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Abstract

Estimating the Value of Political Connections in China:
Evidence from Sudden Deaths of Politically Connected Independent Directors

by

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This paper uses the sudden deaths of retired government officials who were acting as independent directors of private firms to study the effects of losing political connections on the firm's economic performance. Employing an event study, we find that, if a private firm loses political connections because of the sudden death of an independent director who was previously a government official, its stock price drops 1.47% on average within ten trading days. Moreover, after the sudden loss of political connections, there is a reduction in the economic benefits (e.g., bank loans, tax preference, and government subsidies) that a private firm can get from the government or banks, which provides a reasonable explanation for the negative stock price reaction. This paper also finds that, when a politically connected private firm unexpectedly loses its political connection, it increases investments in physical capital in order to regain its competitive advantage, which suggests that physical capital serves as a substitute for political capital.

1 Introduction

Political connections are universally important (Faccio, 2006).[1] Estimates of the economic value of political connections have been fascinating economists all around the world in the last several decades.[2] In a seminal study, Fisman (2001) found that, in Indonesia, the stock prices of firms closely connected with President Suharto dropped more than the stock prices of less well-connected firms upon an announcement of bad news about his health. Acemoglu *et al*. (2013) also found that the announcement of Timothy Geithner as nominee for Treasury Secretary in November 2008 produced a cumulative abnormal return for firms with which he had a connection. This return was about 6% after the first full day of trading and about 12% after ten trading days. When Geithner's nomination ran into trouble in January 2009, due to unexpected tax issues, there was a fall in the value of Geithner-connected firms. In both studies, specific firms benefited directly from political connections. Some other studies, however, have argued that political connections may have negative effects on firms' market value or economic performance because establishment of political connections is a rent-seeking activity, leading to the misallocation of resources (Faccio *et al*., 2006; Fan *et al*., 2007; Boubakri *et al*., 2008; Yu *et al*., 2010).

In this paper, we estimate the value of political connections in China. As one of the largest transitional countries, China provides an ideal institutional environment in which to examine the value of political connections. So far, only a few papers have used Chinese data to study this issue. This paper uses the sudden deaths of retired government officials who were acting as independent (outside) directors of firms to estimate the effects of losing political connections on a firm's economic performance.[3] Specifically, this paper contributes to the existing literature in this field in the following four aspects.

First, we measure firms' political connections from a new perspective. Measurement of political connections is a challenge. In prior studies, most papers assumed that a firm has political connections if one of its large shareholders or senior executives once worked (or currently works) for the government (Bertrand *et al*., 2006; Faccio, 2006; Fan *et al*., 2007; Boubakri *et al*., 2008; Ferguson and Voth, 2008). However, this measurement is rough and inaccurate, especially in China.[4] This paper uses retired government officials who were hired as independent directors to

[1] Political connections refer to informal and implicit political relationships between firms and governments or individuals with political power. In prior studies, they also have been referred to as political relationships or political capital. The firm with political connections is called a politically connected firm. This paper uses the term political connections to represent the political relationships between firms and government. Moreover, the political connections we discuss in this paper are legitimate relationships between firms and government. In reality, there are also illegal political relationships. For example, a firm can bribe a government official in order to obtain privileges or benefits from the government. Because illegal political connections cannot be accurately observed, we don't discuss them in this paper.

[2] A growing literature documents a wide range of benefits obtained by politically connected firms. Political connections can be used as an alternative mechanism to protect a firm's property rights and interests from infringement by other market participants (Allen *et al*., 2005; Bai *et al*., 2006) and can help firms get access to bank loans on favorable terms (Khwaja and Mian, 2005; Fan *et al*., 2008; Claessens *et al*., 2008; Faccio and Parsley, 2009), as well as tax preferences (Bertrand *et al*., 2006; Adhikari *et al*. 2006) and governmental subsidies (Yu *et al*., 2010), all of which ultimately increase firms' market value or improve their economic performance (Fisman, 2001; Johnson and Mitton, 2003; Claessens *et al*., 2008; Bunkanwanicha *et al*., 2009; Acemoglu *et al*., 2013). Moreover, the favorable treatment enjoyed by politically connected firms is found to be more pronounced in transitional countries with interventionist governments and weak protection of property rights (Li *et al*., 2008; Yu *et al*., 2010).

