



The Impact of Central Five-Year Plans and Local Five-Year Plans on the Number of Patent Applications

-----Based on listed manufacturing enterprises

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Abstract. The Chinese government emphasizes industrial upgrading and encourages technological innovation by enterprises. A series of policy documents have been issued by the Chinese government, and the five-year plans specify the government's development direction. Enterprises in the catalog have received government support and consumed government resources, so it is necessary to analyze the impact of the government's five-year plan on enterprise innovation. Both the central government's five-year plan and the local government's five-year plan have impact on enterprises, so it is necessary to analyze the differences in the impact. This paper uses data of listed companies from 2008 to 2020 and uses PSM-DID model, Heckman two-stage model, and instrumental variable model. The results obtained are as follows:1. The government's five-year plan has increased the number of patent applications by enterprises;2. The influence of the central government's policies is greater than that of the local government's policies.

Keywords: Five-Year Plan, patents, central government, local government, agency theory.

1 Introduction

China's economic development has entered a new stage, and the original economic development model was that enterprises invested heavily in human resources and machinery and equipment, and the core competitiveness of products was price-performance ratio; the current economic development model is that enterprises carry out technological innovation, and the core competitiveness of products is technological patents.

The government is the most important external factor, and the government can influence higher education institutions, research institutions, and enterprise associations. The government's resources encourage enterprise innovation. The Chinese government has released a large number of government policies to encourage enterprise innovation. This paper chooses the Five-Year Plan as the research object, mainly because the Five-Year Plan is the core policy, and the Five-Year Plan announces the catalog of key developed industries. The enterprises in the catalog can obtain more resources, in-

cluding: 1, more government subsidies; 2, lower tax rates; 3, more land supply; 4, more government credit endorsement [1]. China's five-year plans emphasize high-quality economic growth, on one hand, the central government's five-year plans set economic development goals; on the other, the central government's five-year plans set environmental protection goals. The government needs to enhance the innovation capacity of enterprises[2]. The central government's five-year plan sets goals for local governments[3]. The innovation of a business needs the influence of the external environment, and government policies can influence the external environment of a business[4].

Some economists believe that government support promotes enterprise technological innovation; Another group of economists believes that government support hinders innovation.

This study uses data from China to analyze the issue. The research is divided into the following parts:

1. the impact of the five-year plans of the central government on patents held by enterprises;
2. the analysis of policies from the perspective of enterprise ownership, industry, and region;
3. the impact of the five-year plans of local governments on patents held by enterprises.

The study ultimately provides reference advice for the government and helps the government improve relevant policies.

2 Literature Review and Hypothesis

Western economics emphasizes free markets, and Western economics believes that the government should reduce its influence on economic activities. Free markets will promote corporate competition, and the result of corporate competition is that companies will engage in technological innovation. Western economic theories have influenced Latin American countries and former Soviet states, where the economies have generally stagnated. In contrast, East Asian countries have experienced rapid economic growth in recent decades. East Asian governments generally emphasize the government's influence, and the government extensively intervenes in economic operations. In recent decades, East Asian countries have achieved rapid economic growth, and East Asian countries have developed into advanced manufacturing production bases. East Asian governments generally use industrial policy [5]. The Chinese government uses administrative power to intervene in the operation of the economy, and the government has used public resources to cultivate a large number of highly skilled industrial workers, who have supported the rapid development of the economy[6]. The economic development of Taiwan has been strongly influenced by government policies, and the local government's industrial policy has focused on nurturing Taiwan's semiconductor industry[7]. In fact, Western governments are also implementing industrial policy [8]. The central issue that this paper analyzes is the

impact of government industrial policy on corporate innovation. This paper references classic papers, and the core of the study is the five-year plan [1].

2.1 The Government's Key Industrial Policies Have Multifaceted Impact on Innovation

The Government's Key Industries Policy has Provided Enterprises with More Resources.

