t} + \eta_i + \gamma_t + \varepsilon_{i,t}$$

Among them, the dependent variable *Sub* represents the average amount of fiscal subsidies for industrial enterprises in various provinces; the independent variables are the degree of regional economic competition *EC* characterized by the proportion of foreign direct investment in GDP. In addition, this study also controls the degree of local government intervention capacity *Gov* characterized by the ratio of local government budgetary and extra-budgetary expenditures to GDP; ownership structure *OS* described by the proportion of the output value of private enterprises above the designated size to the output value of industrial enterprises above the designated size; the degree of industrial advanced level *RIS* represented by the ratio of the output value of the tertiary industry to that of the secondary industry; the tax contribution *Tax* represented by the total income tax paid by industrial enterprises above the designated size in the regional fiscal revenue; *Net* indicated the regional Internet penetration rate measured by the proportion of Internet users in the total population. The dummy variable *OC* of local core officials is characterized by the change in governor. The model controls regional and time-fixed effects, which are disturbance terms. The logarithms of these indexes are taken to eliminate potential data volatility.

In terms of data sources, the provincial fiscal subsidies for industrial enterprises come from the Chinese industrial enterprise database. This study sums up the fiscal subsidies received by industrial enterprises in each province and constructs the fiscal subsidy index of each province. Other control variables come from the China Statistical Yearbook, China Industrial Economic Statistical Yearbook, and the CSMAR Database. In addition, we also excluded a few samples with missing data. Table 1 presents descriptive statistics of the main indices.

This study lists the estimation results of ordinary least squares (OLS) estimation, fixed-effect model (FE), and two-way fixed effect model (TW_FE) in Table 2. In terms of independent variables, the coefficient of regional economic competition ln $EC_{i,t}$ is 0.332. This indicates that

Table 1. Descriptive statistics

Variable	Description	Obs.	Mean	*SD*	Min.	Max.
CU	Capacity utilization	290	0.819	0.122	0.563	1.000
EC	Regional economic competition	290	0.396	0.380	0.048	1.865
Sub	Fiscal subsidy level of regional industry	290	0.030	0.018	0.003	0.092
Gov	Degree of local government intervention	290	0.183	0.082	0.079	0.612
Tax	Tax contribution of regional industrial enterprises	290	525.917	633.708	13.630	3985.160
OS	Ownership structure of regional industry	290	0.456	0.200	0.109	0.834
RIS	Industrial structure upgrading	290	0.393	0.076	0.286	0.769
Commu	Phone penetration	290	0.746	0.385	0.131	2.006
Net	Internet penetration	290	0.211	0.179	0.012	0.736
OC	Change of regional core officials	290	0.286	0.453	0	1

Table 2. Relationship between regional economic competition and fiscal subsidies

	1	2	3
	OLS	FE	TW_FE
$\ln EC_{i,t}$	−0.025	0.194	0.332*
	(−0.34)	(1.07)	(1.75)
$\ln Gov_{i,t}$	−0.090	0.122	−0.515
	(–0.47)	(0.25)	(−0.81)
$\ln OS_{i,t}$	0.150	0.879**	0.957***
	(1.14)	(2.54)	(2.71)
$\ln RIS_{i,t}$	0.121	0.288	0.479
	(0.38)	(0.46)	(0.66)
$\ln Tax_{i,t}$	0.055	0.328	0.558*
	(0.70)	(1.46)	(1.90)
$\ln Commu_{i,t}$	−0.370*	−0.449	−0.351
	(−1.83)	(−1.41)	(−0.91)
$\ln Net_{i,t}$	0.334**	0.334	0.166
	(2.31)	(1.48)	(0.62)
$OC_{i,t}$	−0.026	−0.009	−0.047
	(−0.30)	(−0.10)	(−0.48)
Constant	−3.470***	−3.584**	−5.993***
	(−7.40)	(−2.08)	(−3.23)
Province effect	Control	Control	Control
Year effect	Control	Control	Control
Hausman test			15.25**
N	289	289	289
R^2	0.068	0.093	0.161

Note. The t-value is in parentheses, the p-value of the correlation test is in square brackets, and the significance is * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

when economic competition commences with investment attraction in the region, the level of fiscal subsidies for regional industry in the jurisdiction will rise. In terms of control variables, the higher the tax contribution of industrial enterprises, the greater the possibility that the government will take subsidies. The higher proportion of private industrial enterprises will help to obtain more fiscal subsidies. In recent years, the development of private enterprises has attracted great attention from government departments in China, and the attitude with which local governments treat the private and state-owned economies is more rational and objective.

