

# Research on the Impact of Private Placement on Enterprise Innovation

—Evidence from Chinese A-Share Listed Companies

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## Abstract

This paper selects the data of China's A-share listed companies from 2012 to 2018, and uses propensity score matching and difference-in-difference method to analyze the impact of private placement on enterprise innovation. The research found that: private placement will promote enterprise innovation; after further subdividing the nature of ownership, compared with state-owned enterprises, the role of private placement in promoting enterprise innovation is more obvious in non-state-owned enterprises; after subdividing the characteristics of the sector, compared to the Main board listed companies, the promotion effect of private placements on enterprise innovation is even more pronounced on GEM and SME board listed companies. Based on the empirical research in this article, regulators should further improve the private placement system, while encouraging investors to actively exercise their supervisory power, supervise the use of funds raised by private placement and actively support enterprise innovation activities, so as to enhance the innovation vitality of the entire economic market.

## Keywords

Private Placement, Enterprise Innovation, Nature of Ownership, Sector Characteristics

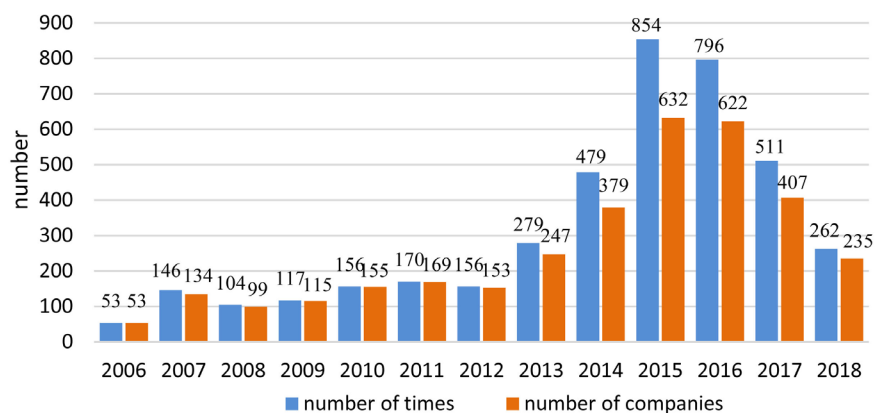
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## 1. Introduction

Private placement refers to the act of a listed company's non-public offering of shares to qualified specific investors. Compared with public offerings, private placements have no performance requirements, low issuance costs, and flexible issuance procedures. Since its introduction by the China Securities Regulatory Commission in 2006, private placement has become the main financing method

for most listed companies in China. According to Wind database statistics, a total of 4083 private placements occurred between 2006 and 2018; especially after 2012, the number of private placements increased significantly, as shown in **Figure 1**. At the same time, the academic community is increasingly paying attention to private placements.

At present, the research on the private placement in the academic circle mainly focuses on the issues of benefit transmission in the process of large shareholders participating in the private placement, the earnings management of the private placement, the discount of the private placement of new shares, and the impact of the private placement on enterprise performance. From the perspective of management and supervision (Barclay et al., 2007; Wruck & Wu, 2008), it is pointed out that in order to maintain its position in the listed company, the controlling shareholders tend to increase the issuance to the passive investors in the process of private placement, because the passive investors will not interfere with the company's daily decision-making and supervision of the company's operation and management too much, and the discount issuance is the compensation for the investors' negative behavior. Peng et al. (2011) pointed out that whether the major shareholders empty the listed company to realize the benefit transmission depends largely on the financial situation of the listed company. When the operating condition of the listed company is poor, the major shareholders will use their own resources and advantages to help the listed company through difficulties to maintain their controlling position; while when the operating condition of the listed company is good, the major shareholders will continue to empty the listed company and occupy small and medium investors. Hertz et al. (2002) found that the performance of the company with the increase of the shareholding ratio of institutional investors is significantly better than that of the company with the decrease of the shareholding ratio of institutional investors, which shows that the introduction of institutional investors through private placement can improve the performance of the company. Also, Wruck and Wu (2007) found that the relationship between private placement investors and



**Figure 1.** Overall issuance of private placement of Chinese Listed Companies from 2006 to 2018.

enterprises had a huge impact on the company, and the performance of companies that introduced new investors was better than that did not.