Economist Luo conducted extensive field research on Chinese enterprises, noting that most Chinese businesses lacked sufficient resources, which led to the failure of many of their Innovation projects [9]. Chinese energy-intensive enterprises are facing a dilemma of financing constraints [10]. Chinese private enterprises have difficulty obtaining financing, and their willingness to innovate is undermined [11].

Innovation projects require outside support, and the government's key industries provide enterprises with a lot of government subsidy. The Korean government supported renewable energy enterprises by substantial government subsidies, which alleviated the shortage of resources and allowed enterprises to retain their innovation projects. As a result, enterprises produced a large number of patents. Economist Raffaello analyzed Italy's key industries and reached a similar conclusion [12].

The Government's Key Industries Policy Has Produced a Signaling Effect.

The government's support means that the enterprise has passed the government's evaluation, which will release a good signaling effect to the outside world. The impact of the signaling effect is widespread: economist Miguel pointed out that the government's signaling effect would affect the enterprise's partners, and the partners would give the enterprise more business support [13]. Economist Li pointed out that the government's signaling effect would affect banks, and the banks would give the enterprise more business loans [14].

The Government's Key Industries Policy Can Guide the Behavior of Enterprises.

Most economists believe that Chinese society is a society of relationships, and relationships play a significant role. Enterprises need to maintain cooperative relationships with local governments. On the one hand, enterprises' investment behavior needs to consider economic benefits; on the other hand, enterprises' investment behavior needs to consider the government's industrial policies. The government's five-year plan will have an impact on both government officials and enterprises. On the one hand, the five-year plan determines the evaluation standards for officials; on the other hand, enterprises will innovate in order to maintain their cooperative relationships with officials [15]. The five-year plan will also affect higher education institutions and research institutions, and the government encourages these institutions to collaborate with enterprises.

The Government's Key Industries Policy will Accelerate the Construction of Legal Systems.

The risk of intellectual property theft from innovation activities can discourage enterprises from innovating. Therefore, the government's efforts to build intellectual property systems will boost enterprises' motivation. Economist Fang surveyed data from different cities in China and found that the local government's attitude can influence enterprises' innovation. If the local government attaches more importance to protecting intellectual property, the number will be bigger, and the quality will be higher [16]. China's legal system is not perfect, and the government will prioritize key industries. The more perfect of the government's system, the more innovation of enterprises.

The Government's Key Industries Policy Has Reduced the Policy Risks Faced by Enterprises.

Enterprises need stable external environments for their investment activities. China's five-year plans have determined the policy direction in the future, reducing policy uncertainty. China's five-year plans are gradually changing, and the five-year plans are not affected by changes of administrative leadership. The lower the external policy risks faced by enterprises, the more R&D investment [17].

In Summary, We Propose the First Research Hypothesis.

H01: Government's key industries policy has enhanced the firms' innovation capabilities.

2.2 There is a Difference in the Attitude of the Central Government and Local Governments Towards Innovation

The objectives of the central government and local governments are different. The objectives of the central government include gradual growth of economic output and gradual improvement of technological level. The objectives of local governments are mainly economic output. This is mainly because the promotion of local government officials is related to economic output, and economists have found that the primary indicator of evaluation for provincial officials of the central government is economic development, followed by environmental protection [18], tax revenue, employment, and technological progress, with economic development as the core indicator. In fact, local officials may selectively implement central policies. A common example is that while the central government emphasizes environmental protection, data shows that high environmental protection targets set by local officials do not necessarily lead to promotion [19].

Corruption exists among local officials, and power rent-seeking occurs between enterprises and local officials [20]. The implementation of local policies may be distorted. As a result, the attention of local governments to innovation is relatively low.

In Summary, We Propose the Second Research Hypothesis.

H02: Central government's key industries policy has a stronger impact on innovation than local government.

3 The Empirical Process and Analysis

3.1 Sample Selection and Data Sources

In this study, we choose manufacturing firms listed on Chinese stock exchanges as our data sample, and the time period is from 2008 to 2020. We retain firms with normal operating status. The dependent variable in this study is the number of patent applications filed by the enterprise. The data comes from the CSMAR database.

