EasyChair Preprint

№ 10544

Can the Urban Industrial Transformation and Upgrading Be Stimulated by Government Venture Capital?

Hongdi Wang, Yanan Xue, Xibo Jin and Weiyang Ye

July 12, 2023

Can the urban industrial transformation and upgrading be stimulated by government venture capital?

Hongdi Wang1, Yanan Xue1, Jin Xibo2*, Ye Weiyang3

Abstract: A new round of technological revolution and industrial transformation is sweeping the world, and urban industrial transformation and upgrading are becoming increasingly important to every city. As a new type of policy tool, government venture capital (GVC) has received high attention from governments and is used to promote the transformation and upgrading of urban industries. Based on the theoretical discussions on the impacts and mechanisms of GVC on urban industrial transformation and upgrading, an empirical study with the evidence of a panel data of 277 cities in China from 2016 to 2020 is conducted. It is found that a significant positive correlation between GVC and the advanced level of urban industries and the rationality of urban industrial structure. Further analysis shows GVC can better promote urban transformation and upgrading at the advanced regions, while GVC can significantly improve the advanced level of industrial structure in the central regions, and improve the rationality of industrial structure in the western regions. Corresponding suggestions are given to the local governments to accelerate urban industrial transformation and upgrading through GVC.

Keywords: government venture capital, urban industrial transformation and upgrading, impacting effects, empirical study

[1] School of Public Administration, Zhejiang University of Finance & Economics
[2] School of Finance, Zhejiang University of Finance & Economics
[3] School of Accounting, Zhejiang University of Finance & Economics
*Corresponding author

1 Introduction

Urbanization has been a defining trend of human development in the past century. As the world's population growth, cities have become the primary hubs of economic activity, cultural exchange, and social interaction. However, with the rapid pace of urbanization, challenges such as urban blue, infrastructure deficits, environmental degradation, socio-economic qualities, and industrial lock-in have emergent. These issues require active government intervention and innovative solutions to transform and upgrade urban economy. One such solution is government venture capital (GVC), which aims to support urban industrial transformation and upgrading efforts by utilizing public resources and leveraging public resources to foster innovation and entrepreneurship (Pan et al., 2020).

GVC is a form of public-private partnership where the government provides funding for start-up businesses or innovative projects that have the potential to create jobs, stimulate economic growth, and address social challenges. In the context of urban transformation and upgrading, GVC can play a vital role in supporting initiatives that address key challenges facing cities. For example, GVC can support the development of innovative technologies and solutions for energy efficiency, waste management, and transportation, among others. This can include investments in renewable energy, smart lighting, green infrastructure, and public transportation systems. By investing in these areas, GVC can help reduce greenhouse gas emissions, enhance infrastructure and public services, and improve the quality of life in urban areas More, GVC can support the development of small and medium-sized enterprises (SMEs) that are critical to strategic and sustainable economic growth By providing funding for SMEs, GVC can help spur entrepreneurship and innovation in line with a city's industrial development plan It has been widely recognized for the importance of GVC for its potential contributions to urban transformation and upgrading

As an innovative policy tool, GVC is designed to override the drawbacks of traditional policy tools and venture capital markets, and are of great significance for the transformation and upgrading of urban industries. First, as the investor, the government is only responsible for guiding and formulating scientific decision-making mechanisms, and will normally not interfere with the operation and management of the fund. During the operation of the fund, the boundary between the government and the market is clear, which can avoid the restrictions on government financial intervention under the world trade agreement. Second, GVC is operated in a market-oriented way, and it can observe the corresponding investment return through the agreed exit mechanism and proceed to the next round of investment. To a large extent, it reduces the government's financial burden and achieves the sustainable and rational utilization of state-owned capital (Trabelsi et al., 2021). Third, with the support of the government, GVC can send out a signal to guide social capital to invest in urban innovative enterprises and high-tech enterprises. Thus, it can effectively promote enterprise innovation, promote technical progress in strategic or social value adding industries, driving the transformation of urban industrial structure, and ultimately reaching urban industrial upgrading.

Aspire the many advances of GVC in promoting urban industrial transformation and upgrading, there are still problems in practice such as idle and wasteful funds, decision-making errors, lack of exit and transfer mechanisms, few followers of private capital, and low investment return (Wang, 2010; Shiet et al., 2016; Xu and Gupta, 2020). Due to government intervention and low efficiency, the role of GVC in urban industrial transformation and upgrading is limited (Bertoni & Tykvová, 2015). In order to fully leverage the policy potentials of GVC, innovative existing fund development models, and

better utilize the functions of GVC to leverage social capital and allow industrial financing constraints, more theoretical and empirical research is needed on GVC and urban industrial transformation and upgrading. This article will theoretically bridge the relationship between GVC and urban industrial transformation and upgrading, and empirically test the relationship through the panel data analysis on 277 cities in China.

2 The mechanism of GVC to promote urban industrial transformation and upgrading

Based on the existing literature and theoretical research, this paper summarizes six mechanisms of GVC to promote the transformation and upgrading of urban industry, and builds a theoretical analysis basis for the construction of subsequent mathematical models.

