

Research on the Impact of State-owned Enterprise Privatization Reform on Firm Innovation

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Abstract. Over the past few decades of state-owned enterprise (SOE) privatization in China, though many studies have been done concerning different aspects of relationship between the privatization of SOE and firm development, little was known about the impact of state-owned enterprise privatization reform on firm innovation. Some of the prior literature didn't manage to provide a convincing result to a certain extent as the data the chose was not enough. This article utilizes a substantial dataset of more than 28,000 listed companies that have undergone privatization, extracting the R&D expenditure data of listed companies from Wind database spanning from 2010 to 2022. After systematic investigation of the impact of SOE privatization (as measured by a dummy variable) on innovation (as measured by R&D investment) using the model of regression, it can be found that the privatization of state-owned enterprises in my country has had a negative impact on corporate innovation, as certain preconditions are needed for the success of privatization and restructuring, which plays a vital role in avoiding certain risks after privatization.

Keywords: Privatization, State-owned Enterprises, Firm innovations, R&D investment.

1. Introduction

During China's Reform and Opening Up, initial marketization measures were first taken. However, full privatization didn't occur until late 1999, approved at the Fourth Plenary Session of the 15th Central Committee of the CPC. This primarily targeted small and medium-sized SOEs, aimed to enhance competitiveness and efficiency of SOEs. WTO accession in 2001 further spurred privatization. A pivotal change came in 2005 with the "split share structure reform," increasing state-owned equity circulation in large listed companies. The State-owned Assets Supervision and Administration Commission directed 196 major SOEs to expand, driving widespread privatization. This marked a significant shift in ownership and operation, which continued until 2013. At present, there are some studies examining the impacts of SOE privatization concerning other aspects of enterprise, including enterprise profits (Megginson and Randenborgh, 1994) [1]; layoffs and salary reductions (La Porta and Lopez-de-Silanes, 1999) [2]. However, what most scholars haven't mentioned is the relationship between the privatization and firm innovation.

Speaking of firm innovation, which is a crucial indicator of the performances of an enterprise, research on scientific and technological innovation capabilities focuses on R&D investment, which is generally used as an indicator of scientific and technological innovation capabilities. Liu Sa et al. (2020) [3] used the three-stage DEA model and found that increasing corporate investment in innovation can improve production efficiency; While Chamanski's (2001) [4] results showed that R&D intensity only affects the performance of non-high-tech SMEs. Despite the differences between two studies, it is easy to know that firm innovation is crucial for the development of an enterprise, especially in terms of profitability and long-term development.

Based on what have been done concerning this topic previously, this article analyses the relationship between the privatization of Chinese SOEs and firm innovation, using the data of more than 28000 listed company which have been through privatization. The analysis of huge amount of data produces a margin contribution, due to the fact that the time span of the research data is extensive, and the volume of data is substantial. Moreover, this article uses the model of regression, utilizing

R&D expense as the index of firm innovation and a dummy variable indicating whether an SOE was privatized or not. Through the help of regression model, this article is able to provide a appropriate perspective of learning the relationship between privatization and firm innovation. It is also worth mentioning that this article generates a conclusion which is quite different from some previous studies, posing a challenge to the conventional idea.

2. Literature Review

2.1. Research Related to Privatization of State-owned Enterprises

2.1.1. Privatization out of China

Frydman, Roman, et al. (1999) [5] have compared the performance of privatized and state enterprises in Central Europe, and find that the effect of privatization depends on the types of owners it changed into. Whether the privatization is effective or not, the effect on cost reduction is not comparable. The research from Gupta (2005) [6] have shown a positive effect on even lower level of privatization since the stock market can play in monitoring and rewarding managerial performance. Arocena, Pablo et al. (2012) [7] have mentioned that increasing the efficiency of SOEs is the ultimate goal of privatization. They have analyzed several sides, including managers' side and the politicians, bureaucrats and government officials' sides. For the management side, those managers in private enterprises have greater incentives to reduce costs and pursue profit maximization or efficiency maximization, while the ability to monitor SOEs' managers is weaker. However, Managers in private enterprises are more influenced by external control mechanisms, for instance, labour market competitions.

Kumari et al. (2020) [8] have found that the privatization in Indian aviation industry pushed the it to a continuing growing trend, privatization is positive to industry expansion. Rai et al. (2022) [9] have studied a sample of 22 banks and have found that the privatization of public banks has a positive short-term impact in average abnormal returns. Even though the cumulative effect of the announcement is negatively significant for both banks' structures.