In summary, the regression results show that, considering regional economic competition, pursuing more external capital inflows and achieving fiscal and tax revenue growth are important reasons why local governments actively implement fiscal subsidies for industrial enterprises. These will further affect the changes in industrial enterprises' production capacity. Next, this study considers regional economic competition and its spatial auto-correlation characteristics, and the empirical analysis will test the impact of local government subsidies on overcapacity.

Regional Economic Competition, Fiscal Subsidies, and Overcapacity

This study uses Moran's *I* index to test whether there is a spatial correlation between the capacity utilization indicators. The results show that the local Moran's *I* index is -0.074, which indicates strong spatial auto-correlation characteristics between different provinces in China, and a spatial econometric model should be used for the estimation. According to Vega et al. (2015), SDM weakens the endogeneity of missing variables. Referring to Elhorst (2010) and Du et al. (2022), this study adopts the SDM estimation considering time and regional fixed effects:

$$Y_{i,t} = a + \beta^T X_{i,t} + \left(p \sum_{j=1}^{N} w_{i,j} Y_{i,t} \right) + \sum_{k=1}^{K} \left(\theta_k \sum_{j=1}^{N} w_{i,j} x_{k,j,t} \right) + \gamma_i + \lambda_t + \varphi_{i,t}$$

where $Y_{i,t}$ represents the dependent variable and W represents the geographical proximity matrix with a diagonal element w of 0.When two provinces have a common boundary, the element $w_{i,j} = 1$; otherwise, it is 0. β represents the response parameters of the model, and the disturbance terms γ_i and λ_t are region-fixed effects and time-fixed effects, respectively; $\varphi_{i,t}$ are disturbance terms; ρ and θ are the spatial auto-correlation coefficients. In the specific estimation process, first, this study examines the relationship between local government fiscal subsidies and regional capacity utilization. Second, owing to regional economic competition, $\ln EC_{i,t}$ has a direct impact on industrial capacity expansion and may have an indirect impact on capacity utilization through interaction with fiscal subsidies $\ln Sub_{i,t}$. Therefore, these two and the interaction term $\ln Sub_{i,t} \times \ln EC_{i,t}$ are included in the model together.

Based on the OLS estimation, the results in Table 3 show that most of the LM-lag test and LM-error test results are significant, suggesting that the generalized SDM estimation should be considered. To make the estimation results more robust, this study uses the spatial fixed effect model, time fixed effect model, and spatial and time fixed effect model to estimate. The Wald and LR tests indicate that the SDM will not degenerate to a special SAR or SEM model. Columns 6–9 show regression results that do not consider regional economic competition. In most models, the impact of local fiscal subsidies on capacity utilization is significantly negative, indicating that the estimation results of key independent variables are robust. Column 9 is the SDM model estimation considering the spatial and time-fixed effects, and the coefficient of fiscal subsidy $\ln Sub_{i,t}$ is -0.021, which confirms Hypothesis 2, fiscal subsidy distorts resource allocation and then reduces capacity utilization. Column 10 shows the regression results of $\ln EC_{i,t}$ included in regional economic competition and its interaction with fiscal subsidies $\ln Sub_{i,t}$. The coefficient of $\ln Sub_{i,t}$ in Column 10 is -0.024, and the significance seems to have improved. It shows that after controlling for regional economic competition and interacting with fiscal subsidies, the overall estimation efficiency of the model has improved. The coefficient

Table 3. Impact of regional economic competition and fiscal subsidies on regional overcapacity: An empirical test based on 29 provinces in China