2.1 To enhance the capital supply

The GVC can use its leverage effect and signal transmission effect to improve the supply level of urban funds, promote the development of emerging industries and weak industries, and promote the transformation and upgrading of urban industries. The GVC plays the leverage role of financial contribution, which can leverage idle social funds. The supporting policy support is also conducive to reducing transaction costs, accelerating the accumulation of social funds, expanding the scale of industrial investment (Ren, 2018), and improving the "amount" of industrial capital supply. The GVC is a financial tool that matches the urban industrial development strategy, and its investment in related industries releases a signal indicating the importance of investing in industries. Through the signal transmission effect, it can enhance the confidence of social investment, guide the allocation of social funds to the key industries of the city, help to realize the optimal allocation of funds in different regions and industries (Liu, 2019), and improve the efficiency of capital utilization and the "quality" of industrial capital supply. The improvement of capital supply level is conducive to supporting industrial technological innovation, transforming resources into productivity, and promoting the "old to new" of backward industries. It has also provided conditions for the expansion and reproduction of key industries, realized the scale expansion of high-tech industries, strategic emerging industries, and other industries, enhanced the cluster effect of urban industrial development, and promoted the transformation and upgrading of urban industries.

2.2 To change the urban industrial structure

The rationality and sophistication of industrial structure will be affected by regional economic changes (Yuan, 2019). GVC can support enterprise innovation through bring in more financial and material resources to carry out technological innovation (Lerner, 2010). Its newly developed products tend to have a higher technical level, thus enhancing the competitive advantage of enterprises and gaining a dominant position in the market. The technology of enterprises in an advantageous position will transfer to enterprises in a disadvantageous position, change the regional industrial structure of cities with backward technology, and guide the evolution of industrial structure from low-level to high-level. In addition, GVC has increased the investment in production factors of industrial capital, enhanced the liquidity of capital factors

among industries, strengthened the coupling between production departments, and greatly increased the rationality of urban industrial structure. Therefore, the urban regional structure plays a conductive role in the process of the change of GVC and industrial structure.

2.3 To adjust the demand structure of urban products

As one of the means of government intervention, GVC is an important factor causing the adjustment of product demand structure in the market. At the same time, the product demand structure drives the government to guide the fund to flow to the areas most in need of investment in the city. On the one hand, GVC to support enterprises' technological innovation, improve their productivity, reduce production costs, increase product added value, change the traditional production structure, consolidate the competitive advantage and satisfaction level of products, become a new direction of market demand, and change the demand structure of urban products. With the progress of the overall technical level of the industry and the expansion of the production scale of new products, the production factors brought by GVC can further boost the growth of emerging industries and adjust the structural proportion among different industries. On the contrary, GVC depends on the current urban market demand structure, and only innovation that meets the market demand is valuable (Sun and Zong, 2022). When the market demand is not met, it points out the areas that need attention for GVC. The market demand will attract funds to gather in the direction most needed by the market, and GVC will also obtain development space.

2.4 To change the urban employment structure

GVC promotes the change of urban structure, and the urban employment structure can reflect the change of urban industrial structure to a certain extent. GVC can attract more high-level labor, provide high-quality intellectual resources for urban industrial development, and improve the rationalization of industrial division and the level of production specialization. In addition, GVC can improve the income level of workers in the production sector, increase residents' consumption of high-end products, promote the transformation of consumer demand to the high-end direction, and promote the development of high value-added industries. The development of advanced industries has reduced the social demand for traditional manual workers, and in turn increased the demand for labor with technology and management ability, that is, technology has replaced the traditional labor force to a certain extent. Promote the refinement, specialization, and diversification of the production process, promote the transformation of products from low added value to high added value, and improve the advanced level of urban industrial structure.

2.5 To promote the division of labor

According to the theory of division of labor, the supply of capital production factors brought by GVC promotes industrial technological innovation, which is conducive to deepening the degree of division of labor in urban society, promoting the emergence and development of emerging industries, and providing diversified production products. GVC can not only improve the technological innovation level of urban industries, but also improve the input and output efficiency of industrial production factors, optimize, and upgrade the production mode of key industries by promoting the division of labor and specialization of production in urban society. Enterprises can get higher output with less input of production factors, which not only reduces resource consumption, but also further improves the added value of products, and promotes the

advanced level of urban industrial structure in terms of production efficiency.

GVC has deepened the urban social division of labor, and will further have a positive impact on the rationality of the urban industrial structure. Firstly, the increasing level of urban social division of labor can increase the categories of urban industries and promote the coordinated development of upstream and downstream supporting industries. Secondly, the development of urban social division of labor and production specialization can also improve the labor productivity of the production sector and the utilization efficiency of production factors (Yuan, 2019). In this case, the diversified development pattern of urban industry can effectively avoid the homogenization of urban industrial development and promote the rationalization of urban industrial structure.