However, there are few studies on the relationship between private placement and enterprise innovation, and they need to be improved. Based on this, this paper uses 2012-2018 data from China's A-share listed companies to use propensity score matching and difference-in-difference method (PSM-DID) to empirically analyze the impact of private placement on enterprise innovation.

## 2. Literature Review and Research Hypothesis

### 2.1. Private Placement and Enterprise Innovation

Most scholars mainly support the view that private placement can promote enterprise innovation. Kevin Amess et al. (2016) believes that private equity companies as a source of financing for enterprise innovation activities can help companies obtain external financing channels and ease financing constraints, thereby promoting enterprise investment in innovation activities. Albert N. Link et al. (2014) using innovative small businesses as a sample to study the impact of private equity investment on innovation and economic growth, the results prove that private equity investment accelerates the innovation investment of small businesses and the business of new technologies into. Research by Josh Lerner et al. (2013) further found that private equity investment activities can not only promote innovation investment, but also promote the effectiveness of innovation investment, which is reflected in the number of patent applications. Relative to foreign countries, private placements started late in China, and there is less domestic literature on the impact of private placements on enterprise innovation, but there are many studies supporting equity financing that can promote enterprise innovation investment, which is of significance for the study of this paper. The study by Chai Binfeng (2011) found that after the equity financing of enterprises, the level of R & D expenditures increased, and the financial leverage of enterprises will decrease. Research by Xiao Xingzhi & Wang Hai (2015) found that equity financing can effectively enhance enterprise innovation activities. Zhang Yilin et al. (2016) supported the point of view that, as investors pursue higher returns, equity financing can enhance enterprise innovation capabilities more than debt financing.

Based on this, this article proposes hypotheses H1: The private placement will promote enterprise innovation.

### 2.2. Nature of Ownership, Private Placement and Enterprise Innovation

Most scholars also find that the nature of ownership can affect enterprise innovation. Studies by John et al. (2008) and Li & Yu (2015) have shown that, compared with private enterprise executives, state-owned enterprise executives are generally reluctant to increase innovation investment. Boubakri et al. (2013) and Cheng Zhongming et al. (2008) believe that because the key industries related to

national economy and people's livelihood are still oriented to serve the national strategy, and to maintain the stable operation of the national economy as the assessment index, the task of completing the government's tasks. The Main objective is to distort the operating objectives of state-owned enterprises; Jiang Xuan-yu (2016) pointed out that compared with private enterprises, state-owned enterprises have more government tasks and have a "crowding effect" on their innovation investment. A study by Tang & Zuo (2014) also found that state-owned enterprises have lower investment in innovation, while non-state-owned enterprises have better R & D and innovation investment than state-owned enterprises.

Based on this, this article proposes hypothesis H2: Under the same conditions, compared with state-owned enterprises, the impact of private placement on enterprise innovation is more significant in non-state-owned enterprises.

### **2.3. Sector Characteristics, Private Placement, and Enterprise Innovation**

The existing literature shows that there are differences in the innovation ability of Listed Companies in different sectors. Because of the low threshold, high risk and strict supervision of Growth Enterprise board (GEM), most of listed companies are engaged in high-tech business and have high growth; the implementation of equity financing can often promote enterprise innovation. Most of the Small and Medium (SME) board enterprises are in the growth period of the enterprise life cycle, which has the characteristics of high growth and high income compared with the enterprises in the mature period. Most of the companies listed on the Main board are traditional industries, and most of them have passed the rapid growth period, and are in the mature period or even the negative growth recession period. Feng Genfu, Zhang Yuchao and Wen Jun (2013) compared and analyzed the enterprise innovation ability of listed companies on the Main board, SME board and GEM board of China, and found that the enterprise innovation ability of listed companies on the GEM board and the SME board was better than Main board listed companies.

Based on this, this paper proposes the hypothesis H3: Under the same other conditions, compared with the Main board listed companies, the impact of private placement on enterprise innovation is more significant in GEM and SME listed companies.

## **3. Research Design**

### **3.1. Sample Selection and Data Source**

This paper selects the A-share listed companies that implemented the private placement from 2012 to 2018 as the data sample, and investigates the annual innovation level changes of the sample companies before and after the implementation of the private investment, specifically measured by the number of patent applications and the level of R & D investment. The original samples are screened

as follows: enterprises with ST, financial and related data missing are excluded; enterprises with multiple private investment and less than one year of listing are excluded; data of three years before and after the event is retained, 631 enterprises with private investment are finally obtained; 1262 enterprises without targeted additional issuance are selected to control the individual characteristics difference of samples and the self selection effect of private investment. As a control group, 9634 effective observations were made to the newly issued enterprises. In order to avoid the influence of extreme values, winsorize is used to reduce all continuous variables at 1% and 99% quantiles. In this paper, Stata 15.0 software is used for data statistics and analysis. All data are from Wind and CSMAR databases.

