**Does the anti-corruption campaign[[1]](#footnote-1) in China enhance or impede firm innovation?**

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**Abstract**

This paper documents the impacts of anti-corruption campaign on firms' innovation. Using firm-level data from CSMAR dataset, I analyze whether anti-corruption campaign's impacts on firms’ innovation are stronger on corruption firms, firms in the corruption industry and the non-SOE (State Owned Enterprises). My results show that anti-corruption campaign enhances the innovation on the whole. Specifically, we find the corruption firms will enhance innovation after the outbreak of corruption due to the disappearance of corruption privilege. The outbreak of corruption will enhance innovation in corruption firms more than other non-corruption firms in the same industry and enhance the non-corruption firms in corruption industry more than those non-corruption firms in the non-corruption industry. For those non-SOE firm, the enhance effects of anti-corruption campaign on innovation are more obvious.

**Key Words**: Innovation; Anti-corruption campaign

1. **Introduction**

The role of innovation as a critical driver of a nation’s long-term economic growth and competitive advantage has been established in the literature. Firms invest in innovations if they expect future market gains from these investments.

However, how to nurture innovation in China is still an open question debated in recent years. For example, does the anti-corruption campaign after the 18th National Congress of the Communist Party of China enhance or impede firm innovation?

Why is the topic interesting and important? It is due to dense networks of interpersonal obligations or connections are a historically and culturally deep-rooted part of business in China (Gold & Guthrie 2002). However, Chinese recognize that connections can become excessive, and become socially corrosive corruption, is an increasing concern in China in recent years (Wedeman 2012).

Many of the firms rely on connections in the operating activities, especially on connections with senior officers in the Communist Party of China. If the anti-corruption campaign involves a firm, will the event enhance or impede the peer firm innovations in the industry? That limiting corruption would increase Chinese firm innovations is not a priori obvious. On the one hand, limiting corruption might increase firm innovations by making firms more competitive and more market-driven. On the other hand, limiting corruption might make it less difficulty for the non-corruption firms to survive in the market. So far there has been two possible mechanisms to indicate whether the anti-corruption campaign in China will enhance or impede firm innovation. Due to the non-corruption firms accounted for most in the market, it is crucial to investigate the effects of corruption on the peer firms to gain a whole picture of firms’ reaction on innovation to anti-corruption campaign.

*Mechanisms*

1. *Positive effects*: The corruption firms might rely on connections to compete in the industry. When connections disappear in the corruption firms after the anti-corruption campaign, the peer firms will struggle to enhance innovation to gain more market share.

2. *Negative effects*: The corruption firms might rely on connections to compete in the industry. When connections disappear in the corruption firms after the anti-corruption campaign, the peer firms will relax in innovation because the competition is not fierce.

We expect the positive effects to be more prevalent. If the innovation is enhanced by anti-corruption campaign, it will be a valuable discovery. Thus we need to investigate to impacts of corruption on innovation of different firms specifically. In this paper, I use annual data concerning inventions and patents of each listed companies from 2010 to 2015 in Shanghai and Shenzhen stock exchange from CSMAR database. I also search for records of violating the law and discipline and committing crimes from the website of the Commission for Discipline Inspection of the Central Committee of the Communist Party of China. Moreover, we find the correlation of firms and arrested government officers from news sought from baidu.com and google.com one by one manually. The number of firms involved in corruption is 93 and there are 31 corrupted provincial and ministerial level officials related to them. Using the data, I find the corruption firms will enhance innovation after the involving in the corruption due to the disappearance of corruption privilege. Furthermore, the anti-corruption corruption will enhance innovation in corruption firms more than other non-corruption firms in the same industry. In addition, the empirical results show that the anti-corruption campaign will enhance innovation in the non-corruption firms in corruption industry more than those non-corruption firms in the non-corruption industry. For those non-SOE firms, the enhancing effects of anti-corruption campaign on firms’ innovation are more obvious than the SOE firms.

The remainder of the paper is organized as follows. Section 2 reviews related literature. Section 3 describes the data and variables. Section 4 illustrates our research design. Section 5 presents results of our empirical tests. Section 6 concludes.

1. **Literature review**

Our study is highly correlated with two strands of literature. First is the about innovation. Second is about corruption or anti-corruption.

The first strand of literature is about the innovation.

Innovation is a crucial driver of a nation’s long-term economic growth and competitive advantage. People are all curious about optimal organizational form for nurturing innovation. As Porter (1992) states, “To compete effectively in international markets, a nation’s businesses must continuously innovate and upgrade their competitive advantages.” Lerner (2012) therefore suggests that perhaps the best way to motivate innovation is a corporate venture capital (CVC) program, that combines features of corporate research laboratories and venture backed start-ups within a powerful system that consistently and efficiently produces new ideas. Tian et al. (2015) proved that stock liquidity will impede firm innovation. There are two possible mechanisms: increased exposures to hostile takeovers and higher presence of institutional investors who do not actively gather information about firm fundamentals or monitor. Both could result in a cut in investment in innovation to boost current earnings. Cornaggia et al. (2015) showed banking competition reduces innovation. They argued that banking competition enables small, innovative firms to secure financing instead of being acquired by public corporations. Therefore, banking competition reduces the supply of innovative targets. Overall, these results shed light on the real effects of banking competition and the determinants of innovation. Tian et al. (2015) also argues that unions promote innovation. A reduction in R&D expenditures, reduced productivity of inventors, and departures of innovative inventors are plausible mechanisms through which unionization impedes firm innovation.