The independent variable is government's key industries. The data comes from the CNRDS database.

if the listed enterprise's industry is included in the government's key industries list in the current year, then $du=1$, $dt=1$;

if the listed enterprise's industry is not included in the government's key industries list in the current year, then $du=0$, $dt=0$.

In this paper, we generate the policy variable did , specifically, $did = du * dt$.

The control variables in this paper are divided into enterprise-level control variables and city-level control variables. The data comes from the CSMAR database. Total factor productivity is calculated using the OP method.

3.2 Model Design

considering that the number of patent applications for enterprises is an integer, it needs to be logarithmically processed, and the model in this paper is:

$$\ln(\text{Patent_green_apply}+1)_{it} = \alpha + \beta_{it} DID_{it} + \beta_{it} \text{Control}_{it} + \varepsilon$$

3.3 Empirical Process

Descriptive Statistics.

The basic situation of manufacturing enterprise data can be seen from Table 1.

Table 1. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
id	20,750	290442.4	282578	8	900953
year	20,750	2014.95	3.834159	2007	2020
Patent all apply	19,720	73.436	313.3578	0	12021
State key industry	20,750	0.6411566	0.4796727	0	1
Province key industry	20,750	0.7290602	0.4444558	0	1
Tfp op	20,582	6.997036	0.8306872	1.319145	11.63908
Net profit	20,689	4.053552	15.91112	0.0003089	495.2333

Variable	Obs	Mean	Std. Dev.	Min	Max
Age	20,745	17.03611	5.831638	1	63
Sharehold ratio	20,134	60.38302	15.4033	8.97	101.16
Lev	20,750	0.3841608	0.1924853	-0.194698	0.999358
Asset turnover	20,749	0.680299	0.4452848	0.000738	8.786926
Roe	20,750	0.164148	5.554337	0.000041	713.2036
City Deposit	20,508	16.40996	19.19134	0.0498061	81.03519
City per Gdp	20,352	9.24058	5.210053	0.4346	46.7749

Central Government's Key Industry Policy Analysis Using PSM-DID.

According to Fig. 1. Before sample matching and Fig. 2. After sample matching, this paper first uses the PSM-DID model.

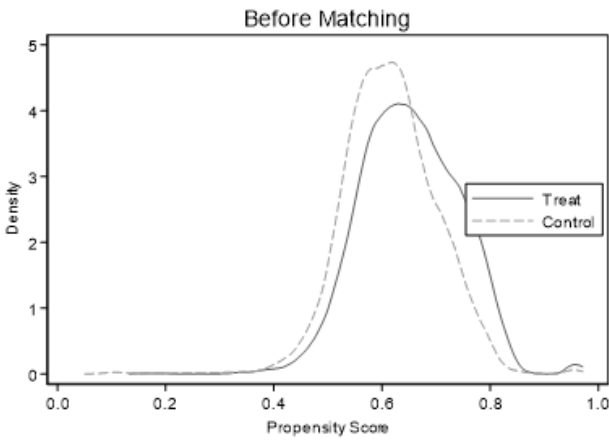


Fig. 1. Before sample matching

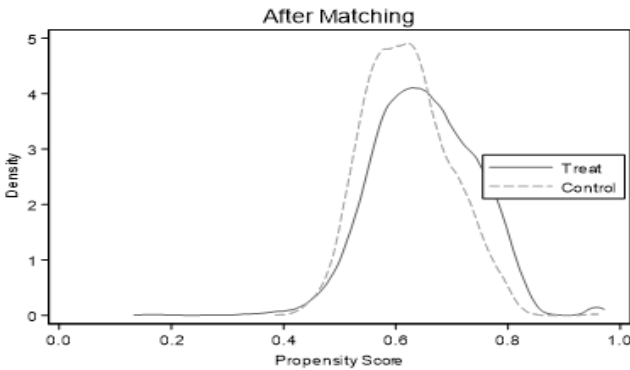


Fig. 2. After sample matching

*Empirical Results Analysis.***Table 2.** Central Government's Key Industry Policy Analysis Using PSM-DID