### 3.2. Variable Selection

**Explained variable:** the explained variable of this paper is enterprise innovation, including the innovation output index and the innovation input index. The innovation output index is measured by the number of patent applications (NP), and the innovation input index is measured by the relative value of R & D investment (RD). Meanwhile, considering that the enterprise innovation has a certain period, the relevant data one year behind is selected as the explained variable.

**Explanatory variable:** the explanatory variable of this paper is private placement, which is measured by two virtual variables:

- **Virtual variable (group):** if the enterprise implements private placement, the value is 1; otherwise, the value is 0;
- **Virtual variable (time):** if the enterprise implements private placement in the current year, the value of this year and subsequent years is 1; otherwise, the value is 0.

**Control variables:** select the largest shareholder's shareholding ratio (topsh), company size (size), income growth rate (gp), return on assets (ROA), asset liability ratio (lev), book to market ratio (BM), age, industry virtual variables as control variables.

The specific definitions of variables are shown in **Table 1**.

### 3.3. Research Model Construction

In this paper, the propensity score matching method and difference-in-difference method are used for analysis, as follows:

Firstly, the samples are divided into two groups: the experimental group and the control group. The companies implementing the private placement are the experimental group and the companies that do not implement the private placement are the control group. By using the propensity score matching method (PSM), the matching samples that are similar to the sample characteristics of the companies that implement the private placement are found in the control group, so that the two groups of matched samples are similar in the observed

**Table 1.** Variables and assignment.

Variable symbol	variable name	definition
NP	innovation output	logarithm of number of patent applications plus 1
RD	innovation input	ratio of R & D investment to operating revenue
group	whether to implement private placement	virtual variable, if the enterprise implements private placement, the value is 1; otherwise, the value is 0
time	observation period	virtual variable, if the enterprise implements private placement in the current year, the value of this year and subsequent years is 1; otherwise, the value is 0
topsh	the largest shareholder's shareholding ratio	ratio of the number of shares held by the largest shareholder to the total number of shares of the company
size	company size	logarithm of total assets
gp	income growth rate	ratio of increase in operating revenue of the year to total operating revenue of the previous year
roa	return on assets	ratio of net profit to total assets
lev	asset liability ratio	ratio of total liabilities to total assets
bm	book to market ratio	ratio of book value to market value
age	age of company	logarithm of observation year minus listing year plus 1
board	sector characteristics	virtual variable, if the enterprise is listed on GEM or SME board, it is 1, otherwise it is 0
nature	nature of ownership	virtual variable, 1 for state-owned enterprises and 0 for non-state-owned enterprises
yd	year	virtual variable
id	industry	virtual variable

company characteristics, so as to make the event of the private placement regarded as a quasi “natural experiment”, which satisfies the hypothesis of difference-in-difference model.

The difference-in-difference model studies the causal effect of the event on the sample by studying the difference between the experimental group and the control group before and after the event. This method can help us estimate the change of innovation level of the listed companies before and after the implementation of the private placement, and whether this change is significantly different from the innovation level of the companies without the implementation of the private placement in the same period.

Then construction of difference-in-difference model is as follows:

$$Y_{it} = \alpha_0 + \alpha_1 \text{group}_i + \alpha_2 \text{time}_{it} + \alpha_3 \text{did}_{it} + \beta \text{control}_{it} + \text{yd} + \text{id} + \varepsilon_{it} \quad (1)$$

In the model,  $Y$  is the explained variable. In this paper,  $Y$  is the number of patent applications (NP) and R & D investment level (RD) that represent the measurement of enterprise innovation. “did” = group  $\times$  time, representing the cross multiplication term, is the key explanatory variable in the model; controls is the

control variable; in addition, the year virtual variable (yd) and industry virtual variable (id) are also set in this paper. Through the study of the regression coefficient and significance of the crossover item did, we can get the actual effect of the private placement on the innovation of enterprises.