The second strand of literature is about the corruption.

Corruption is thought to hinder economic growth by diverting capital, effort, and talent away from productivity-boosting activities and towards political rent-seeking activities (Murphy et al. 1991, 1993; Shleifer & Vishny 1993; Fisman & Svensson 2007, Agarwal et al 2015). Official corruption is of special importance in an economy with bureaucratic problems because its market socialism system relies on virtuous government officials. This gives government officials opportunities to intervene in judicial and regulatory decisions (Chen 2003; Jones 2003). The discretionary powers of officials can easily make establishing ties of connections with them a high-return investment to any non-SOE business enterprises (McGregor 2010).

An investment in official connections that greases the gears of the bureaucracy and lets the firm get things done (Wei 2001; McMillan & Woodruff 2002; Li et al. 2008). Such anti-corruption reforms might thus hurt firms by reducing the value of their past investment in connection (Fisman 2001; Calomiris et al. 2010).

1. **Data Description and Variable Definition**
	1. Descriptions of data

We collected data about firms having connections with corrupted provincial and ministerial level officials. In addition, we also record the name of the arrested officials and the date when the officials were investigated by the central commission for discipline inspection. The number of firms involved in corruption is 93 and there are 31 related corrupted provincial and ministerial level officials. In addition, we download annual data concerning inventions and patents of each listed companies from 2010 to 2015 in Shanghai and Shenzhen stock exchange from CSMAR database. The data include stock code, full name of firms, industry code, industry name, the size of the firms, the leverage ratio of the firms, the TobinQ value of the firm, the number of years from the IPO year, number of inventions, number of utility models and number of designs[[2]](#footnote-2). The data is panel data and we have 2,334 firms, and each firm has patents data of 6 years (from 2010 to 2015), thus we have 14,004 pieces of data in total.

* 1. Definition of variables

The definitions of the main variables are shown in Table 1.

[Insert Table 1 here]

Table 2 presents the summary statistics and the correlation matrix of the main variables. In the Table 2 Panel A, we find that the 1.9% of the firms are corruption firms and only 1.9% of firms are SOE firms. The average years from their IPO open year is 9.064 years and the median of them is 15 years. The average TobinQ value of the all the firms in the sample is 3.488 and the median of them is 3.202. The average size of firms in our sample is 21.942 billion yuan and the median of them is 22.650 billion yuan. Only 10% of the firms have a leverage ratio above 0.995 and the average leverage ratio is 0.470. As for our measure of innovation, we find that the number of inforce patents are more than the number of patents application measured by Invention, Design and UtilityModel.

Table 2 Panel B is the correlation matrix of the main variables. We find *Size*, *Leverage* and *SOE* are significantly positive correlated to *Corruption*. That means large-sized, high-leveraged and SOE firms are more likely to involve in corruption.

[Insert Table 2 here]

**4. Research Design**

The anti-corruption campaign might have impacts on the corruption firms, non-corruption firms in the same industry as the corruption firms, the non-corruption firms in the non-corruption industry and the non-SOE firms. The different impacts of anti-corruption campaign among those kinds of firms remain to be explored in the following empirical design.

Based on the discussions above, we propose four hypotheses.

*Hypothesis 1: The anti-corruption campaign will enhance innovation of the corruption firms.*

*Hypothesis 2: The anti-corruption campaign will enhance innovation of the corruption firms more than those non-corruption firms in the same industry.*

*Hypothesis 3: The anti-corruption campaign will enhance innovation of the non-corruption firms in corruption industry more than those non-corruption firms in the non-corruption industry.*

*Hypothesis 4: The anti-corruption campaign will enhance innovation of the non-corruption firms in corruption industry more than those non-corruption firms in the non-corruption industry mainly for those non-SOE firms.*

The first question we want to know about is whether anti-corruption campaign enhance or impede innovation significantly after the outbreak of corruption. To capture the effect, we use regression discontinuity method. The regression function is as following:

$$Innovation\_{i}=α+β\_{1}\*AfterCorruption\_{i}+β\_{2}\*Control\_{i}+ε\_{i}$$

What we are concerning about is the coefficient of *AfterCorruption*, the positive or negative sign of it could be interpreted as an enhancing or impeding impacts of outbreak of corruption. In this regression, the innovation is measured by both the patent applications and approved patents.

In order to test whether there is difference between the corruption firms and their peer firms after the outbreak of corruption. We are going to use difference-in-difference method to indicate that the corruption firms in the same industry as corruption firms might enhance or impede more innovation than non-corruption firms in the same industry as corruption firms after the anti-corruption campaign. Before the difference-in-difference method, we should use propensity score matching method to match the corruption firms with those non-corruption firms.

Then we group firms as the treatment group if the one or more corrupted government officers is correlated to it, and group firms as the control group if none of arrested government officers is related to it. We calculated the propensity scores of loans in the two groups using the following Probit regression:

$$Pr(Corruption\_{i}=1)=Φ(α+β\*Control\_{i})$$

where Φ(∙) is the standard normal distribution function. *Controli* represents the variables describing the characteristics of firm *i*. $Control\_{i}$ includes *Size*, *Leverage*, *TobinQ, AfterIPO*, *InventionApplication*, *DesignApplication*, *UtilityModelApplication*, *ApprovedInvention*, *ApprovedDesign* and *ApprovedUtilityModel*.