[3] An independent director (also known as an outside director) is a member of the board of directors who does not have any material or pecuniary relationship with the company or related persons, except for salary.

[4] For example, this measurement doesn't tell us when the CEO or senior executives worked for the government. If the CEO or senior executives worked for the government a long time ago, then their political power may have disappeared. Faccio (2006) pointed out that connections with politicians who served farther back in time are less likely to have a major impact on firm activities.

define the firm's political connections. China traditionally puts a high value on social networks (Bian, 1997). Even after government officials retire, their social networks accumulated before retirement still exist for a certain period of time. Therefore, it is not uncommon in China for firms to hire retired government officials as independent directors.[5] We call them "government official independent directors." As a scarce resource, retired government officials serve as a bridge linking firms and government, and help firms obtain various government-related benefits by employing their social networks. Therefore, a government official independent director can be regarded as political capital for a firm. Unlike former studies, we also provide detailed information about when retired government officials were hired as independent directors, what kind of job they held before retirement, and their administrative levels, all of which contribute to estimating the value of political connections. We also collect information on independent directors from academia and business circles, most of whom did not have political backgrounds, and we use their sudden deaths as a comparison to show the importance of retired government officials to private firms.

Second, this paper uses an exogenous shock to solve the endogeneity problem of political connections.[6] Political connections are indeed endogenous. For example, there may exist reverse causality between political connections and the firm's economic performance. On the one hand, political connections can help a firm obtain economic benefits and thus improve its economic performance. On the other hand, firms with good economic performance are more likely to attract retired government officials to work for them because such firms can pay higher salaries. Omitted variables can also induce endogeneity; it is plausible that unobservables such as business acumen are correlated with the ability to establish political connections. Our strategy addresses the endogeneity problem. If a government official independent director suddenly dies, then the firm unexpectedly loses its political connections. As opposed to studying the beginning of a political relationship (e.g., an announcement of the hiring of a retired government official), examining the unexpected termination of a political connection is cleaner. Because there is little chance of pre-announcement news leakage in the case of sudden death, the value of the lost connection should be fully reflected in the firm's stock price. Therefore, we can use this exogenous shock to eliminate the endogeneity problem.

Third, we use an event study to investigate how the cumulative abnormal returns (*CAR*s) change in response to the sudden deaths. Unlike prior studies (Fisman, 2001; Faccio and Parsley, 2009; Kim, 2014), we first construct a control group to match the treatment group whose government

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Moreover, this measurement doesn't provide any information about what kind of job they held in the government or their administrative levels, which are related to political power. To sum up, a single dummy variable can't accurately measure a firm's political connections.

[5] In 2001, the Central Commission for Discipline Inspection (CCDI) issued strict stipulations which prohibit government cadres from doing any business or working for firms while still employed by the government.

[6] Most papers ignore the endogeneity problem of political connections. Only a few papers have tried to deal with it. They mainly used three methods to alleviate endogeneity. The first is to simply use the lagged value of political connections (Du *et al*., 2012). But this is not a good way to solve the endogeneity problem because, as Bellemare *et al*. (2015) demonstrated, lag identification is almost never a solution to endogeneity problems. The second method is to find IVs for political connections. However, the IVs that have been used were not truly exogenous (Deng and Zeng, 2009; Chen *et al*., 2010). For example, Deng and Zeng (2009) used the firm's place of registration as the IV for political connections. Specifically, if the registration place was located in the Yangtze River Delta or Pearl River Delta region, the IV took the value of 1. They argued that establishment of political connections is difficult in these regions because of their high degree of marketization. However, a firm probably has better economic performance if it is located in an area with a high degree of marketization, so this IV is not truly exogenous. The third method is to use Heckman two-step estimation. However, this method is mainly useful to solve the endogeneity caused by sample selection bias. The endogeneity caused by reverse causality cannot be solved by a Heckman approach.

official independent directors suddenly died. Then, we calculate the difference of *CAR*s between the treatment group and control group. By doing so, we can effectively eliminate the effects of other factors (e.g., greater local market instability or uncertainty immediately following a sudden death) on the stock prices during the event window because the *CAR*s of the control group reflect the effects of those factors on stock prices. In addition, we use Difference-in-Differences (DID) estimation to estimate the effects of political connections on the economic benefits (e.g., bank loans, tax preference, and government subsidies) obtained by private firms in China. Furthermore, we use DID to investigate whether physical capital serves as a substitute for political capital. That is, we study whether private firms increase investments in physical capital and innovation in order to regain their competitive advantage after the sudden loss of political connections. To the best of our knowledge, no other papers have used DID to study the last two questions.[7]