	6	7	8	9	10
	OLS	Spatial-Fixed Effect	Time-Fixed Effect	Spatial and Time-Fixed Effects	Spatial and Time-Fixed Effects
$\ln Sub_{i,t}$	−0.026 (−1.36)	−0.022* (−1.69)	−0.017 (−0.89)	−0.021* (−1.68)	−0.024** (−1.96)
$\ln Sub_{i,t} \times \ln EC_{i,t}$					0.032** (2.23)
$\ln EC_{i,t}$					0.059 (1.46)
$\ln OS_{i,t}$	0.045 (1.36)	0.098 (1.49)	0.007 (0.16)	0.145** (2.21)	0.133** (2.03)
$\ln RIS_{i,t}$	−0.254** (−2.36)	−0.210* (−1.66)	−0.193* (−1.72)	−0.382*** (−2.75)	−0.466*** (−3.31)
$\ln GOV_{i,t}$	−0.047 (−1.14)	−0.092 (−0.73)	−0.094 (−1.45)	−0.147 (−1.12)	−0.177 (−1.29)
$\ln OP_{i,t}$	0.167*** (8.27)	0.099** (2.47)	0.187*** (9.10)	0.132*** (3.19)	0.150*** (3.39)
$\ln EG_{i,t}$	−0.058*** (−2.99)	−0.010 (−0.44)	−0.083*** (−4.06)	−0.018 (−0.88)	−0.016 (−0.80)
$OC_{i,t}$	0.001 (0.01)	0.014 (0.74)	0.005 (0.17)	0.014 (0.72)	0.019 (1.00)
$W \times \ln Sub_{i,t}$		−0.026 (−1.08)	−0.150 (−1.31)	−0.024 (−0.93)	−0.032 (−1.26)
$W \times (\ln Sub_{i,t} \times \ln EC_{i,t})$					0.003 (0.12)
$W \times \ln EC_{i,t}$					0.093 (0.91)
$W \times \ln OS_{i,t}$		−0.111 (−1.12)	0.254*** (3.08)	0.151 (1.20)	0.160 (1.29)
$W \times \ln RIS_{i,t}$		−0.369* (−1.69)	−0.968*** (−4.45)	−0.973*** (−3.25)	−1.150*** (−3.56)
$W \times \ln GOV_{i,t}$		0.148 (0.95)	−0.032 (−3.00)	0.106 (0.42)	0.055 (0.21)
$W \times \ln OP_{i,t}$		−0.058 (−0.95)	0.123*** (2.67)	0.208** (2.42)	0.265*** (2.81)
$W \times \ln EG_{i,t}$		0.052 (1.58)	0.041 (0.79)	−0.022 (−0.53)	−0.029 (−0.67)
$W \times OC_{i,t}$		−0.024 (−0.81)	−0.048 (−0.81)	−0.022 (−0.58)	−0.020 (−0.52)
$W \times$ dep.var		0.040 (0.49)	−0.216** (−2.54)	−0.104 (−1.23)	−0.102 (−1.22)
intercept	−0.784*** (−4.71)				

continued on following page

Table 3. Continued

	6	7	8	9	10
	OLS	**Spatial-Fixed Effect**	**Time-Fixed Effect**	**Spatial and Time-Fixed Effects**	**Spatial and Time-Fixed Effects**
R^2	0.374	0.786	0.472	0.807	0.813
lik	38.94	193.75	61.62	209.39	213.68
LM-lag	6.684**				
R-LM-lag	4.832**				
LM-error	3.316*				
R-LM-error	1.469				
Wald-spatial-lag		10.59	33.38***	20.64***	25.79***
LR-spatial-lag		11.57	32.63***	24.73***	30.31***
Wald-spatial-error		10.65	34.43***	20.07***	25.43***
LR-spatial-error		11.70	33.37***	22.94***	28.72***

Note. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively, and the number in the extension sign represents the t value. lik stands for log likelihood.

of the interaction term $\ln Sub_{i,t} \times \ln EC_{i,t}$ is 0.032. This indicates that after controlling for local fiscal subsidies, fierce economic competition has a positive impact on industrial capacity utilization, which is consistent with Hypothesis 3. This is because regional economic competition may force regional industrial enterprises to accelerate technological upgrading and quality improvement. The resulting cost control and technological progress effects are conducive to improving capacity utilization.

Among other control variables, the coefficient of $\ln OS_{i,t}$ is 0.133, which means that a higher proportion of the private economy is conducive to improving capacity utilization. This conclusion is similar to Cheng et al. (2021) that state-owned enterprises (SOEs) were significantly less likely than private firms to reduce their overcapacity. Large SOEs, such as steel and coal, are significant in regional GDP, taxation, and employment. When these enterprises face bankruptcy, equipment shutdown, or reorganization, local governments usually tend to make some new policies to protect them. Conversely, private enterprises quickly adjust production and business strategies during periods of economic downturn or severe decline in profits to transfer limited resources to other production and business areas. The level of industrial structure $\ln RIS_{i,t}$ is negatively correlated with capacity utilization. As the service industry gradually becomes the main engine of regional economic growth, the market demand potential of traditional domestic industries, especially manufacturing, has been saturated, and the production capacity during the early production expansion process has been redundant.