We match the corruption firms with those non-corruption firms using the data of the year when the corruption broke out. The matching rule is that each corruption firm is matched with a non-corruption firm in the same industry with the nearest propensity score. We calculate the propensity score considering the main characteristics of those firms, such as size, leverage, TobinQ. After the matching, we have several pairs of corruption and non-corruption firms in the same industry.

Using these paired sample, we could conduct the difference-in-difference regression. The regression function is as following:

$$Innovation\_{i}=α+β\_{1}\*Corruption\_{i}+β\_{2}\*AfterCorruption\_{i}+β\_{3}\*Corruption×AfterCorruption\_{i}+β\_{4}\*Control\_{i}+ε\_{i}$$

Control variables include *Size, Leverage, TobinQ, AfterIPO. Innovation* is measured by *InventionApplication, DesignApplication, UtilityModelApplication, ApprovedInvention*, *ApprovedDesign* and *ApprovedUtilityModel*.

If the coefficient of interaction term *Corruption×AfterCorruption* is positive and significant, we can conclude that the corruption firms will enhance innovation more than the non-corruption firms in the same industry after the anti-corruption campaign.

Similarly, the difference between non-corruption firms in corruption industry more than those non-corruption firms in the non-corruption industry might be solved thorough the same process. Thus we match the non-corruption firms in corruption industry with those non-corruption firms in the non-corruption industry using the propensity score matching. After the matching, we conduct the difference in difference method the same as above.

As the background of state-owned will change the styles and strategies of the firms a lot. It is necessary to divide the sample into SOE firms and non-SOE firms and check the difference respectively. We would like to check whether the corruption effects on peer firms’ innovations more or less obvious in the SOE firms. We group the firms into SOE firms and non-SOE firms, and the repeat the propensity score matching and difference in difference regression.

**5. Empirical Results**

*5.1 The anti-corruption campaign will enhance innovation of the corruption firms.*

In table 3, we run the regression using OLS regression method, we find the coefficient of dummy *AfterCorruption* is positive and significant, which means the innovation increases significantly after the outbreak of corruption. We find no matter we use the patent application and approved patents as the measure of innovation, we find the increased effects of corruption outbreak is significant. It could be interpreted that the innovation is enforced if the corruption outbreak. It is probably due to those corruption firms usually rely on corruption privileges to earn and remain market shares, and if the corruption privileges disappeared, the firms tend to rely on innovation to survive in the market.

[Insert Table 3 here]

*5.2 The anti-corruption campaign will enhance innovation of the corruption firms more than those non-corruption firms in the same industry.*

The above analysis has shown that the outbreak of corruption will enhance innovation of corruption firms, and we are more curious whether the effects is more obvious in corruption firms than the non-corruption firms in the same industry. We need to use difference in difference method to identify the effects. Before using the difference in difference method, we should use propensity score matching method to match each corruption firm with a firm with the nearest propensity score. Thus we have 258 pairs of firms. Using the 516 firms, we could conduct the difference in difference in Table 4. The coefficient of interaction term *Corruption×AfterCorruption* is positive and significant. It could be interpreted that the outbreak of corruption will enhance innovation more than the non-corruption firms in the same industry.

The reason for the result is those corruption firm relied on the corruption privilege to survive in the market, and will relied more on innovation when the corruption privilege disappeared after anti-corruption campaign than their non-corruption peer firms.

[Insert Table 4 here]

*5.3 The anti-corruption campaign will* *enhance innovation of the non-corruption firms in corruption industry more than those non-corruption firms in the non-corruption industry.*

Before the difference in difference method, we should also use propensity score matching method to match each corruption firm with a firm with the nearest propensity score. Thus we have 12,808 pairs of firms. Using the 25,616 firms, we could conduct the difference in difference in Table 5. The coefficient of interaction term *Corruption×AfterCorruption* is still positive and significant. It could be interpreted that the outbreak of corruption will enhance innovation of the non-corruption firms in corruption industry more than those non-corruption firms in the non-corruption industry.

The reason for the result might be that all the non-corruption firms in the corruption industry will make more efforts to gain more market shares because the privilege of the corruption firms disappeared and the market is more fair. In contrary, the firms in the non-corruption industry will have no incentive to invest in innovation.

 [Insert Table 5 Here]

*5.4 The anti-corruption campaign will enhance innovation of* *the non-corruption firms in corruption industry more than those non-corruption firms in the non-corruption industry mainly for those non-SOE firm.*

In addition, we also want to know more about whether those enhance effect is more or less obvious in SOE firms. We divide the sample into two groups, one is the SOE firms and the other is the non-SOE firms. The same difference in difference process in conducted in both the SOE firms and non-SOE firms. We have 3,270 pairs of firms in the SOE firms group and 9,538 pairs of firms in the non-SOE firms group. The innovation is also measured by patents application and approved patents. We find among the SOE firms, the difference in the impacts of corruption on innovation between the non-corruption firms in corruption industry and those non-corruption firms in the non-corruption industry disappeared. However, among those non-SOE firms, the difference in the impacts of corruption on innovation between the non-corruption firms in corruption industry and those non-corruption firms in the non-corruption industry become more significant. The explanation for the results is that those non-SOE firms are more sensitive to the competition of market because the lack of backup from the country and government. When some firms involved in corruption in the same industry, the non-SOE firms might focus more on the innovation in order to gain more market shares in the market. As for the SOE firm, they are supported by the government and less motivated to promote innovation when the corruption broke out.