Finally, we estimate the value of political connections from a new perspective. That is, we investigate whether a politically connected firm suffers economic loss if it unexpectedly loses political connections. Estimating the value of political connections in this way is very practical for developing and transitional countries, especially for China. Political connections are, in effect, an informal institution (Allen *et al*., 2005). With the increase in anti-bribery efforts and the development of the market economy in China, maintaining political connections became more and more difficult and costly in the last decade.[8] Under these circumstances, it is especially meaningful to study whether politically connected firms are placed at an economic disadvantage if they suddenly lose political connections. Furthermore, we will also discuss how politically connected firms respond if they suddenly lose political connections. In order to regain competitive advantage, firms may use capacity accumulation (e.g., an increase in physical capital and R&D investment) as a credible threat to prevent potential entrants from entering the market. This provides insights into how firms cope with shocks to key personnel or other scarce resources.

Using Chinese private firms from 2003 to 2012, we ask three questions: (1) How does the sudden loss of political connections affect a private firm's market value? (2) Why does the sudden loss of political connections have such effects on the private firm's market value? (3) How does the private firm respond after the sudden loss of political connections? [9] Employing the event study and DID estimation, we draw three conclusions. First, we find that a firm's stock price drops 1.47% on average within ten trading days if its government official independent director suddenly dies. By contrast, the sudden deaths of independent directors from academia or business circles have much smaller effects on their firms' stock prices. Second, we find that, after the sudden loss of political connections, the ratio of total loans to total assets and the ratio of government subsidies to net profits decrease by 6.18% and 9.87%, respectively, within two years, while the effective tax rate faced by the private firm increases by 5.06% within two years. The reduction in these

[7] A common practice when studying these two questions in the existing literature is to include a political connection dummy variable as an independent variable and estimate its coefficient using regular OLS estimation.

[8] The regulations issued by the Organization Department of the Central Committee of the Communist Party of China (CPC) in October 2013 provide a good example. The regulations further standardize the behavior of retired government officials who work for listed firms. For example, a government official independent director should work for a listed firm for no more than two terms (six years) and should not work past age 70. Since these regulations took effect, many government official independent directors have resigned their positions. Therefore, many firms lost their political connections. Under these circumstances, maintaining political connections became more and more difficult and costly for Chinese firms.

[9] We use only private firms to conduct the empirical analysis because state-owned enterprises (SOEs) have close relationships with government from the start and have preferential access to government subsidies and other key resources. It is hard to differentiate between the value of political connections and the "parental" assistance from government to SOEs.

economic benefits after the sudden loss of political connections provides a reasonable explanation for the negative stock price reaction. The sudden deaths of independent directors from academia or business circles, however, have no significant effects on these economic benefits. Third, when a politically connected firm suddenly loses political connections, it increases investments in both physical capital and innovation to regain its competitive advantage.

The paper is structured as follows. Section 2 introduces the institutional background in China and explains why and how private firms establish political connections with the government. Section 3 analyzes how retired government officials affect private firms' economic performance and develops hypotheses. Section 4 describes our sample data and introduces how we collect the information on sudden deaths of independent directors. Section 5 tests hypotheses and conducts a variety of robustness checks. Section 6 concludes.

2 Institutional Background in China

2.1 The development of private businesses since 1978

Private business began to regain legitimacy in 1978, when the state endorsed the reemergence of individual household businesses during the *Third Plenum of the Communist Party's Eleventh Central Committee*.[10] Since then, private business has developed rapidly. From 1978 to 2014, China's private businesses grew from 0 to over 56 million firms, employing 218 million people and producing more than 60% of China's industrial output.[11] The growth rate of the private sector since its revival has far outpaced that of the public sector.

In spite of the speed with which the private sector developed after 1978, the path was by no means free of obstructions. For example, private businesses have been considered "a marginal sector to be tolerated temporarily and tightly controlled" since 1978. Moreover, private firms were considered an inferior ownership form for ideological reasons. Until the early 1990s, private firms were carefully controlled and not allowed to hire more than eight employees. Challenges to the legitimacy of private business also came in the form of various political movements, for example, periodic campaigns against spiritual pollution in 1983-1984 and against bourgeois liberalization in 1987, and other movements cracking down on private businesses on the plea of "rectifying the market" and "attacking speculation" (Li *et al*., 2006). There is reason to believe that it will be a long time before private firms acquire equal status with other types of firms, such as SOE and foreign-funded firms.