2.6 To accelerate the industrial replacement

The government guides the fund to cultivate and support key industries such as urban high-tech industries and strategic emerging industries, and through encouraging technological innovation to transform and upgrade traditional industries, improve the input-output efficiency of traditional industries, eliminate backward production capacity, and promote the conversion of old and new production capacity. We will gradually shift the focus of industrial structure to the tertiary industry and increase the proportion of high-end industries in the urban industrial structure (Sohn et al., 2012). GVC can bring capital, technology, talent, and other key production factors to emerging industries, which can accelerate the rapid expansion of the new industry. After the development and expansion of urban leading industries, the advanced production technology within the industry will also spread to the downstream traditional industries, updating, and upgrading the production mode of traditional industries. This technology diffusion effect can effectively reduce the barriers to entry between industries (Li, 2018), promote the integration and symbiosis of different industries, and jointly promote the rational development of urban industrial structure.

In short, GVC can use its own information advantages to select seed industries with high innovation, advanced technology, and great potential for subsequent development from regional industries. By supporting and incubating the development of advantageous industries, it can drive the progress of other supporting industries and the transformation and upgrading of traditional industries..

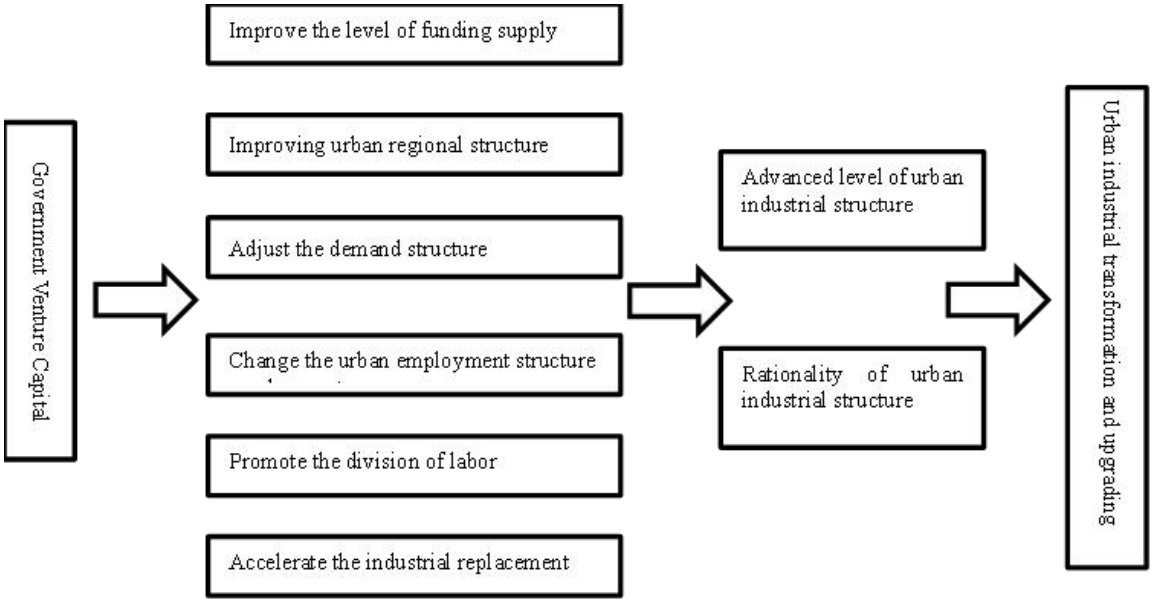

Figure 1 theoretical analysis framework of the impact of GVC on urban industrial structure

3 Model, variables, and data

3.1 The benchmark models

In order to answer research question that whether GVC can stimulate the urban industrial transformation and upgrading, the two benchmark models are constructed as follows:

$$REA_{it} = \theta_i + \beta_1 GVC_{it} + \beta_2 ECO_{it} + \beta_3 DOM_{it} + \beta_4 FIN_{it} + \beta_5 GOV_{it} + \beta_6 INF_{it} + \beta_7 HUM_{it} + \beta_8 OPEN_{it} + \varepsilon_{it}$$

$$ADV_{it} = \theta_i + \beta_1 GVC_{it} + \beta_2 ECO_{it} + \beta_3 DOM_{it} + \beta_4 FIN_{it} + \beta_5 GOV_{it} + \beta_6 INF_{it} + \beta_7 HUM_{it} + \beta_8 OPEN_{it} + \varepsilon_{it}$$

Where "i" refers to different cities; "t" is the time; θ_i represents the fixed effect of each city and ε_{it} represents the random error. In order to further explore the impact of government venture capital on urban industrial transformation and upgrading, the study will conduct regression analysis from the national level, regional level, and quantile effect.

3.2 Variables

The level of urban industrial transformation and upgrading is the **explained variable**, and is measured by the advanced degree (REA) and rationalization (ADV) of the urban industrial structure, as shown in Table 2.