2.1.2. Privatization in China

For China, privatization is a significant step in transforming centralized economies into market economies (Gan, Jies, 2009) [10]. They have also stated that China's privatization has effectively implemented the largest privatization process in human history, with nearly 100,000 enterprises and a total asset value of 11.4 trillion yuan being successfully privatized. This accounts for approximately two-thirds of China's state-owned enterprises and their corresponding assets.

Because of the growing concern about government debt, the central government implemented the 'retain the large, release the small' (Zhua Da Fang Xiao). Then increasingly, small- and medium-sized SOEs have been privatized as larger SOEs have important strategic and economic roles (Todo, Yasuyuki et al. 2014) [11].

2.2. Research Related to Corporate Innovation

2.2.1. Corporate Innovation out of China

Carreira et al. (2009) have found that privatization process can affect negatively to the innovating activity which is originally high in public enterprises in Spain [12]. Choudhury et al. (2009) have found that privatization and commercialization will not affect innovation but the enterprise between privatized and state commercials will promote the reform [13]. Bergman et al. (2016) have investigated the innovation in public services improvement in Sweden and found that when combined with increased competition, the performance innovation will also increase [14].

2.2.2. Corporate Innovation in China

Fang et al. (2017) stated that firm innovation according to the patent numbers rose following SOE privatization [15]. However, Zhang et al. (2020) argued that privatization mainly increases the spending on development but there were no direct relationships between it and the number of patents [16]. This may be because they have different judgments on whether the enterprise is privatized.

According to Pan et al. (2022), privatization cannot be the only determinant that promotes innovation as it might depend on the extent of privatization [17]. They held that only the privatized companies owned by domestic non-state-owned capital, instead of the privatized enterprises controlled by state-owned capital or from foreign, may contribute to the innovation.

Moreover, not only the number of patents but also the quality of patents should be considered. An Outline of the National Intellectual Property Strategy issued by the State Council of China states that Intellectual property indicators will be included in the performance appraisal of SOEs. However, it mainly focuses on the quantity of patents, with little attention to quality. Therefore, in order to increase the benefit of privatization, the indicators of innovation should consider more factors.

2.3. Literature Comments

Most of the privatization literature outside China believes that privatization is beneficial to corporate profitability and management capabilities, and some literature believes that its pros and cons depend on the transfer object. Most of the research results on the privatization of state-owned enterprises in China believe that privatization is beneficial to corporate profitability and management. In the privatization process in China, the degree of privatization of small and medium-sized enterprises is higher than that of large enterprises. This difference may cause the relationship between firm innovation and privatization to differ depending on the size of the enterprise.

In the literature on the relationship between privatization and innovation, literature from various regions have different discussions on privatization and innovation. Each literature discusses the degree of privatization, the objects of privatization and the competition situation after privatization, and draws different conclusions. However, they fail to take into account that privatization may have a negative impact on corporate innovation and why. This is also what this article will focus on.

3. Logic Deduction

(1) After the privatization reform, state-owned enterprises will be more inclined to apply research and experimental development where the gap between private rate of return and social rate of return is small, and less investment will be made in basic research that meets the country's major strategic needs. The establishment of state-owned enterprises serves one of the purposes, which is to ease the market failure arising from basic research due to its characteristics as a quasi-public good with limited non-competitiveness and non-exclusivity. It aims to compensate for the severe deficiency in private investment incentives and, at the same time, promote the overall technological advancement of the nation through knowledge spillover. However, after implementing privatization reforms in state-owned enterprises, the new business operators will be less inclined to consider the enhancement of the nation's overall technological level. They will be more focused on maximizing wealth, directing more of the enterprise's innovative resources towards applied research and experimental development that can yield rapid returns. This may consequently lead to a decrease in the actual innovative output of the enterprise. (Zhu Lile et al.,2021) [18].