Given the ideological and economic environment opposed to the private sector, private entrepreneurs have been finding ways to make their business operations easier. In the early 1990s, many private businesses chose the somewhat expedient strategy of "wearing a red hat", that is, they registered themselves as "collective enterprises" (Che and Qian, 1998). The disguise of "collective ownership" not only made these firms ideologically acceptable but also won them material advantages such as favorable tax treatment and better access to credit and other resources (Naughton, 1994). Moreover, after 2002, private entrepreneurs were allowed to join the Communist Party of China (CPC). Party membership helps private entrepreneurs to obtain loans

[10] When the Communist Party won the civil war and founded the People's Republic of China in 1949, it began the socialist transformation of private businesses. Between 1952 and 1977, private businesses were completely banned in China.

[11] National Bureau of Statistics of the People's Republic of China, http://www.stats.gov.cn/.

from banks or other state institutions, and affords them more confidence in the legal system (Li *et al*., 2008). Recently, many private entrepreneurs have sought a new "red hat", that is, establishing political connections with governments.

2.2 How do private firms establish political connections with government in China?

Establishing political connections with (central, provincial or municipal) governments is a fast and efficient strategy for reducing the costs associated with market, state, and legal failures. In general, there are three main ways for private firms to establish a relationship with government in China: (1) the CEO, senior executive or member of the board of directors (excluding independent directors) once worked for the government; (2) the CEO, senior executive or member of the board of directors participates in political activities, and (3) private firms hire a politically connected person.

2.2.1 The CEO or senior executives of private firms once worked for the government

After Deng Xiaoping's Southern Tour in 1992, China's private sector expanded dramatically. A great number of government employees quit their government posts to enter the private sector. This exodus from the government or government-controlled institutions to private businesses has been vividly dubbed a "plunge into the sea" (*xiahai*). These new entrants to the thriving private sector have become an important contingent of what are popularly known as the "red capitalists" in China, that is, entrepreneurs with close personal and political ties to the Party. Connections with the Party and the government afford the "*xiahai*" entrepreneurs certain advantages over other private entrepreneurs without such connections. These advantages include better access to key resources that are controlled by the Party and the government, such as business operation licenses, bank loans, land, and eligibility for favorable but discretionary government policies such as tax benefits. Many papers employed this fact to estimate the effect of political connections on firms' economic performance (Fan *et al*., 2007; Yu *et al*., 2010; Wu *et al*., 2010). As explained earlier, this measurement of political connections is rough and inaccurate. But we will control this dummy variable when conducting empirical analysis.

2.2.2 Obtaining political status: PC or CPPCC membership

Private entrepreneurs can actively participate in political activities and therefore establish relationships with government. The most common way is by obtaining a membership in the PC (People's Congress) or the CPPCC (Chinese People's Political Consultative Conference).[12] Membership in the PC or the CPPCC is advantageous to private entrepreneurs because it not only gives them some measure of political power but also makes it easier for them to cultivate formal and informal ties with important government bureaucrats who are also members of the two organizations. Moreover, in areas where state economies dominate, this political status may reduce ideological discrimination from governments or other regulatory agencies. By making friends with

[12] The People's Congress is China's legislature and the highest organ of state power in China. The Chinese People's Political Consultative Conference is an advisory body to the party and government, analogous to an advisory legislative upper house. The main functions of the CPPCC members are to hold political consultations and to exercise democratic supervision of the party and government.

government officials and having some political power themselves, these private entrepreneurs can effectively shield themselves against state encroachment when local governments act as a "grabbing hand".