Table 2 selection of variables and indicators

Variable type	Variable name	Code	Index	Reference
Explained variable	Urban industrial transformation and upgrading level	REA	Rationality of industrial structure	Liu (2019); Shen (2019); Peng (2021); Deng(2021)
		ADV	Advanced degree of industrial structure	Shen (2019); Zuo (2020)
Explanatory variable	Government venture capital	GVC	Number of enterprises invested by government guided funds	Li (2014); Li (2018); Chen (2018)

Control variable	Economic development level	ECO	Per capita GDP	Dai (2014); Chen (2017); Yuan (2019)
	Urban industrial base	DOM	Number of Industrial Enterprises above Designated Size	Wang (2014)
	Financial development level	FIN	Total deposits and loans per capita at the end of the year	Zheng (2020); Chen (2017)
	Government support	GOV	Government expenditure on science and technology	Mackiewicz et al. (2021); Chen (2020)
	Urban infrastructure	INF	Length of urban drainage pipeline	Deng (2021); Yuan (2019)
	Urban human capital	HUM	Proportion of college students in permanent population	Li (2012); Chen (2017); Yuan (2019)
	Opening up level	OPEN	Foreign direct investment	Chen (2017); Yuan (2019)

This study refers to Zuo (2020) for the advanced degree of industrial structure, uses the industrial structure hierarchy coefficient to measure the advanced degree of urban industrial structure, and represents the advanced level of the evolution of the three major industries in the city from the perspective of the proportion of industries. The calculation formula is as follows:

$$ADV = \sum_{m=1}^{3} \frac{Y_{itm}}{Y_{it}} \times m,\ m=1,2,3 \qquad (Eq.1)$$

In formula (3-1), ADV represents the industrial structure of city i in the period of t, Y_{it} represents the gross domestic product of city i, Y_{itm} represents the gross domestic product of the m industry of city i, $\frac{Y_{itm}}{Y_{it}}$ represents the proportion of the m industry of city i in the local gross domestic product in the period of t, and the values of m are 1, 2, and 3, respectively, representing the primary, secondary, and tertiary industries of the region. The main reason for assigning values to different industries is that the importance of the three industries in the transformation and upgrading of urban industries is different.

There are only a few quantitative studies on the rationality of urban industrial structure. This paper introduces the Theil index, which has significant advantages in estimating the size and importance of the deviation between variables. It not only calculates the structural deviation between the output value of the three industries and the number of employees, but also considers the different importance of the three industries. The calculation formula is as follows:

$$REA = \sum_{m=1}^{3} \left(\frac{Y_{itm}}{Y_{it}}\right) ln \left(\frac{Y_{itm}/Y_{it}}{L_{itm}/L_{it}}\right),\ m=1,2,3 \qquad (Eq.2)$$

In formula (3-2), REA represents the industrial structure of city i in period t, L_{it} means the total number of employed people in city i, L_{itm} represents the number of employed people in the m industry in city i, Y_{itm}/Y_{it} represents the proportion of the m industry in the GDP of city i in period t, and L_{itm}/L_{it} represents the proportion of the m industry in the total number of employed people in city i in period t. The interpretation of other repeated indicators is consistent with formula (3-1). In the formula ln $\left(\frac{Y_{itm}/Y_{it}}{L_{itm}/L_{it}}\right)$, the coupling degree of output and labor input structure in the industry is calculated.

GVC is the **explanatory variable**, which is usually measured by the investment amount or the dummy variable of including GVC. In the actual operation process, GVC investment institutions will release the investment event information. This study uses the number of enterprises invested by GVC as the measurement. According to the ownership information of the invested enterprise in the published GVC investment event, the total amount of fund investment in various cities across the country is sorted out.

Seven **control variables** are extracted from the literature review, which are (1) the level of regional economic development; (2) urban industrial base; (3) financial development level; (4) policy support; (5) urban infrastructure; (6) human capital; and (7) the level of urban opening up.

3.3 Sample

3.3.1 Data sources

There are two sources of data for this paper. One is China Urban Statistical Yearbook and China Statistical Yearbook, including the data of Eco, DOM, FIN, GOV, INF, HUM and OPEN. There is no direct data source for REA and ADV which is further calculated according to the relevant formula. For the lack of data in some cities, this study uses linear interpolation method to supplement. In addition, there are serious data missing and key data missing in some cities, including cities in Xinjiang Autonomous Region, Tibet Autonomous Region, and Inner Mongolia Autonomous Region other than the provincial capital. These cities are in remote areas with very few data, and are not included. The filtered data of 277 cities are finally obtained. The GVC data mainly comes from the commercial query platform. GVC investment events from January 1st, 2016 to December 31st, 2020 are collected and cleaned by means of web crawler in the commercial query platforms such as Tianyan Search and Enterprise Inspection. Eventually, 13375 event data were sorted out.

3..2 Data description

According to the analysis of the data, the average number of GVC investment event per year in China's cities is about 0.894, the maximum value is 6.497 in Beijing in 2020, and the minimum value is 0. Among the explained variables, the average value of the rationality of urban industrial structure (REA) index is -2.778, with the maximum value of 4.418 in Beijing in 2020 and the minimum value of -4.603 in Bijie in 2016; The average value of ADV index is 233.1, of which the maximum value is 283.2 in Beijing in 2020 and the minimum value is 188.2 in Heihe in 2016. Overall, there is still a big gap between the support of GVC and the rationality of industrial structure in China.