(2) State-owned businesses can benefit from their ownership to ease financial restrictions while the benefits gained from the government may reduce after the privatization (Liang et al, 2012) [19]. Statistics from the Chinese Industrial Enterprise Database reveal that state-owned enterprises are more likely to receive government subsidies when they perform poorly or incur losses, and that government subsidies received by other ownership enterprises are significantly lower than those of state-owned enterprises (Lin and Tan, 1999) [20]. Government grants assist businesses in obtaining enough resources for R&D and innovation (Wang Yihui, 2013) [21], which lowers the risk associated

with the new capital these businesses bring to the table (Hussinger, 2008) [22] and increases their willingness to innovate (Almus et al., 2003) [23], assisting businesses in carrying out innovative activities more effectively. However, due to changes in enterprise ownership following the privatization of state-owned companies, their government subsidies will be significantly reduced. This will result in tighter budgetary restrictions and funding shortages, which will lower their capacity for innovation.

Based on the above discussions, this paper proposed the following hypothesis 1:

Hypothesis 1. Privatization of state-owned enterprises in China can damage firm innovation.

4. Research design

4.1. Research Hypothesis

Privatization of state-owned enterprises in China can damage firm innovation.

4.2. Econometric Modeling

Based on the theoretical assumptions in the previous section, in order to explore the relationship between corporate innovation and the privatization reform of SOEs, this paper establishes the regression model of the following formula:

$$\text{Innovation}_{i,t} = \alpha + \beta \text{minying}_{i,t} + \gamma X_{i,t} + v_t + u_i + \varepsilon_{i,t} \quad (1)$$

In Equation (1), the explanatory variable $\text{Innovation}_{i,t}$ denotes the degree of innovation of enterprise i in year t , as measured by the share of R&D investment in operating revenue. The core explanatory variable $\text{minying}_{i,t}$ indicates whether the enterprise undertook privatization reform in year t ; $X_{i,t}$ is the set of relevant control variables; v_t is a time fixed effect; and u_i is the individual effect of enterprises to eliminate the differences that exist among enterprises. Based on the theoretical assumptions, this paper expects the coefficient of privatization reform to <0 , which means as privatization reform proceeds, enterprises become less innovative.

4.3. Variable Definition

4.3.1. Explained Variables

Drawing on existing articles, this paper measures corporate innovation from the perspective of innovation input. Since R&D expense is the most important innovation input, this paper uses the ratio of R&D investment to sales to measure the R&D investment density of enterprises.

4.3.2. Explanatory variables

The explanatory variable of this paper is whether the SOEs are privatized or not. If the enterprise has implemented the privatization and restructuring of SOEs during the sample period, the nature of the enterprise changes from state-owned to non-state-owned, creating a "minying" dummy variable. It takes the value of 0 before the privatization and restructuring of SOEs, and the value of 1 after the privatization and restructuring of SOEs.

4.3.3. Control variables

In this paper, a set of enterprise-level variables that may affect the innovation of corporate enterprises are selected as control variables, enterprise size, gearing ratio, current ratio, and return on total assets. The variables are defined as shown in the Table 1 below:

Table 1. Variable Definition

variable	meaning
innovation	the ratio of R&D investment to sales
minying	1=after the privatization and restructuring of SOEs, 0=before the privatization and restructuring of SOEs
ROA	Return on total assets: the ratio of a company's net profit to its total assets
SIZE	Enterprise size: the natural logarithm of the enterprise's total assets
LEV	Gearing ratio: the ratio of total liabilities to total assets
Liquid	Current ratio: ratio of current assets to current liabilities

4.4. Sample Selection and Data Source

This paper selects A-share non-financial state-owned listed companies during 2010-2022 as the original sample. This research extracted the R&D expenditure data of listed companies from Wind, the financial data from the CSMAR database developed by Shenzhen GuotaiAn, and the corporate governance data from the CCER database. In order to control the effect of extreme values, this article shrink the data according to the standard of 1%.

This paper uses enterprise micro data from 2010-2022 to validate the model, taking into account that financial enterprises have less inputs and outputs in the R&D category and the privatization reform is earlier, so the samples of financial listed companies are excluded. After processing, a total of 3490 valid samples remains.

4.5. Descriptive Statistics

Table 2 reports the results of descriptive statistics for the main variables in this paper. From the results in Table 2, the mean value of rd is 0.056, which indicates that enterprises' R&D investment only accounts for 5.6% of their operating revenues, and the overall level of R&D investment is low. The mean value of the SOE privatization dummy variable minying is 0.62, indicating that about 62% of the enterprises' one-year observations are samples of SOE privatized enterprises.