## 4. Empirical Analysis

### 4.1. Descriptive Statistics

The descriptive statistics of each variable is shown in **Table 2**. The whole sample is divided into two sub samples: implemented and unimplemented, which is convenient to compare the differences of each indicator level. It can be seen from **Table 2** that, in terms of the index of innovation ability, the average value of the number of patent applications (NP) and R & D investment (RD) in the

**Table 2.** Descriptive statistics.

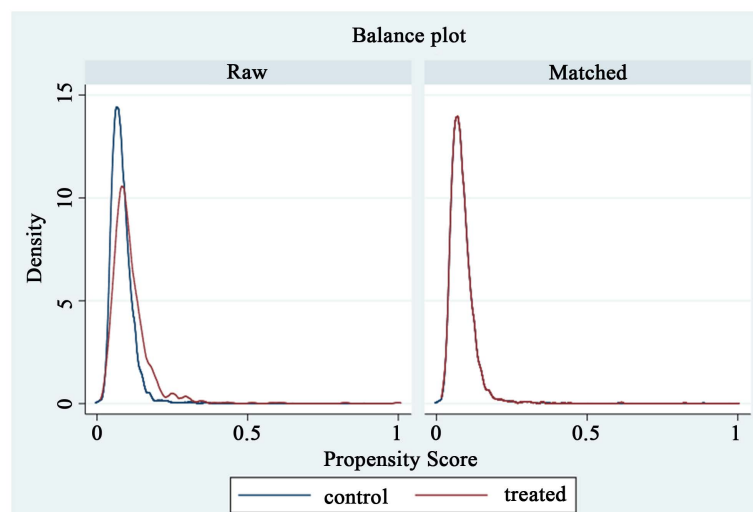
variable	number	mean	standard deviation	minimum	median	maximum	group
	9634	3.2784	1.4314	0.6931	3.2581	9.7789	total
NP	3211	3.4838	1.3717	0.6931	3.4012	9.7789	implemented
	6423	3.2302	1.4410	0.6931	3.2189	8.9922	unimplemented
	9634	0.0391	0.0430	0.0000	0.0326	0.7635	total
RD	3211	0.0420	0.0384	0.0000	0.0349	0.7635	implemented
	6423	0.0385	0.0441	0.0000	0.0320	0.3488	unimplemented
	9634	34.9879	14.8596	2.1970	33.1750	89.9900	total
topsh	3211	35.9810	15.5207	7.1400	34.2300	89.9900	implemented
	6423	34.7546	14.6926	2.1970	33.0200	86.3500	unimplemented
	9634	22.3669	1.3402	19.2878	22.1528	28.5087	total
size	3211	22.3271	1.2754	20.1034	22.0568	27.2688	implemented
	6423	22.3763	1.3549	19.2878	22.1753	28.5087	unimplemented
	9634	0.6783	7.7971	-2.7804	0.1716	434.5933	total
gp	3211	1.5591	16.3756	-1.0672	0.2057	434.5933	implemented
	6423	0.4714	3.4518	-2.7804	0.1679	172.0099	unimplemented
	9634	0.0401	0.0553	-1.0676	0.0365	0.4819	total
roa	3211	0.0423	0.0508	-0.2751	0.0375	0.4819	implemented
	6423	0.0396	0.0563	-1.0676	0.0364	0.3399	unimplemented
	9634	0.4214	0.1984	0.0174	0.4081	0.9732	total
lev	3211	0.4268	0.1920	0.0656	0.4158	0.9637	implemented
	6423	0.4201	0.1998	0.0174	0.4054	0.9732	unimplemented
	9634	0.8108	0.8456	0.0318	0.5308	7.8194	total
bm	3211	0.7062	0.8128	0.0331	0.4523	5.4007	implemented
	6423	0.8354	0.8514	0.0318	0.5494	7.8194	unimplemented
	9634	2.1870	0.6932	0.6931	2.1972	3.3322	total
age	3211	2.0698	0.6454	0.6931	1.9459	3.2189	implemented
	6423	2.2146	0.7012	0.6931	2.1972	3.3322	unimplemented

sample of implemented is 3.4838 and 0.0420, higher than the sample of unimplemented (3.2302 and 0.0385), indicating that the innovation ability of the listed companies implementing private placement is generally higher than that of the listed companies without private placement. In addition, the standard deviation of NP in the total sample is 1.4314, the minimum is 0.6931 and maximum is 9.7789, indicating that there are obvious differences in innovation level among enterprises. And the large standard deviation of topsh (14.8596) and gp (7.7971) also indicate that there are obvious differences among enterprises, showing that the sample companies of private placement have certain characteristics. The implementation of private placement by listed companies is not necessarily random, that is, there is a problem of sample selection bias. Therefore, this paper uses the method of PSM tendency score matching and did double difference to solve the problem of selective bias, which makes the research results more scientific and reasonable.