Significant spatial lag of some variables suggests that there may be spatial spillover effects between regions in China. Following LeSage (2009), this study uses the partial differential method to test spatial spillover effects and decomposes the influence of independent variables on dependent variables into direct and indirect effects. Among them, the SDM model and its corresponding partial differential matrix can be expressed as:

$$Y = \left(I - pW\right)^{-1} \alpha + \left(I - pW\right)^{-1} \left(X\beta + WX\theta\right) + \left(I - pW\right)^{-1} \varepsilon$$

$$\left[\frac{\partial Y}{\partial X_{1,k}} \cdots \frac{\partial Y}{\partial X_{N,k}}\right] = \left(I - pW\right)^{-1} \begin{bmatrix} \beta_k & w_{1,2}\theta_k & \cdots & w_{1,N}\theta_k \\ w_{2,1}\theta_k & \beta_k & \cdots & w_{2,N}\theta_k \\ \vdots & \vdots & \ddots & \vdots \\ w_{N,1}\theta_k & w_{N,2}\theta_k & \cdots & \beta_k \end{bmatrix}$$

According to the partial differential matrix of Y for the k th independent variable, if the specific independent variable of a specific unit changes, the change in the dependent variable of this unit is a direct effect, while the dependent variables of other units change as an indirect effect. Accordingly, this study organizes the direct, indirect, and total effects obtained by decomposition in Table 4.

Table 4 outlines that, although the direct impact of local government fiscal subsidies $\ln Sub_{i,t}$ on the utilization rate of local industrial capacity is negative (coefficient of −0.024), the indirect effect is not significant. This demonstrates that the negative interference of the local government's fiscal subsidies on the industrial capacity utilization rate of the jurisdiction is mainly concentrated in the region, and the spatial spillover effect has not affected other regions. The direct and indirect effects of the regional industrial advancement $\ln RIS_{i,t}$ are both significantly negative (coefficients are −0.446 and −1.041). This indicates that the industrial structure of each region is tilted toward the service industry. This change leads to redundant capacity in traditional industries, especially the manufacturing industry, and the trend toward advanced local industries will weaken the capacity utilization rate in other regions. In addition, the direct and indirect effects of opening-up $\ln OP_{i,t}$ measured by the degree of trade dependence of each province are both significantly positive. This indicates that when the domestic market demand for industrial products becomes saturated, expanding overseas market demand will be important to solving domestic surplus capacity. In recent years, China has expanded its opening-up through the construction of pilot free trade zones and accelerated foreign investment and economic and trade cooperation with developing countries in Asia and Africa based on the

Table 4. Decomposition of direct, indirect, and total effects on capacity utilization

	Direct Effect	Indirect Effect	Total Effect
$\ln Sub_{i,t}$	−0.024* (−1.87)	−0.028 (−1.15)	−0.051** (−2.21)
$\ln Sub_{i,t} \times \ln EC_{i,t}$	0.032** (2.19)	0.001 (0.02)	0.032 (1.06)
$\ln EC_{i,t}$	0.058 (1.45)	0.080 (0.82)	0.138 (1.29)
$\ln OS_{i,t}$	0.130* (1.93)	0.136 (1.18)	0.266** (2.34)
$\ln RIS_{i,t}$	−0.446*** (−3.14)	−1.041*** (−3.42)	−1.487*** (−4.28)
$\ln GOV_{i,t}$	−0.182 (−1.72)	0.072 (0.29)	−0.110 (−0.42)
$\ln OP_{i,t}$	0.144*** (3.39)	0.234** (2.71)	0.378*** (3.85)
$\ln EG_{i,t}$	−0.014 (−0.65)	−0.027 (−0.65)	−0.041 (−0.98)
$OC_{i,t}$	0.020 (1.05)	−0.020 (−0.56)	0.000 (0.00)

Note. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively, and the number in the extension sign represents the t value.

"Belt and Road." These promote industrial capacity utilization and the optimization and upgrading of traditional industries in the country.

Further, this study extends the research object from the provincial level to the industrial capacity utilization at the urban level and considers the heterogeneity of different cities in different geographical locations. A total of 270 prefecture-level and above cities in China are divided into two groups: 97 cities in the coastal area, which economic level is more developed than that in the inland area, and the level of industrial development is higher. The inland area includes a total of 173 cities, and the overall level of economic and industrial development is relatively backward. In the process of measuring the capacity utilization rate of urban industry, the inputs of capital, labor, and energy consumption of urban industry were measured by the average balance of the net fixed assets of industrial enterprises above state designated scale, the average number of employees and urban industrial power consumption, and the output was expressed by the gross value of industrial output above state designated scale and industrial pollution emission. These data come from the CSMAR Database and China City Statistical Yearbook.