[Insert Table 6 here]

**6. Conclusion**

This paper documents the impacts of anti-corruption campaign on firms' innovation. Using firm-level data of each listed companies from 2010 to 2015 in Shanghai and Shenzhen stock exchange from CSMAR database and records of violating the law and discipline and committing crimes from the website of the Commission for Discipline Inspection of the Central Committee of the CPC, I analyze whether anti-corruption campaign's impacts on firms’ innovation are stronger on corruption firms, firms in the corruption industry and the non-SOE. My results show that anti-corruption campaign enhances the innovation on the whole. Specifically, we find the corruption firms will enhance innovation after the outbreak of corruption due to the disappearance of corruption privilege. The anti-corruption campaign will enhance innovation in corruption firms more than other non-corruption firms in the same industry and enhance the non-corruption firms in corruption industry more than those non-corruption firms in the non-corruption industry. For those non-SOE firm, the enhance effect of anti-corruption campaign on innovation are more obvious.

Based on the above findings, we conclude that the anti-corruption campaign will enhance firms’ innovation.

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**Appendix**

**Table 1. Definition of main variables**

|  |  |  |
| --- | --- | --- |
| **Variable** | **Symbol** | **Definition** |
| Whether the firm is involved in the corruption  | *Corruption*  | Takes value of 1 if the firm is involved in the corruption, otherwise take value of 0. |
| Whether the corruption of the firms or the matched corruption firms break out  | *AfterCorruption* | Takes value of 1 after the outbreak of corruption, otherwise takes value of 0 |
| The asset size | *Size* | The asset size of firm |
| Theleverage ratio | *Leverage* | The leverage ratio of firm |
| The TobinQ value | *TobinQ* | The TobinQ value of firm |
| Time from the IPO year | *AfterIPO* | The number of years after the firm’s IPO year |
| Innovation | Inventions Applications | *InventionApplication* | The number of inventions applications |
| Design Applications | *DesignApplication* | The number of design applications |
| UtilityModel Applications | *UtilityModelApplication* | The number of utilitymodel applications |
| Approved Invention | *ApprovedInvention* | The number of inforced inventions of firm |
| Approved Design | *ApprovedDesign* | The number of inforced design of firm |
| Approved UtilityModel | *ApprovedUtilityModel* | The number of inforced utilitymodel of firm |
| Whether the firm is a SOE(State-owned Enterprises) firm | *SOE* | Takes value of 1 if the firm is a SOE (State-owned Enterprises) firm, otherwise take value of 0 |

**Table 2. Summary statistics of main variables**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | No. of Obs. | Mean | S.D. | Min. | p10 | p25 | p50 | p75 | p90 | Max. |
| *Corruption* | 14,004 | 0.019 | 0.135 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| *AfterCorruption* | 14,004 | 0.010 | 0.099 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| *Size* | 14,004 | 21.942 | 1.488 | 20.443 | 20.965 | 21.734 | 22.650 | 23.726 | 13.076 | 30.732 |
| *Leverage* | 14,004 | 0.470 | 0.754 | 0.133 | 0.252 | 0.434 | 0.617 | 0.755 | 0.995 | 46.159 |
| *TobinQ* | 14,004 | 3.488 | 32.252 | 1.121 | 1.423 | 2.036 | 3.202 | 5.077 | 0.671 | 2,512.748 |
| *AfterIPO* | 14,004 | 9.064 | 6.540 | 1 | 3 | 9 | 15 | 18 | 0 | 25 |
| *InventionApplication* | 14,004 | 10.710 | 102.864 | 0 | 0 | 0 | 4 | 14 | 0 | 5,237 |
| *DesignApplication* | 14,004 | 10.199 | 63.872 | 0 | 0 | 0 | 5 | 16 | 0 | 3,186 |
| *UtilityModelApplication* | 14,004 | 2.765 | 18.261 | 0 | 0 | 0 | 0 | 3 | 0 | 668 |
| *ApprovedInvention* | 14,004 | 20.266 | 298.228 | 0 | 0 | 1 | 7 | 22 | 0 | 17,151 |
| *ApprovedDesign* | 14,004 | 39.422 | 221.503 | 0 | 0 | 1 | 20 | 65 | 0 | 6,684 |
| *ApprovedUtilityModel* | 14,004 | 12.870 | 74.983 | 0 | 0 | 0 | 2 | 20 | 0 | 2,430 |
| *SOE* | 14,004 | 0.019 | 0.135 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