Table 2. Descriptive Statistics

Variable	N	Mean	p50	SD	Min	Max
innovation	35372	0.0560	0.0400	0.0540	0	0.323
minying	46839	0.620	1	0.485	0	1
Liquid	39151	2.763	1.830	2.783	0.303	17.17
LEV	39431	40.76	39.28	20.89	5.118	101.5
ROA	39274	0.0590	0.0550	0.0840	-0.302	0.323
SIZE	39274	21.38	21.30	1.434	13.08	31.31

4.6. Regression Analysis

Table 3 reports the results of the baseline regression of SOEs' privatized restructuring and R&D investment intensity. Column (1) shows the net effect without adding control variables and fixed effects. Column (2) adds control variables. Column (3) adds time fixed effects and individual fixed effects. All regression results are negatively significant at the 1% significance level, indicating that SOE privatization reform does significantly reduce enterprises' R&D investment intensity and slows down enterprises' innovation. The regression results in column (3) show that when enterprises change their nature from SOEs to non-SOEs, the degree of enterprises' innovation decreases by 0.2%. This may be related to the fact that state-owned enterprises may face a more severe financing environment and backward property rights protection after privatization and restructuring. Therefore, certain preconditions are needed for the success of privatization and restructuring, which is a unique kind of mixed-ownership restructuring.

Table 3. Regression analysis

groups variates	(1)	(2)	(3)
	innovation	innovation	innovation
minying	-0.010*** (24.606)	-0.002*** (-2.779)	-0.002** (-2.472)
Liquid		0.000 (0.679)	0.000 (0.795)
LEV		-0.000*** (-16.768)	-0.000*** (-6.228)
ROA		-0.129*** (-54.591)	-0.115*** (-19.927)
SIZE		0.000 (0.118)	-0.003*** (-3.812)
Constant	0.049*** (54.711)	0.074*** (15.561)	0.122*** (7.683)
N	3.5e+04	3.5e+04	3.5e+04
r2			0.120

5. Conclusion

5.1. Conclusion

Improving enterprise production and management efficiency is the biggest source of motivation for the privatization of Chinese state-owned enterprises. However, many studies have different answers about the impact of privatization on innovation. This paper uses larger panel data than previous studies and uses fixed effects regression models to study the relationship between the two. The main conclusion drawn from the empirical study of this article is that the privatization of state-owned enterprises in my country has had a negative impact on corporate innovation. This is very different from the traditional relationship between privatization and innovation of Chinese enterprises, and poses a great challenge to traditional concepts.

The negative impact of privatization on corporate innovation mainly explains two issues. First, after privatization, business operations have shifted from social welfare orientation to profit orientation, resulting in R&D investment and projects that cannot generate short-term profits being reduced or stopped. Second, after privatization, enterprises will need to face market turbulence and great uncertainty, which will reduce investment in long-term assets (intellectual property rights).

5.2. Policy Suggestion

Faced with this situation, this paper can make up for the damage caused by privatization to innovation. First of all, privatization should be aimed at increasing the production and management efficiency of enterprises and thereby improving their profitability. This can reduce the government's financial burden and increase social and economic vitality, but should not be aimed at improving the innovation capabilities of enterprises, because this will be counterproductive.

Secondly, the government should encourage innovation in state-owned enterprises. The innovation capabilities of enterprises after privatization will decline. In order to improve the knowledge spillover effects and innovation capabilities of the overall society, the government should increase incentives for the innovation departments of state-owned enterprises to make up for the innovation losses caused by privatization.

Third, implement flexible innovation incentives for privatized enterprises. Comprehensive innovation support for privatized enterprises will increase the government's financial burden, but adding flexible incentives can stimulate innovation while keeping government spending at a reasonable level. For example, taxes can be reduced in proportion to the company's R&D investment,

or innovation achievement awards can be set up in different fields with honors and a certain amount of bonuses.

5.3. Outlook

This study also has shortcomings. For example, our innovation indicator is the investment of innovation funds, and when a company is privatized, the state will naturally reduce or cancel the investment of innovation funds in the company. This is not because privatization has brought about a reduction in innovation, but after weighing the pros and cons. For this company, innovation is not that important, which is why it made the decision to privatize and reduce innovation funds. Solving this problem is very difficult and requires more realistic details to assess the country's innovation research priorities and the company's innovation strengths. Hope it can continue to be improved in more detailed areas in the future.

Author Contributions

All the authors contributed equally and their names were listed in alphabetical order.

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