Table 3 Descriptive Statistics

Variables	(1)	(2)	(3)	(4)	(5)
	N	Mean	SD	Min	Max
DOM	1385	6.605	1.086	3.045	9.309
Eco	1385	7.479	0.934	5.033	10.55
Rea	1381	-2.778	1.534	-4.603	4.418
Adv	1385	233.1	13.37	188.2	283.2
VC	1384	0.894	1.243	0	6.497

INF	1385	3.962	5.021	0.103	57.53
Open	1327	1.792	2.925	-4.474	29.53
Hum	1385	4.722	1.036	1.567	7.189
Fin	1385	1.808	2.473	0.163	25.77
Gov	1385	2.590	6.995	0.0542	122.0

T-statistics in parentheses ***P<0.01, * * p<0.05, * p<0.1

4 Empirical analysis

4.1 Panel data analysis

The P values of Hausmann statistics are all 0.000<0.05, and the fixed effect model should be selected. The result of panel data analysis is shown in Table 4.

Table 4 fixed effect model regression results

Variables	FE	
	(1)	(2)
	ADV	REA
GVC	0.859***	0.083***
	(2.79)	(2.89)
ECO	0.001***	0.588***
	(5.60)	(4.99)
DOM	-0.003***	0.008
	(-4.96)	(0.09)
FIN	1.697***	0.178***
	(4.53)	(3.89)
GOV	0.011	0.002
	(0.14)	(0.06)
INF	0.175**	-0.020
	(2.13)	(-0.45)
HUM	0.014***	-0.140*
	(3.43)	(-1.91)
OPEN	0.109	-0.017
	(0.91)	(-1.12)
Constant	225.575***	-7.138***
	(170.27)	(-8.03)
Observations	1326	1312
Number of ID	267	267
R^2	0.4774	0.4613

From the regression results at the national level, GVC has significantly improved the advanced degree of urban industrial structure and the industrial rationality of urban structure, and the regression coefficients are 0.859 and 0.083, respectively, with a significant level of 1%. Through the signal transmission effect and leverage effect, GVC can leverage the social idle funds, guide the rational distribution of funds, and alleviate the financing gap of innovative enterprises. Based on the mechanism of GVC to improve the level of capital attack, it is found that when the government establishes GVC, it often introduces supporting measures to create a better business environment for industrial development. From the perspective of the mechanism of GVC to change the urban regional structure, GVC can promote the flow of technology among industries and change the regional structure. At the same time, it can make up for the disadvantages of

market failure by properly intervening in the market. GVC can also attract more high-quality labor, and play the role of GVC in changing the mechanism of urban employment structure. The mechanism of GVC to promote the division of labor in urban society also plays a key role in improving the technological innovation level of urban industries, optimizing the input and output structure of industrial production factors, and improving the production mode of emerging industries. Based on the mechanism of GVC to accelerate the change of urban industries, it is found that GVC can promote the rapid rise of emerging industries, form new urban leading industries, and promote the transformation and upgrading of urban industries. In short, the regression results strongly support that GVC can promote the transformation and upgrading of urban industries.

In terms of control variables, the level of economic development is significantly correlated with the advanced degree of urban industrial structure and the rationality of urban industrial structure. The regression coefficients are 0.001 and 0.588, respectively, and the significance level is 1%. It shows that the level of economic development can promote the advanced degree of urban industrial structure and the rationality of urban industrial structure. The higher the level of local economic development, the better the transformation and upgrading of urban industries; The regression coefficient is -0.003, and the significance level is 1%, which is not related to the rationality of urban industrial structure. It shows that the impact of urban industrial base on urban industrial transformation and upgrading is not obvious enough, which is inconsistent with the hypothesis; The level of financial development is significantly correlated with the advanced degree of urban industrial structure and the rationality of urban industrial structure, and the regression coefficients are 1.697 and 0.178, respectively, with a significant level of 1%. It shows that the financial development level of a city can promote the transformation and upgrading of urban industries, which is in line with expectations; There is a significant correlation between urban infrastructure and urban industrial structure, with a regression coefficient of 0.175 and a significance level of 5%. The improvement of infrastructure can optimize the allocation of resources, improve the mobility of production factors, and promote the advanced development of industrial structure; Urban human capital is significantly correlated with the advanced degree of urban industrial structure, with a regression coefficient of 0.014 and a significance level of 1%. Human capital can support industrial technological innovation activities, promote the rapid development of high-end industries, and improve the degree of urban industry.

4.2 Robustness analysis

4.2.1 Regional heterogeneity test

It is found that there are obvious regional differences in the distribution of GVC investment events. The GVC development in the eastern region of China is high, followed by the central region, and the western region lowest. The average value of GVC in eastern cities is 1.332, which is significantly higher than the average value of 0.76 in central cities and 0.337 in western cities. Due to the existence of regional differences, it is necessary to further explore the impact of GVC on the regional differences of urban industrial transformation and upgrading.