**Table 2 Panel B. Correlations Matrix of main variables**

Numbers in parentheses are the p values.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | *Corruption* | *AfterCorruption* | *Size* | *Leverage* | *TobinQ* | *AfterIPO* | *SOE* |
| *Corruption* | 1.000 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| *AfterCorruption* | 0.507 | 1.000 |  |  |  |  |  |
|  | (0.000) |  |  |  |  |  |  |
| *Size* | 0.090 | 0.097 | 1.000 |  |  |  |  |
|  | (0.000) | (0.000) |  |  |  |  |  |
| *Leverage* | 0.0143 | -0.002 | -0.068 | 1.000 |  |  |  |
|  | (0.089) | (0.802) | (0.000) |  |  |  |  |
| *TobinQ* | 0.556 | -0.062 | 0.034 | 0.189 | 1.000 |  |  |
|  | (0.938) | 0.844 | (0.000) | (0.000) |  |  |  |
| *AfterIPO* | -0.005 | 0.043 | 0.159 | 0.208 | -0.171 | 1.000 |  |
|  | (0.948) | (0.000) | (0.000) | (0.000) | (0.000) |  |  |
| *SOE* | 0.019 | 0.003 | 0.373 | 0.019 | 0.048 | 0.427 | 1.000 |
|  | (0.021) | (0.970) | (0.000) | (0.037) | (0.503) | (0.307) |  |

**Table 3 The impact of outbreak of corruption on the innovation of corruption firms**

This table presents the results of the OLS regression of *AfterCorruption* on *Innovation* and a list of control variables. Control variables include *Size, Leverage, TobinQ, AfterIPO. Innovation* is measured by *InventionApplication, DesignApplication* and *UtilityModelApplication* in Panel A, and by *ApprovedInvention*, *ApprovedDesign* and *ApprovedUtilityModel* in Panel B.

$$Innovation\_{i}=α+β\_{1}\*AfterCorruption\_{i}+β\_{2}\*Control\_{i}+ε\_{i}$$

Coefficients statistically significant at the 10%, 5%, and 1% significance level are marked by \*, \*\*, and \*\*\*, respectively. Numbers in parentheses are the standard errors.

**Panel A. The impact of outbreak of corruption on the innovation of corruption firms (Innovation measured by patent applications)**

|  |  |
| --- | --- |
|  | *Innovation* |
|  | (1) | (2) | (3) |
|  | *InventionApplication* | *DesignApplication* | *UtilityModelApplication* |
| *AfterCorruption*  | 47.483\*\*\* | 12.903\*\*\* | 119.801\*\*\* |
|  | (12.669) | (3.073) | (20.592) |
| *Size* | 49.722\*\*\* | -0.710 | 122.165\*\*\* |
|  | (7.629) | (-0.577) | (16.085) |
| *Leverage* | 4.741\* | 0.267 | 11.555\* |
|  | (2.541) | (0.463) | (6.676) |
| *TobinQ* | -3.156 | -1.256 | -8.248 |
|  | (-0.357) | (-1.753) | (-25.353) |
| *AfterIPO* | -6.225\*\* | -0.060 | -13.758\*\* |
|  | (-2.581) | (-0.132) | (-6.156) |
| *Constant* | -1,058.739\*\*\* | 32.582 | -2,603.231\*\*\* |
|  | (-150.048) | (28.387) | (-421.550) |
|  |  |  |  |
| Observations | 258 | 258 | 258 |
| R-squared | 0.210 | 0.226 | 0.186 |

**Panel B. The impact of outbreak** **of corruption on the innovation of corruption firms (Innovation measured by approved patents)**

|  |  |
| --- | --- |
|  | *Innovation* |
|  | (1) | (2) | (3) |
|  | *ApprovedInvention* | *ApprovedDesign* | *ApprovedUtilityModel* |
| *AfterCorruption*  | 8.592\*\*\* | 3.474\*\*\* | 14.994\*\*\* |
|  | (2.353) | (0.737) | (3.752) |
| *Size* | 27.698\*\*\* | 0.168 | 33.378\*\*\* |
|  | (7.774) | (0.368) | (7.301) |
| *Leverage* | 2.959\*\* | 0.114 | 3.368\* |
|  | (1.452) | (0.645) | (1.810) |
| *TobinQ* | -2.617 | 0.131 | -2.344 |
|  | (-5.542) | (0.210) | (-3.378) |
| *AfterIPO* | -4.094\*\*\* | -0.408\*\* | -4.679\*\*\* |
|  | (-1.105) | (-0.186) | (-0.766) |
| *Constant* | -575.2\*\*\* | 3.234 | -697.3\*\*\* |
|  | (-79.05) | (9.306) | (-96.69) |
|  |  |  |  |
| Observations | 258 | 258 | 258 |
| R-squared | 0.209 | 0.231 | 0.190 |

**Table 4. The different impacts of outbreak of corruption on innovation of firms between corruption firms and non-corruption firms in the same industry**

This table presents the results of the difference-in-difference regression results of *Corruption, AfterCorruption* and *Corruption*×*AfterCorruption* on *Innovation* and a list of control variables. Control variables include *Size, Leverage, TobinQ, AfterIPO. Innovation* is measured by *InventionApplication, DesignApplication and UtilityModelApplication* in Panel A, and by *ApprovedInvention*, *ApprovedDesign* and *ApprovedUtilityModel* in Panel B.

$$Innovation\_{i}=α+β\_{1}\*Corruption\_{i}+β\_{2}\*AfterCorruption\_{i}+β\_{3}\*Corruption×AfterCorruption\_{i}+β\_{4}\*Control\_{i}+ε\_{i}$$

Coefficients statistically significant at the 10%, 5%, and 1% significance level are marked by \*, \*\*, and \*\*\*, respectively. Numbers in parentheses are the standard errors.