	(1)	(2)	(3)	(4)
	PSM-DID	PSM-DID	PSM-DID	PSM-DID
did	0.706***	0.740***	0.702***	0.702***
	(0.022)	(0.022)	(0.022)	(0.022)
Net-profit	0.011***	0.013***	0.011***	0.012***
	(0.001)	(0.001)	(0.001)	(0.001)
Tfp-op	0.704***	0.551***	0.658***	0.654***
	(0.017)	(0.014)	(0.018)	(0.018)
Age	0.018***	0.021***	0.018***	0.018***
	(0.002)	(0.002)	(0.002)	(0.002)
Sharehold-ratio	0.002**	0.002**	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Lev			0.426***	0.429***
			(0.063)	(0.063)
Asset-turnover	-0.509***		-0.505***	-0.495***
	(0.031)		(0.031)	(0.031)
Roe		-0.066***		-0.040**
		(0.014)		(0.014)
City-Deposit	0.000	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
City-per-Gdp	0.054***	0.057***	0.056***	0.057***
	(0.003)	(0.003)	(0.003)	(0.003)
N	18062.000	18062.000	18062.000	18062.000
r2	0.242	0.232	0.244	0.244

The results of Table 2 for the central government's key industrial policy show:

1. The central government's key industrial policy has increased the number of patent applications by enterprises, and the policy has achieved its expected policy effects.

2. Net profit and total factor productivity represent the operational efficiency of enterprises. The greater the economic benefits of enterprises, the more R&D they can invest, and the more patent applications they can make.

Parallel trend test.

According to the premises of the PSM-DID model, a parallel trend test was conducted, The end result is Graph 3. Parallel trend test.

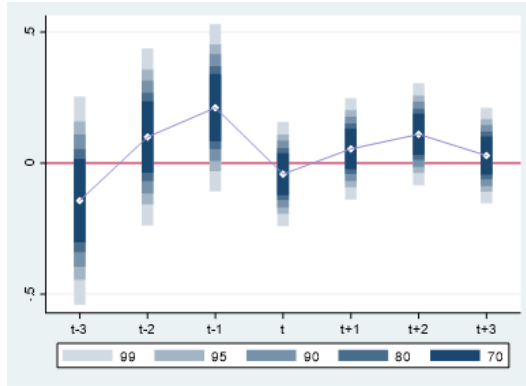


Fig. 3. Parallel trend test

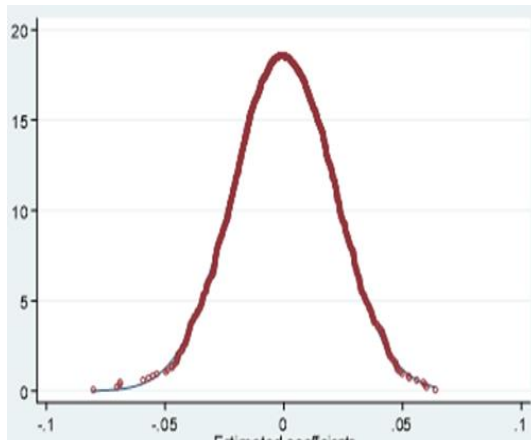


Fig. 4. Placebo test

The end result is Graph 4. Placebo test, Using a placebo test, it was found that, under random conditions, the coefficient of the policy should be concentrated within -0.05 to 0.05. The policy coefficient in this article is not within this range, which proves that the policy has had a substantial impact.

According to Fig. 3. Parallel trend test and Fig. 4. Placebo test, The results showed that the model passed the parallel trend test.

The Stability Test of the Central Government's Key Industrial Policy.

This paper uses three econometric models for robustness analysis, and the results of this paper pass the robustness test.