In terms of control variables, financial development level (FIN), urban infrastructure (INF), opening up level (OPEN) and government support (GOV) all show that eastern cities are better than central and western cities. As to Economic development level (ECO), urban human capital (HUM) and urban industrial base (DOM), eastern cities are slightly higher than central and

western cities, and the gap is not large.

Table 5 descriptive statistics of variables in Eastern, Middle and Western China

variable	region	N	Mean	SD	Min	Max
FIN	eastern	560	2.541	3.358	0.261	25.77
	middle	505	1.187	1.124	0.163	6.836
	western	320	1.507	1.772	0.237	11.05
GVC	eastern	560	1.332	1.483	0	6.497
	middle	504	0.760	0.996	0	4.454
	western	320	0.337	0.775	0	4.111
ADV	eastern	560	237.1	12.71	211.9	283.2
	middle	505	230.8	13.07	188.2	265
	western	320	229.8	13.21	205.2	271.9
ECO	eastern	560	7.884	0.935	6.011	10.55
	middle	505	7.351	0.734	5.360	9.694
	western	320	6.975	0.910	5.033	10.07
REA	eastern	560	-2.547	1.890	-4.404	4.418
	middle	505	-2.712	1.263	-4.601	2.216
	western	320	-3.284	1.031	-4.603	1.211
INF	eastern	560	5.570	6.696	0.141	57.53
	middle	505	2.822	2.365	0.290	17.79
	western	320	2.947	3.788	0.103	32.24
OPEN	eastern	560	2.304	3.755	0.00120	29.53
	middle	505	1.828	2.205	-4.474	13.75
	western	320	0.627	1.396	-0.119	8.850
HUM	eastern	560	4.881	0.986	2.723	7.130
	middle	505	4.676	1.013	2.140	7.189
	western	320	4.516	1.116	1.567	7.179
GOV	eastern	560	4.196	10.48	0.0576	122.0
	middle	505	1.722	2.462	0.0542	19.71
	western	320	1.148	1.514	0.126	15.25
DOM	eastern	560	7.074	1.122	3.045	9.309
	middle	505	6.569	0.814	4.143	7.998
	western	320	5.840	0.944	3.497	8.822

4.2.2 Quantile test

It can be seen from table 6 that the role of GVC is obviously different when the urban industrial structure is in different conditions. The estimated coefficient is 1.139, but it is not significant when the explained variable is at the lower quantile level of 25%. With the improvement of urban industrial upgrading level, when the quantile level reaches 50%, the estimated coefficient increases significantly to 1.587, and it is significant at the 1% level. When the advanced level of urban industrial structure continues to rise, reaching 75% and 90% respectively, the estimated coefficients are 0.194 and 0.572 respectively, but the estimated results are not significant. The results show that cities with medium level of industrial structure can significantly promote the development of urban industrial upgrading. The possible explanation is

that when the high level of urban industrial structure is low, there is often a lack of technology and talent reserve required for the development of high level. It is difficult for GVC to fully perform. When the urban industrial structure reaches the medium level and the tertiary industry is in a period of rapid development, GVC can make full use of the relatively good industrial base and production factors to accelerate the development of high value-added industries and promote industrial upgrading. When the urban industry has reached a high level and the development of advanced industries has become saturated, the marginal effect of GVC on the development of urban industries becomes smaller.

Table 6 quantile regression results of advanced level of urban industrial structure

variable	(1) 25%	(2) 50%	(3) 75%	(4) 90%
GVC	1.139	1.587***	0.194	0.572
Control	Yes	Yes	Yes	Yes
Sta.err	0.875	0.665	0.653	1.223
P-value	0.195	0.018	0.767	0.640
T-value	1.30	2.38	0.30	0.47
N	1326	1326	1326	1326

T-statistics in parentheses ***P<0.01, * * p<0.05, * p<0.1

It can be seen from Table 7 that when the quantile of the rationality of urban industrial structure is at the 25% level, the estimated coefficient of GVC is 0.006, and the p value is 0.864, which fails the significance test. When the quantile level further increases to 50% and 75%, the estimated coefficients are -0.017 and 0.068, respectively, and the P values are 0.674 and 0.293, respectively, which are still not significant. When the quantile level increases to 90%, the study found that the estimated coefficient and significance level have significantly improved, and the estimated coefficient reached 0.635, which is significant at the 1% level. The results show that GVC can only significantly improve the rationality of urban industrial structure at the 90% quantile level, inhibit the deviation of urban industrial development from the balanced structure, and promote industrial rationalization. GVC does not significantly affect the rationality of urban industrial structure at other levels. The possible explanation is that for cities with low industrial rationality, their industrial structure is generally in the process of rapid adjustment. When formulating GVC strategy, they usually adopt the policy of giving priority to the development of high-tech industries, inclining the funds to high-tech industries, and relatively weakening the support for the development of other industries. This may cause the phenomenon of low capital utilization efficiency, industrial productivity and inter industry cooperation ability in the short term, which is not conducive to significantly promoting the rational development of urban industrial structure. With the development of urban industry, the city government will pay more attention to the importance of balanced industrial development. By adjusting the strategy of setting up GVC, the government reasonably allocated funds to various industries, promotes the coordinated and orderly development of industries, and improves the rationality of urban industrial structure.