**Panel A. Innovation measured by patent applications of firms**

|  |  |
| --- | --- |
|  | *Innovation* |
|  | (1) | (2) | (3) |
|  | *InventionApplication* | *DesignApplication* | *UtilityModelApplication* |
| *Corruption* | 26.95\*\*\* | -30.25\*\*\* | 33.59\*\*\* |
|  | (4.631) | (6.105) | (5.231) |
| *AfterCorruption* | -7.989 | -30.39\*\*\* | -11.26 |
|  | (14.25) | (5.951) | (19.70) |
| *Corruption*×*AfterCorruption*  | 21.53\*\*\* | 34.75\*\*\* | 33.90 |
|  | (5.87) | (7.44) | (24.76) |
| *Size* | 2.994\*\*\* | 1.979\*\*\* | 4.069\*\*\* |
|  | (0.731) | (0.305) | (1.011) |
| *Leverage* | -36.32\* | -14.49 | -52.30\* |
|  | (20.62) | (8.613) | (28.51) |
| *TobinQ* | -9.303\*\*\* | -0.759 | -13.13\*\*\* |
|  | (2.325) | (0.971) | (3.215) |
| *AfterIPO* | -2.593\*\* | -0.624 | -3.376\*\* |
|  | (1.019) | (0.426) | (1.408) |
| *Constant* | -5.813 | 2.303 | -7.229 |
|  | (6.981) | (2.916) | (9.652) |
|  |  |  |  |
| Observations | 516 | 516 | 516 |
| R-squared | 0.089 | 0.120 | 0.086 |

**Table 4 Panel B. Innovation measured by approved patents of firms**

|  |  |
| --- | --- |
|  | *Innovation* |
|  | (1) | (2) | (3) |
|  | *ApprovedInvention* | *ApprovedDesign* | *ApprovedUtilityModel* |
| *Corruption* | 39.85\*\*\* | -90.15\*\*\* | 84.95 |
|  | (10.74) | (18.37) | (79.44) |
| *AfterCorruption* | -3.084 | -59.65\*\*\* | -20.45 |
|  | (29.97) | (17.77) | (77.48) |
| *Corruption*×*AfterCorruption* | 72.45\*\*\* | 72.79\*\*\* | 197.4\*\*\* |
|  | (17.59) | (22.29) | (67.05) |
| *Size* | 5.191\*\*\* | 5.530\*\*\* | 14.33\*\*\* |
|  | (1.538) | (0.912) | (3.970) |
| *Leverage* | -51.15 | -56.15 | -166.3 |
|  | (43.37) | (25.23) | (111.9) |
| *TobinQ* | -18.92\*\*\* | -2.083 | -51.10\*\*\* |
|  | (4.892) | (2.901) | (12.32) |
| *AfterIPO* | -4.899\*\* | 0.257 | -10.61\* |
|  | (2.143) | (1.271) | (5.531) |
| *Constant* | -11.28 | 5.332 | -26.76 |
|  | (14.68) | (8.708) | (37.90) |
|  |  |  |  |
| Observations | 516 | 516 | 516 |
| R-squared | 0.184 | 0.200 | 0.186 |

**Table 5 The different impacts of outbreak of corruption on innovation of firms between corruption firms in the corruption industry and non-corruption industry**

This table presents the results of the difference-in-difference OLS regression of *Corruption, AfterCorruption* and *Corruption*×*AfterCorruption* on *Innovation* and a list of control variables. Control variables include *Size, Leverage, TobinQ, AfterIPO. Innovation* is measured by *InventionApplication, DesignApplication and UtilityModelApplication* in Panel A, and by *ApprovedInvention*, *ApprovedDesign* and *ApprovedUtilityModel* in Panel B.

$$Innovation\_{i}=α+β\_{1}\*Corruption\_{i}+β\_{2}\*AfterCorruption\_{i}+β\_{3}\*Corruption\_{i}×AfterCorruption\_{i}+β\_{4}\*Control\_{i}+ε\_{i}$$

Coefficients statistically significant at the 10%, 5%, and 1% significance level are marked by \*, \*\*, and \*\*\*, respectively. Numbers in parentheses are the standard errors.

**Panel A. Innovation measured by patent applications of firms**

|  |  |
| --- | --- |
|  | *Innovation* |
|  | (1) | (2) | (3) |
|  | *InventionApplication* | *DesignApplication* | *UtilityModelApplication* |
| *Corruption* | 16.62\*\*\* | -10.45\*\*\* | 21.56\*\*\* |
|  | (3.623) | (5.134) | (7.312) |
| *AfterCorruption* | -6.955 | -32.09\*\*\* | -21.36\*\*\* |
|  | (13.34) | (3.476) | (2.780) |
| *Corruption*×*AfterCorruption* | 27.42\*\*\* | 52.85\*\*\* | 15.09\*\*\* |
|  | (3.872) | (9.234) | (4.374) |
| *Size* | 3.238\*\*\* | 1.823\*\*\* | 5.659\*\*\* |
|  | (0.325) | (0.249) | (1.011) |
| *Leverage* | -43.42\*\* | -17.49\*\*\* | -32.50\* |
|  | (21.55) | (5.113) | (18.76) |
| *TobinQ* | -7.234\*\*\* | -0.239 | -33.13\*\*\* |
|  | (1.235) | (0.895) | (7.215) |
| *AfterIPO* | -6.334\*\*\* | -1.583\*\*\* | -6.498\*\*\* |
|  | (1.019) | (0.126) | (1.232) |
| *Constant* | -4.434 | 3.545 | -2.767 |
|  | (5.341) | (3.981) | (4.981) |
|  |  |  |  |
| Observations | 25,616 | 25,616 | 25,616 |
| R-squared | 0.182 | 0.194 | 0.185 |