## 4.2. Propensity Score Matching

In order to solve the self selection effect of samples of implementing private placement, we first matched the propensity scores of implemented samples and unimplemented samples. In order to ensure the effectiveness of the matching results, take the proportion of the largest shareholder, the enterprise scale, the growth rate of operating revenue, the net profit rate of total assets, the asset liability ratio, the book to market ratio, and the age of the company as matching variables, take the year before the implementation of the private placement of the experimental group as the matching year to conduct 1:3 nearest neighbor matching, and determine the three years before and after the event as the test interval.

As can be seen from **Figure 2**, after matching with the propensity score matching method, propensity scores of the experimental group and the control group basically overlap, meeting the common support hypothesis.



**Figure 2.** Kernel density function of samples before and after matching.



As shown in **Table 3**, U is the difference between the experimental group and the control group before matching, and M is the difference between the experimental group and the control group after matching. According to the experience standard given by Rosenbaum and Rubin, 1985, when the standardization gap (bias) is less than 10%, the matching result is more effective. It can be seen that the absolute value of the standard deviation of each variable after matching is within 10%, even within 5%, which shows that there is no significant difference between the experimental group and the control group in each matching variable, meeting the balance hypothesis. Therefore, the common support hypothesis and the balance hypothesis are satisfied, and the propensity score matching results are effective.

### 4.3. Difference-in-Difference Regression Analysis

After using the method of propensity score matching, the sample companies in the experimental group and the control group have the same probability of implementing targeted additional issuance. Next, we use the did difference-in-difference model to test the impact of the private placement on enterprise innovation.

(1) Private placement and enterprise innovation:

In order to test hypothesis H1, carry out full sample difference-in-difference regression analysis, as shown in **Table 4**, the explained variable is the number of patent applications (NP), the first column is the regression result without adding control variables, and the second column is the regression result with adding

**Table 3.** Balance hypothesis test results.

Variable	Unmatched		Mean		% bias	% reduct bias	t-test		V(T)/V(C)
	Matched	Treated	Control				t	P > t	
topsh	U	35.787	35.256	3.5		0.99	0.324	1.09	
	M	35.787	35.717	0.5	86.7	0.10	0.923	1.14	
size	U	22.328	22.354	-2.0		-0.42	0.675	0.97	
	M	22.328	22.31	1.3	50.0	0.36	0.717	0.90	
roa	U	33.491	10.604	8.1		2.68	0.007	4.82*	
	M	33.491	21.909	4.1	49.4	0.74	0.461	2.01*	
gp	U	2.7574	2.4734	12.7		3.60	0.000	1.16*	
	M	2.7574	2.7105	2.1	83.5	0.41	0.680	1.02	
lev	U	0.42379	0.41558	4.2		1.12	0.263	0.90	
	M	0.42379	0.42598	-1.1	73.3	-0.23	0.817	0.99	
bm	U	0.69927	0.81678	-13.9		-3.69	0.000	0.82*	
	M	0.69927	0.68386	1.8	86.9	0.42	0.677	1.30*	
age	U	9.5998	10.876	-20.5		-5.40	0.000	0.81*	
	M	9.5998	9.3946	3.3	83.9	0.70	0.485	0.95	

**Table 4.** Empirical analysis results of hypothesis H1.

explained variable	1	2
	NP	NP
group	0.1553 (1.5643)	0.1491 (1.0808)
time	0.1007 (1.6434)	0.1322 (0.7004)
did	0.1921* (1.7087)	0.2085** (2.3570)
topsh		-0.0037*** (-2.5879)
roa		3.9988*** (10.0530)
gp		-0.0895*** (-7.2201)
lev		1.2369*** (8.8945)
bm		0.0729** (2.1168)
age		-0.0190 (-0.5812)
_cons	3.1921*** (94.6068)	2.8525*** (31.0866)
Year	yes	yes
Industry	yes	yes
N	9634	9634
adj.r2	0.072	0.2282

control variables. It can be seen that the regression coefficient of the cross product did is significantly positive no matter whether the control variable is added or not, which shows that the directional additional issuance has a significant role in promoting enterprise innovation. The empirical results support the hypothesis H1.