Table 7 quantile regression results of rationality of urban industrial structure

variable	(1) 25%	(2) 50%	(3) 75%	(4) 90%
GVC	0.006	-0.017	0.068	0.635** **
Control	Yes	Yes	Yes	Yes
Sta.err	0.035	0.041	0.065	0.323
P-value	0.864	0.674	0.293	0.05
T-value	0.17	-0.42	1.05	1.97
N	1326	1326	1326	1326

4.2.3 Endogenous test

This study selected the number of GVC funds as the tool variable. The coefficient of the instrument variable is significant at the level of 1%, and the regression coefficient is 0.384, indicating that the instrument variable is highly correlated with the explanatory variable. Moreover, the statistical value of Cragg Donald Wald f is 19.384>10, which also passes the weak instrumental variable test. In the corresponding panel data analysis, the regression coefficients of the explained variables REA and ADV are 0.6712 and 4.63, significant at the level of 1%. It shows that after dealing with the endogenous defects, GVC still significantly promotes the transformation and upgrading of urban industries, and there is still a positive causal relationship between the two.

4.2.4 Substitution variable test

In order to further test the reliability of the results, substitution variable method is carried out to test the robustness. Following Ma (2021) and Liu (2019), the indicators of rationality and advanced degree of industrial structure are replaced by the deviation degree of industrial structure (TL) and the proportion of high-end technology (TS). The panel data analysis is rerun and the consistent result is obtained. The coefficient of TL is 0.041 at the significant level of 5%, and the coefficient of TS is 0.119 at the significant level of 1%.

4.3 Discussions

The panel data analysis result confirms the null hypothesis that GVC can promote the transformation and upgrading of urban industries, and it provides China's evidence for similar theoretical research in this topic. The results of regional heterogeneity and quantile regression analysis enrich the mechanism discussions of the effects of GVC on stimulating industrial transformation and upgrading.

In the test of regional heterogeneity, there is a significant correlation between GVC and the advanced level of urban industrial structure in the eastern and western regions, while there is no correlation in the central region. GVC can leverage the advantages of fund aggregation and promote the upgrading of urban industrial structure. The industrial development in the western region is at its early stages, and its dependence on government policies and capital supply is

stronger, making it susceptible to the influence of GVC. There is a significant correlation between GVC and the rationality of urban industrial structure in the eastern region, while there is no correlation between them in the central and western regions. The economic development of the cities in the central and western regions also shows an obvious pattern of agglomeration of provincial capitals, leading to relatively low efficiency in resource allocation.

In the test of quantile regression, when the advanced level of urban industrial structure is around 50%, the government guidance fund can significantly improve the advancement of urban industrial structure, and the result is insignificant when the advanced level of urban industrial structure is lower or higher. When the urban industrial structure reaches a high level, the development of advanced industries becomes saturated. In contrast, when the advanced level of urban industrial structure is at a high level around 90%, GVC can significantly improve the rationality of industrial structure, and the result is insignificant when the advanced level is lower. This study suggests that cities with low advanced level of industrial structure lack the development foundation and conditions for balanced industrial development, and the policy emphasis on balanced industrial development is not high. GVCs will be reasonably and strategically allocated to various industries, improving the rationality of urban industrial structure in the developed regions.

5. Conclusions and implications

This study explores the mechanism of GVC to promote the transformation and upgrading of urban industries. By improving the level of capital supply, we can change the driving urban regional structure, adjust the urban product demand structure, change the urban employment structure, and promote social division of labor. Data from 277 cities in China across year 2016-2020 are fed into panel data analysis. The empirical results show that GVC does play a significant role in promoting the transformation and upgrading of urban industries. Through the heterogeneity analysis, it is found that compared with the central and western regions, the eastern region can make full use of the advantages of regional funds, talents, policies, and other aspects to better perform the guiding function of GVC on promoting the urban industrial transformation and upgrading. Through quantile regression, it is found that only when the level of urban industrial transformation and upgrading is at the medium level, can the advanced degree of industrial structure be significantly improved, and when it is at the advanced level, can the rationality of industrial structure be improved.

Through empirical analysis, it is found that the effect of GVC is different in different regions and cities with different development levels. At last, some policy recommendations are given below. Firstly, the countermeasures shall be selected according to local conditions, such as the local economic level, regional industrial advantages, resource endowment, and GVC development level. Secondly, the government should constantly improve the business environment for the enterprises to pursue technological innovation. Thirdly, the government shall appropriately relax investment restrictions according to its own development strategy. For those regions with high level of economic development, GVC shall be strategically utilized to promote the transformation and upgrading of local industries, meanwhile avoiding the direct competition with PVC. For regions with low level of economic development, it is necessary to use GVC to stimulate PVC. Fourthly, the government should have a clear industrial positioning, keep eyes on the development

directions of emerging industries, and make agile strategic adjustment. Fifthly, the government should create a good business environment for scientific research and technical innovations, address the needs of innovative enterprises, establish useful innovation platforms for experience exchange and investment/financing. Sixthly, the government shall endorse the local colleges and universities, establish the training and employment mechanism for talents in the field of GVC management, and improve the comprehensive quality of industrial employees. Finally, the government should establish an all-round and multi-disciplinary policy system to support and supervise the normative operation of GVC funds.