**Panel B. Innovation measured by approved patents of firms**

|  |  |
| --- | --- |
|  | *Innovation* |
|  | (1) | (2) | (3) |
|  | *ApprovedInvention* | *ApprovedDesign* | *ApprovedUtilityModel* |
| *Corruption* | 7.687\*\*\* | -80.62\*\*\* | 45.27 |
|  | (2.744) | (12.969) | (79.34) |
| *AfterCorruption* | -2.873 | -67.35\*\*\* | -10.35 |
|  | (34.03) | (7.267) | (23.32) |
| *Corruption*×*AfterCorruption* | 12.78\*\*\* | 55.05\*\*\* | 47.45\*\*\* |
|  | (2.678) | (12.43) | (13.78) |
| *Size* | 6.839\*\*\* | 3.782\*\*\* | 17.38\*\*\* |
|  | (1.328) | (0.732) | (2.692) |
| *Leverage* | -45.79 | -78.99\*\*\* | -121.3 |
|  | (37.49) | (12.57) | (99.82) |
| *TobinQ* | -23.70\*\*\* | -3.546\*\*\* | -81.25\*\*\* |
|  | (3.567) | (0.932) | (11.33) |
| *AfterIPO* | -3.678\*\*\* | 0.343 | -20.40\*\*\* |
|  | (0.257) | (1.437) | (2.438) |
| *Constant* | -32.58 | 5.332\*\*\* | -34.65\*\* |
|  | (28.43) | (1.708) | (16.54) |
|  |  |  |  |
| Observations | 25,616 | 25,616 | 25,616 |
| R-squared | 0.189 | 0.183 | 0.197 |

**Table 6 The different impacts of outbreak of corruption on innovation of firms between corruption firms in the corruption industry and non-corruption industry (Grouped by SOE firms and non-SOE firms)**

This table presents the results of the difference-in-difference OLS regression of *Corruption, AfterCorruption* and *Corruption*×*AfterCorruption* on *Innovation* and a list of control variables. Control variables include *Size, Leverage, TobinQ, AfterIPO. Innovation* is measured by *InventionApplication, DesignApplication and UtilityModelApplication* in Panel A and Panel C, and by *ApprovedInvention*, *ApprovedDesign* and *ApprovedUtilityModel* in Panel B and Panel D.

$$Innovation\_{i}=α\_{i}+β\_{1}\*Corruption\_{i}+β\_{2}\*AfterCorruption\_{i}+β\_{3}\*Corruption×AfterCorruption\_{i}+β\_{4}\*Control\_{i}+ε\_{i}$$

Coefficients statistically significant at the 10%, 5%, and 1% significance level are marked by \*, \*\*, and \*\*\*, respectively. Numbers in parentheses are the standard errors.

**Panel A. Innovation measured by patent application of firms (SOE firms)**

|  |  |
| --- | --- |
|  | *Innovation* |
|  | (1) | (2) | (3) |
|  | *InventionApplication* | *DesignApplication* | *UtilityModelApplication* |
| *Corruption* | 129.3\*\*\* | 9.215\*\*\* | 166.7\*\*\* |
|  | (33.44) | (1.986) | (47.81) |
| *AfterCorruption* | 18.36 | 2.385 | 23.45 |
|  | (37.40) | (4.459) | (52.75) |
| *Corruption*×*AfterCorruption* | -12.53 | 4.509 | -9.473 |
|  | (14.06) | (5.253) | (12.11) |
| *Size* | 25.95\*\*\* | 0.029 | 32.67\*\*\* |
|  | (4.901) | (0.584) | (6.910) |
| *Leverage* | -146.4\*\*\* | -3.926\* | -195.7\*\*\* |
|  | (40.750) | (2.293) | (57.30) |
| *TobinQ* | -2.536 | -0.899 | -5.758 |
|  | (6.250) | (0.745) | (8.810) |
| *AfterIPO* | -5.406\*\* | -0.734\*\*\* | -7.333\*\* |
|  | (2.095) | (0.250) | (2.954) |
| *Constant* | -558.3\*\*\* | 4.135 | -689.1\*\*\* |
|  | (122.1) | (14.55) | (172.1) |
|  |  |  |  |
| Observations | 6,540 | 6,540 | 6,540 |
| R-squared | 0.128 | 0.236 | 0.201 |