(2) Nature of ownership, private placement and enterprise innovation:

In order to test hypothesis H2, according to the nature of ownership, the whole sample is divided into two sub samples of state-owned enterprises and non-state-owned enterprises, and model (1) is regressed in each sub sample. The regression results of subsamples are shown in columns (2) and (3) of **Table 5**. When nature = 1, the regression coefficient of the cross product did is positive but not significant, indicating that the promotion effect of the directional issuance on enterprise innovation is not significant in state-owned enterprises; when nature = 0, the regression coefficient of the cross product did is positive and significant at the level of 5%, indicating that the promotion effect of the

**Table 5.** Empirical analysis results of hypothesis H2 and H3.

explained variable	NP				
	(1) total	(2) Nature = 1	(3) Nature = 0	(4) Board = 1	(5) Board = 0
group	0.1491 (1.0808)	0.0712 (0.8602)	0.2812* (1.8767)	0.0807 (0.9398)	0.2069 (1.6366)
time	0.1322 (0.7004)	-0.0344 (-0.6439)	0.1413* (1.6628)	0.1012* (1.7751)	0.1053 (1.449)
did	0.2085** (2.3570)	0.2651** (2.2579)	0.1231 (0.5795)	0.2664** (2.1835)	0.1906 (1.0656)
topsh	-0.0037*** (-2.5879)	(-0.0034**) (-1.9919)	-0.0021 (-0.8142)	-0.0032* (-1.6841)	-0.0024 (-1.1024)
roa	3.9988*** (10.0530)	3.4598*** (7.7894)	4.4150*** (5.5393)	3.2037*** (6.1851)	4.2641*** (7.0472)
gp	-0.0895*** (-7.2201)	-0.1017*** (-7.5207)	-0.1174*** (-3.4855)	1.0572*** (6.5581)	1.2073*** (5.9201)
lev	1.2369*** (8.8945)	1.2882*** (7.8903)	1.2675*** (4.7620)	0.1065*** (6.9383)	0.0446 (1.5046)
bm	0.0729** (2.1168)	0.2737*** (3.9367)	0.0332 (0.6668)	-0.0687*** (-5.3432)	-0.1059*** (-4.6464)
age	-0.0190 (-0.5812)	-0.0096 (-0.1230)	-0.0174 (-0.4402)	0.2444*** (-4.2000)	-0.0196 (-0.3697)
_cons	2.8525*** (31.0866)	3.0270*** (29.1150)	2.6297*** (13.0695)	2.4799*** (16.6076)	2.6849*** (12.3133)
year	yes	yes	yes	yes	yes
industry	yes	yes	yes	yes	yes
N	9634	5922	3712	4971	4663
adj.r2	0.2282	0.2693	0.2030	0.2482	0.2149

directional issuance on enterprise innovation is not significant in non-state-owned enterprises. The empirical results support hypothesis H2.

(3) Sector characteristic, private placement and enterprise innovation:

In order to test hypothesis H3, the whole sample is divided into two sub samples according to plate characteristics, and model (1) is regressed in each sub sample. The regression results of sub samples are shown in columns (4) and (5) of **Table 5**. When board = 1, the regression coefficient of the cross product did is positive and significant at the level of 5%, which indicates that the promotion effect of the directional issuance on enterprise innovation is significant in gem or SME listed companies; when board = 0, the regression coefficient of the cross product did is positive but not significant, which indicates the promotion effect of the directional issuance on enterprise innovation. The empirical results support hypothesis H3.

#### 4.4. Robustness Test

In order to ensure the reliability of the research conclusion, the following ro-

business tests are carried out:

(1) Change the model measurement indicators: use the R & D investment level (R & D expenditure is logarithm) as the indicator to measure enterprise innovation, and change the relevant control variables. The regression results of PSM-DID model are as follows:

According to the full sample regression results in column (1) of **Table 6**, it can be seen that the regression coefficients of the did cross product are significantly positive, indicating that the private placement has a significant role in promoting enterprise innovation. After further distinguishing the property rights and plate characteristics of the samples, we get the regression results of the four sub samples from column (2) to column (5). It can be seen that after changing the explained variables and control variables, the PSM-DID regression results are similar to the previous ones. The Main board listed companies are not significant. The robustness of the conclusions was tested.