References

[1] Bertoni F, & Tykvová, T. Does Governmental Venture Capital Spur Invention and Innovation? Evidence from Young European Biotech Companies. Research Policy, 2015,44(4), 925– 935.

[2] Chen Xudong, Yang Shuo, Zhou Yuhao. Government-guided fund and Regional Enterprise Innovation: An Effectiveness analysis based on "Government + Market" model [J]. Journal of Shanxi University of Finance and Economics, 2020, 42(11):12. (In Chinese)

[3] Chen Zhiqiang, Tian Meijuan, Zhang Hongmei. Can the government venture capital Guidance Fund promote the improvement of regional innovation capacity? -- An empirical study based on provincial panel data [J]. Times Finance, 2017(24):2. (In Chinese)

[4] Dai Dan. Research on Influencing Factors of Industrial transformation and Upgrading [D]. Guangdong Academy of Social Sciences, 2014. (In Chinese)

[5] Deng Yuxuan, Qi Mingde. Spatial effect of financial technology on optimization and upgrading of urban industrial structure [J]. Fiscal Science, 2021, 66(6):46-59.(In Chinese)

[6] Lerner J. The future of public forces to boost entrepreneurship and venture capital[J]. Small business economics, 2010, 35 (3): 255-264

[7] Li Fufu, Yin Haifeng. Empirical study on financial support and Development of strategic emerging Industries in China: Based on Panel Granger Causality Test and Cointegration analysis [J]. Science and Technology Progress and Countermeasures, 2014, 31(15):6. (In Chinese)

[8] Li Ningshen. Can government guided funds really promote regional technological innovation? [D]. Xiamen University, 2018

[9] Liu GM. Government Industrial Investment Fund: Organizational Form, Mechanism of Action, and Development Performance [J]. Financial Research, 2019 (7): 6

[10] Liu Guang, Liu Yiping.]Analysis on the influence mechanism of venture Capital on industrial transformation and upgrading [J]. Industry & Science Forum, 2019(9):3. (In Chinese)

[11] Mackiewicz M, & Namy lak B. Development Conditions for Creative Clusters in Poland in View of Institutional Environment Factors[J]. Growth and Change,2021, 52, 1295– 1311.

[12] Pan F, Zhang F, Wu F. State led financing in China: the case of the government guided investment fund[J]. The China quarterly, 2020:1-24

[13] Ren Xiaodong. Research on the Role of Financial Support in Industrial Transformation and Upgrading [D]. Guangdong Academy of Social Sciences, 2018

[14] Sohn DW, Kim HJ, Hu RW. Effect of venture capital and government support on the performance of venture firms in Korea[J]. Asian Journal of technology innovation, 2012, 20 (2): 309-322

[15] Sun Zao, Zong Rui. Local demand and independent innovation of enterprises - why reasonable income distribution is more conducive to enterprise innovation [J] Financial Research, 2022, 48 (3): 15 (In Chinese)

[16] Trabelsi D & Siyahhan B. Startup Cash Flows and Venture Capital Investments: A Real Options Approach[J]. Managerial and Decision Economics, 2021,42(3), 737– 750.

[17] Wang Liming, Wang Jilin. Research on the Current Situation, Problems, and Countermeasures of the Operation of Domestic Venture Capital Guidance Funds [J] Modern

Management Science, 2010 (2): 112-114 (In Chinese)
[18] Wang Ying. Analysis and Empirical Research on Influencing Factors of emerging Industry Development in Jiangsu -- Taking Suzhou and Nanjing as examples [J]. Journal of Jiangsu University: Social Sciences Edition, 2014. (In Chinese)
[19] Wang Z, Mu Z. the research overview of venture analysis and performance evaluation of the government emerging industry venture capital guide fund[c]//2016 International Symposium on advances in electrical, electronics and computer engineering Atlantis press, 2016: 60-63
[20] Xu J, Yu L, Gupta R. Evaluating the performance of the government venture capital guiding fund using the empirical fuzzy analytical hierarchy process[J]. Sustainability, 2020, 12 (17): 6908
[21] Yan Alperovych, Georges Hübner and Fabrice Lobet. How does government versus private venture capital backing effect a firm's efficiency? Evidence from Belgium [J]. Journal of business venture, 2015, 30 (4): 508-525
[22] Yuan Hang. Research on the Impact of Innovation Driven Transformation and Upgrading of China's Industrial Structure. Beijing University of Posts and Telecommunications, 2019 (In Chinese)
[23] Zuo Pengfei, Jiang Qiping, Chen Jing. Internet development, urbanization and industrial structure transformation and upgrading In China [J]. Journal of Quantitative and Technical Economics, 2020(7):71-91. (In Chinese)