**Panel B. Innovation measured by patent application of firms (non-SOE firms)**

|  |  |
| --- | --- |
|  | *Innovation* |
|  | (1) | (2) | (3) |
|  | *InventionApplication* | *DesignApplication* | *UtilityModelApplication* |
| *Corruption* | -7.356\*\*\* | -80.13\*\*\* | -11.84\*\*\* |
|  | (1.959) | (9.080) | (3.831) |
| *AfterCorruption* | -8.092\*\*\* | -73.15\*\*\* | -10.74\*\*\* |
|  | (2.705) | (8.300) | (3.502) |
| *Corruption*×*AfterCorruption* | 13.74\*\*\* | 78.34\*\*\* | 23.09\*\*\* |
|  | (3.585) | (11.01) | (4.642) |
| *Size* | 0.667\*\*\* | 4.328\*\*\* | 0.821\*\*\* |
|  | (0.157) | (0.481) | (0.203) |
| *Leverage* | 8.912 | -8.200 | 12.779\* |
|  | (5.529) | (16.97) | (7.158) |
| *TobinQ* | -0.123 | -1.946 | -0.650 |
|  | (0.457) | (1.402) | (0.592) |
| *AfterIPO* | -0.852\*\*\* | -0.977 | -0.809\*\* |
|  | (0.291) | (0.894) | (0.377) |
| *Constant* | 0.176 | 2.526 | 0.332 |
|  | (1.000) | (3.070) | (1.295) |
|  |  |  |  |
| Observations | 19,076 | 19,076 | 19,076 |
| R-squared | 0.283 | 0.194 | 0.178 |

**Panel C. Innovation measured by approved patents of firms (SOE firms)**

|  |  |
| --- | --- |
|  | *Innovation* |
|  | (1) | (2) | (3) |
|  | *ApprovedInvention* | *ApprovedDesign* | *ApprovedUtilityModel* |
| *Corruption* | 230.2\*\*\* | 13.72\*\*\* | 536.3\*\*\* |
|  | (72.09) | (2.931) | (188.4) |
| *AfterCorruption* | 43.27 | 1.789 | 80.65 |
|  | (80.63) | (12.23) | (210.7) |
| *Corruption*×*AfterCorruption* | 60.91 | 20.74 | 167.4 |
|  | (95.00) | (14.41) | (248.3) |
| *Size* | 44.20\*\*\* | 0.361 | 110.0\*\*\* |
|  | (10.57) | (1.603) | (27.62) |
| *Leverage* | -229.9\*\*\* | -8.961 | -633.5\*\*\* |
|  | (57.76) | (13.31) | (209.3) |
| *TobinQ* | -9.013 | 0.574 | -29.89 |
|  | (13.48) | (2.044) | (35.21) |
| *AfterIPO* | -11.91\*\*\* | -0.573 | -26.46\*\* |
|  | (4.517) | (0.685) | (11.80) |
| *Constant* | -948.4\*\*\* | -2.216 | -2,298\*\*\* |
|  | (263.2) | (39.92) | (687.9) |
|  |  |  |  |
| Observations | 6,540 | 6,540 | 6,540 |
| R-squared | 0.244 | 0.232 | 0.254 |

**Panel D. Innovation measured by approved patents of firms (non-SOE firms)**

|  |  |
| --- | --- |
|  | *Innovation* |
|  | (1) | (2) | (3) |
|  | *ApprovedInvention* | *ApprovedDesign* | *ApprovedUtilityModel* |
| *Corruption* | -17.34\*\*\* | -224.1\*\*\* | -43.31\*\*\* |
|  | (2.560) | (27.93) | (9.111) |
| *AfterCorruption* | -3.401 | -166.5\*\*\* | -11.19 |
|  | (2.340) | (25.53) | (8.327) |
| *Corruption*×*AfterCorruption* | 11.74\*\*\* | 174.2\*\*\* | 54.55\*\*\* |
|  | (3.101) | (33.85) | (11.04) |
| *Size* | 1.075\*\*\* | 12.56\*\*\* | 2.850\*\*\* |
|  | (0.136) | (1.479) | (0.482) |
| *Leverage* | -7.245 | -84.43 | 18.19 |
|  | (4.783) | (52.19) | (17.02) |
| *TobinQ* | -0.316 | -7.605\* | -3.512\*\* |
|  | (0.395) | (4.314) | (1.407) |
| *AfterIPO* | -0.0375 | 1.857 | -1.702\* |
|  | (0.252) | (2.751) | (0.897) |
| *Constant* | -0.013 | 5.562 | 0.094 |
|  | (0.865) | (9.445) | (3.080) |
|  |  |  |  |
| Observations | 19,076 | 19,076 | 19,076 |
| R-squared | 0.221 | 0.123 | 0.268 |

1. A campaign against corruption began in China following the closing of the 18th National Congress of the Communist Party of China in 2012. Upon taking office, Xi claimed to crack down on "tigers and flies", that is, to punish high-level officials and local civil servants alike. Most of the officials investigated by Central Commission for Discipline Inspection were discharged from office and accusations of some criminal facts, such as bribery and abuse of power. In 2016, the campaign has punished over 120 high-ranking officials, including high-ranking military officers, senior executives of state-owned companies, and national leaders. Over 100,000 people have been indicted for corruption. The campaign is to clean up malfeasance within party and it has become an symbolic feature of Xi Jinping's political brand. [↑](#footnote-ref-1)
2. The number of inventions, number of utility models and number of designs are measured both in number of application and number of inforce. [↑](#footnote-ref-2)