**Table 6.** Results of robustness tests.

explained variable	NP				
	(1) total	(2) nature = 1	(3) nature = 0	(4) board = 1	(5) board = 0
group	0.0257 (0.3494)	0.0381 (0.0428)	0.0966 (0.2473)	0.0359 (0.0428)	0.0524 (0.4197)
time	0.0723** (2.4139)	0.1021* (1.8079)	0.0825*** (3.0398)	0.0003 (0.0091)	0.0700 (1.4900)
did	0.2137** (2.9435)	0.1624 (0.7569)	0.2891** (2.1507)	0.2587** (2.1629)	0.1995 (1.4848)
topsh	-0.1047** (-2.3624)	-0.1205 (-1.1455)	-0.1033*** (-2.8553)	-0.0482 (-0.9670)	-0.1971** (-2.5032)
roa	4.5084*** (16.1035)	4.8925*** (8.6393)	5.6706*** (22.8139)	3.3478*** (9.2841)	4.8129*** (11.0279)
gp	1.4535*** (13.5299)	0.6272*** (3.0471)	1.2122*** (10.1011)	1.1081*** (6.1263)	1.3643*** (8.1150)
lev	-0.1040*** (-4.4574)	0.1099*** (3.1865)	-0.2735*** (-6.4993)	-0.4062*** (-5.9623)	-0.0923*** (-3.1617)
bm	0.0748*** (3.1963)	-0.0724 (-1.3124)	0.0959*** (4.1036)	0.3766*** (8.6522)	-0.0073 (-0.1815)
age	2.4733*** (35.1588)	17.7164*** (84.2474)	17.0731*** (237.6207)	2.1176*** (21.7986)	2.7654*** (20.1121)
_cons	0.0257 (0.3494)	0.0381 (0.0428)	0.0966 (0.2473)	0.0359 (0.0428)	0.0524 (0.4197)
year	yes	yes	yes	yes	yes
industry	yes	yes	yes	yes	yes
N	9634	5922	3712	4971	4663
adj.r2	0.1729	0.1472	0.1828	0.1992	0.1599

(2) Considering that enterprise innovation has a certain period, and it takes a certain time from innovation input to innovation output, therefore, the number of patent applications and R & D expenditure related data lagging two periods are used to measure enterprise innovation indicators, and the empirical results are basically consistent with the above. Therefore, the conclusion of this paper is robust.

## **5. Research Summary**

### **5.1. Conclusion**

This paper selects the data of China's A-share listed companies from 2012 to 2018, and uses propensity score matching and difference-in-difference method (PSM-DID) to empirically analyze the impact of private placement on enterprise innovation. The results show that: the private placement will promote enterprise innovation; after further subdividing the nature of property rights, compared with state-owned enterprises, the role of private placement in promoting enterprise innovation is more obvious in non-state-owned enterprises; after subdividing the plate characteristics, compared with the Main board listed companies, the role of private placement in promoting enterprise innovation is more obvious in GEM and SME listed companies. Therefore, for the listed companies, we should strengthen the management of raised funds, and pay attention to the driving force of innovation, so as to realize more economic value; for the regulatory authorities, we should strengthen the supervision of the process of private placement, standardize the Refinancing Behavior of enterprises, protect the interests of small and medium-sized shareholders, and encourage private enterprises, GEM and SME board enterprises to actively participate in the private placement, so as to enhance the innovation vitality of the entire economic market.

### **5.2. Research Innovation and Deficiency**

The research innovations are as follows: First, explore the impact of private placement on enterprises from the perspective of innovation value and company growth, and enrich the relevant literature on the economic consequences of the private placement; Second, enrich the research methods of private placements. This paper uses PSM-DID to solve the self selection bias and non observable factor estimation bias in the research process, which makes the research process and results more scientific and reasonable.

There is still room for improvement in the selection of control variables in this paper. The research topic of this paper focuses on private placement and enterprise innovation. The control variables selected are mainly based on internal factors of enterprises. However, there are some external factors that affect innovation investment of enterprises, such as financial development, government subsidies, etc. Therefore, in further research, external factors control va-

riables should be added to make the research results more scientific and perfect.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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