According to the table 3, central Government's Key Industrial Policy has a stable impact on the number of patent applications by enterprises.

Table 3. The Stability Test of the Central Government's Key Industrial Policy

	(1)	(2)	(3)	(4)
	ivregress-2sls	ivregress-2sls	Heckman	Heckman
did	0.693***	0.694***	0.704***	0.704***
	(0.024)	(0.024)	(0.022)	(0.022)
Net-profit	0.013***	0.013***	0.012***	0.012***
	(0.001)	(0.001)	(0.001)	(0.001)
Tfp-op	0.601***	0.595***	0.649***	0.645***
	(0.020)	(0.020)	(0.018)	(0.018)
Age	0.015***	0.015***	0.018***	0.018***
	(0.002)	(0.002)	(0.002)	(0.002)
Sharehold-ratio	0.003***	0.003**	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Lev	0.749***	0.758***	0.510***	0.517***
	(0.070)	(0.070)	(0.062)	(0.062)
Asset-turnover	-0.443***	-0.449***	-0.491***	-0.482***
	(0.032)	(0.032)	(0.029)	(0.029)
Roe		0.323*		-0.028***
		(0.171)		(0.006)
City-Deposit	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
City-per-Gdp	0.037***	0.037***	0.045***	0.046***
	(0.003)	(0.003)	(0.002)	(0.002)
N	15561.000	15561.000	19248.000	19248.000
r2	0.240	0.240	0.251	0.251

Testing the Heterogeneity of Central Government's Key Industrial Policies.

Time-lag analysis.

According to the table 4 and table 5, the central government's key industries has a diminishing impact on the number of patent applications by enterprises, indicating that the government should provide ongoing policy support.

Table 4. lagging behind by one period

	(1)	(2)	(3)	(4)
	ivregress-2sls	ivregress-2sls	Heckman	Heckman
did	0.658***	0.658***	0.663***	0.668***
	(0.024)	(0.024)	(0.024)	(0.024)

Table 5. lagging behind by 2 periods

	(1)	(2)	(3)	(4)
	ivregress-2sls	ivregress-2sls	Heckman	Heckman
did	0.648***	0.647***	0.652***	0.658***
	(0.027)	(0.027)	(0.026)	(0.026)

Differential analysis of property rights.

According to the table 6 and table 7, this paper studied the differences between different types of enterprises and the results showed that: in state-owned enterprises, the central key industrial policy had a relatively greater impact on the number of patent applications; in private enterprises, the central key industrial policy had a relatively smaller impact on the number of patent applications. This indicates that state-owned enterprises will obey the national strategy and state-owned enterprises will carry out innovation based on the central industrial policy.

Table 6. state-owned enterprises

	(1)	(2)	(3)	(4)
	ivregress-2sls	ivregress-2sls	Heckman	Heckman
did	0.905***	0.905***	0.905***	0.904***
	(0.045)	(0.045)	(0.040)	(0.040)

Table 7. private enterprises

	(1)	(2)	(3)	(4)
	ivregress-2sls	ivregress-2sls	Heckman	Heckman
did	0.587***	0.586***	0.610***	0.609***
	(0.028)	(0.028)	(0.025)	(0.025)

Industry Segment Analysis.

According to the table 8, table 9 and table 10, the results show that the central government's key industries policy has effectively increased the number of patent applications for technology-intensive enterprises; however, the policy has reduced the number of patent applications for labor-intensive enterprises. The reason for this is that technology-intensive enterprises are the ones that the Chinese government prioritizes and supports, and when they receive government resources, they will invest in innovation; labor-intensive enterprises, on the other hand, are the ones that the Chinese government requires to reform, and when they receive government resources, they will first update their machinery and equipment before investing in innovation.