This study further examines the impact of economic competition and fiscal subsidies on the differential utilization of urban industrial capacity. Table 5 provides the regression results based on OLS estimation and SDM, in which Wald and LR tests show that the SDM is reasonable. The coefficient of fiscal subsidies in coastal cities is positive, but its interaction coefficient with economic competition is negative, which means that when controlling the influence of economic competition, local governments providing more fiscal subsidies to industrial enterprises will have a certain weakening impact on capacity utilization. The reason is that reasonable economic competition helps to promote the improvement of capacity utilization, but if the government provides more fiscal subsidies to local enterprises, it will have a certain degree of resources misallocation impact on the production behavior and free competition of enterprises, resulting in the weakening of capacity utilization. In contrast, in underdeveloped inland cities, government subsidies and regional economic competition will not have a significant impact on enterprise capacity utilization. This also fully shows that in the process of solving the problem of overcapacity, the differences in locations, economic development, and industrial characteristics of different cities should be considered, and more targeted policies and measures should be formulated.

CONCLUSION AND DISCUSSION

Conclusion

This study analyzed the relationship between regional economic competition, fiscal subsidies, and overcapacity and found that regional economic competition has both positive and negative effects on capacity utilization. On the one hand, to strive for more foreign investment, local governments tend to increase fiscal subsidies to industrial enterprises, which reduces the production cost of enterprises, leads to the misallocation of resources, further contributing to overcapacity. On the other hand, the technology diffusion and competitive effect of foreign investment can also weaken the overcapacity. The heterogeneity analysis based on geographical location shows that the fiscal subsidies to industrial enterprises weaken the improvement effect of economic competition on capacity utilization in coastal cities, but there is no such impact in inland cities.

Practical Implications

The above conclusions also provide insights into the governance of China's industrial overcapacity. In the future, all regions should encourage the efficient allocation of various production factors in different regions and industries through reasonable regional economic competition and free market competition. The regional governments should consider the heterogeneity of different regions in terms of geographical location, industrial structure, and technological foundation and put fiscal subsidies

Table 5. Impact of regional economic competition and fiscal subsidies on regional overcapacity: An empirical test based on 270 cities in China

	Costal City		Inland City	
	OLS	Regional and Time Fixed Effects	OLS	Regional and Time-Fixed Effects
ln $Sub_{i,t}$	−0.002 (−0.14)	0.033*** (2.61)	−0.019 (−1.59)	−0.012 (−1.27)
ln $Sub_{i,t}$ × ln $EC_{i,t}$	−0.023*** (−2.61)	−0.016** (−1.97)	0.038*** (4.97)	0.008 (1.46)
ln $EC_{i,t}$	0.053*** (4.07)	0.052*** (3.12)	0.033** (2.46)	0.009 (0.81)
W × ln $Sub_{i,t}$		0.403*** (4.12)		0.146 (1.45)
W × (ln $Sub_{i,t}$ × ln $EC_{i,t}$)		−0.109** (−2.23)		0.138** (2.40)
W × ln $EC_{i,t}$		0.155 (1.50)		0.077 (0.70)
W × dep.var		0.455*** (3.92)		−0.203 (−1.00)
Intercept	−0.091 (−0.47)		0.572*** (3.10)	
LM-lag	42.08***		244.55***	
R-LM-lag	12.19***		45.02***	
LM-error	33.03*****		246.16***	
R-LM-error	3.14*		46.63***	
Wald-spatial-lag		35.84***		14.27*
LR-spatial-lag		42.62***		18.44**
Wald-spatial-error		40.51***		13.92*
LR-spatial-error		48.76***		17.49**
R^2	0.395	0.854	0.222	0.866
Controls	Yes	Yes	Yes	Yes
W × Controls		Yes		Yes
N	582	582	1038	1038

Note. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively, and the number in the extension sign represents the t value.

according to the principles of science, prudence, and efficiency priority. For zombie enterprises with bleak market prospects and low technological levels, inefficient fiscal subsidies should be reduced.

Limitations and Future Research Directions

In this research, foreign direct investment was used to measure the degree of regional economic competition. The reason is that capital elements are obviously scarce, and their flow trends between different regions are greatly affected by the decisions of local governments. In the future, the causal relationship between regional economic competition and overcapacity can also be discussed from the perspective of industrial policy implementation and market segmentation. There are still research limitations. For example, the focus of industrial development in different regions should be considered to be heterogeneous, and this study does not discuss different manufacturing industry segments in more detail. In addition, in the process of spatial econometric analysis, this study has not revealed the specific spatial spillover direction between different types of cities, such as large cities and small cities. These are the parts that need to be improved in future research.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest, and they contribute equally to this work.

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