Table 8. Technology intensive enterprises

	(1)	(2)	(3)	(4)
	ivregress-2sls	ivregress-2sls	Heckman	Heckman
did	0.904***	0.917***	0.857***	0.855***
	(0.038)	(0.038)	(0.036)	(0.036)

Table 9. Capital intensive enterprises

	(1)	(2)	(3)	(4)
	ivregress-2sls	ivregress-2sls	Heckman	Heckman
did	-0.095**	-0.096**	-0.037	-0.037
	(0.043)	(0.043)	(0.039)	(0.039)

Table 10. Labor intensive enterprises

	(1)	(2)	(3)	(4)
	ivregress-2sls	ivregress-2sls	Heckman	Heckman
did	-0.784***	-0.788***	-0.714***	-0.715***
	(0.115)	(0.114)	(0.098)	(0.098)

Regional Differences Analysis.

According to the table 11, table 12 and table 13, the central government's key industrial policies have the greatest impact on enterprises in the western region, and the least impact on enterprises in the eastern region, which indicates that enterprises in the western region are relatively resource-poor and that the government's support for innovation has a significant impact. The government should allocate more resources to underdeveloped areas.

Table 11. Eastern enterprises

	(1)	(2)	(3)	(4)
	ivregress-2sls	ivregress-2sls	Heckman	Heckman
did	0.565***	0.564***	0.589***	0.590***
	(0.029)	(0.029)	(0.026)	(0.026)

Table 12. Central enterprises

	(1)	(2)	(3)	(4)
	ivregress-2sls	ivregress-2sls	Heckman	Heckman
did	0.825***	0.826***	0.824***	0.824***
	(0.053)	(0.053)	(0.048)	(0.048)

Table 13. Western enterprises

	(1)	(2)	(3)	(4)
	ivregress-2sls	ivregress-2sls	Heckman	Heckman
did	0.906***	0.872***	0.870***	0.866***
	(0.070)	(0.070)	(0.062)	(0.062)

Central government's key industrial policies vs local government's key industrial policies.

According to the table 14 and table 15, the results show that the influence of the central government's key industrial policies is greater than that of local governments, and the results are robust. On the one hand, this indicates that the central government has stronger mobilization power than local governments, as listed companies have

national businesses and listed companies will conduct research and development according to the policies of the central government.

On the other hand, in theory, local governments are familiar with the local economic conditions, and local governments' key policies should play a greater role. However, in practice, local governments' key policies have stimulated the scale growth of local enterprises. In recent years, local enterprises have taken advantage of local government policies to engage in arbitrage and invested heavily in a large number of projects. There has been a lot of inefficient investment in local areas. This indicates that the central government should pay attention to the policy orientation of local governments and increase its supervision over local governments.

Table 14. Local Government's Key Industry Policy Analysis Using PSM-DID

	(1)	(2)	(3)	(4)
	PSM-DID	PSM-DID	PSM-DID	PSM-DID
did	0.446***	0.495***	0.446***	0.446***
	(0.024)	(0.024)	(0.024)	(0.024)

Table 15. Local Government's Key Industry Policy Robustness analysis

	(1)	(2)	(3)	(4)
	ivregress-2sls	ivregress-2sls	Heckman	Heckman
did	0.428***	0.428***	0.442***	0.442***
	(0.026)	(0.026)	(0.024)	(0.024)

4 Conclusion

This paper mainly analyzes the impact of government's key policies on corporate innovation. The results show that: (1) Overall, government's key policies have increased the number of patent applications by enterprises, and similar results have been obtained from different models. (2) The influence of central government policies is greater than that of local governments, indicating that local governments pay more attention to increasing economic output, and the central government needs to adjust its performance evaluation standards for local governments.

The limitations of this paper are as follows: (1) This paper analyzes the data of listed companies, and the relevant conclusions cannot be extended to all enterprises. (2) Innovation can be divided into substantive innovation and strategic innovation, and this paper focuses on the number of innovations. The paper has not analyzed the impact of government policies on the quality of innovation.

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The Coordination Mechanism Between Trade Policy and Industrial Policy from the Perspective of Industrial Dynamic Development and Chinese Practice.

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