Election as a PC or CPPCC member, however, is not easy for most private entrepreneurs. First, a general election is held only every five years in China (e.g. in 2002, 2007, and 2012). During non-election years, private entrepreneurs have no chance of election as PC or CPPCC members. Second, the quota of PC or CPPCC members is limited. Most PC and CPPCC members are from governments and army, and only a small quota is left to entrepreneurs from SOEs or private firms. For example, 2987 PC and 2237 CPPCC members were elected in 2012. Among them, only 597 PC and 151 CPPCC members are from business circles.[13] Even we take into account PC and CPPCC members at all administrative levels, the quota is still very small, compared to the number of private firms.[14]

Third, the PC and CPPCC have very strict requirements for election of new members. One of the requirements is that the firm for which the candidate works had good performance and made a great contribution to the local economy, such as reducing unemployment, for several years before the general election. But it is usually the firms with bad performance that have strong incentive to establish political connections with the government because they hope to improve the firm's economic performance with government help. To sum up, not all entrepreneurs with political enthusiasm will be elected as PC or CPPCC members. Therefore, obtaining political status proves infeasible for many private entrepreneurs who are eager to get help from the government.

2.2.3 Hiring a politically connected person

In addition to obtaining political status, private firms also can establish political connections with the government by hiring a politically connected person. This person might be a PC or CPPCC member. However, as mentioned earlier, only a small proportion of PC or CPPCC members are from business circles. Therefore, hiring a PC or CPPCC member is not common in China.

In reality, the person with political power is most likely a retired government official. In China, incumbent government officials usually have legal rights to decide which firms have access to privileges, including when, how, and to what extent firms receive these privileges, and which firms are allowed to enter certain regulated industries. According to Chinese law, incumbent government officials are prohibited from doing business or working for firms to prevent them from taking advantage of their political power to seek economic benefits or privileges for firms. Retired government officials, however, are allowed to do business beginning three years after retirement (called a "cooling off period").[15] Therefore, firms without political connections can hire retired government officials as independent directors. In China's cultural environment, although government officials have already retired, the social networks accumulated before retirement still exist for a certain period of time, even after three years. Firms can make full use of these social

[13] http://www.npc.gov.cn/.

[14] In China, administrative levels include state level, provincial and ministerial level, bureau level, county level, and township level.

[15] Faccio (2006) pointed out that connections with politicians who served farther back in time are less likely to have a major impact on firm activities. In our sample, retired government officials were hired as independent directors 5.6 years after retirement on average.

networks to obtain privileges and economic benefits, such as bank loans, tax preference, government subsidies, etc.

Indeed, many retired government officials were hired as independent directors by firms in the last decade. According to statistics, 901 retied government officials were hired as independent directors by Chinese listed firms in 2013.[16] Considering that a small proportion of retied government officials served more than one firm and there are 2532 listed firms, 2.3 listed firms on average hired one government official independent director in 2013. To sum up, hiring retired government officials as independent directors is common for firms because it is the fastest and most efficient way to establish a relationship with the government in China.

2.3 The independent director system in China

Since this paper investigates the effect of the sudden death of a government official independent director on a firm's economic performance, it is necessary to outline the independent director system in China. An independent director (also known as an outside director) is a member of the board of directors who does not have any material or pecuniary relationship with the company or related persons, except for salary. The main responsibility of independent directors is to improve the overall performance of a company through their objective view of the company's health and operations. Therefore, they do not have to pander to other management personnel in order to retain their jobs. Since 2001, the China Securities Regulatory Commission (CSRC) has required that at least one-third of the board of directors of a listed company be independent.[17] In China, independent directors are mainly from political circles (e.g., retired government officials or bank retirees with government background), academia (e.g., professors from universities or senior researchers from research institutes) and business circles (e.g., CEO or senior executives of other firms, accountants, lawyers, etc.).[18]

Table 1 shows the characteristics of government official independent directors in our sample. As shown in Column (1), 2283 retired government officials were hired by private listed firms during 2003 to 2012. It can be seen that more than three quarters of them didn't receive higher education.[19] Only 39% of them ever held business-related jobs before hired as independent directors. Only 41.7% of them had work experience related to the firm's main business.[20] The average age of retired government officials when they were hired as independent directors is 68.5. More than one third of them were absent from at least 50% of board meetings during the tenure as

[16] http://www.infzm.com/content/102347.

[17] The NYSE and NASDAQ stock exchange standards for independent directors are similar. Both require that "a majority of the board of directors of a listed company be independent". In the US, independent outsiders make up 66% of all boards and 72% of S&P 500 company boards, according to the *Wall Street Journal* (2010).

[18] Only a very small proportion of independent directors comes from other backgrounds. For example, famous actor and TV series producer Jizhong Zhang was hired as an independent director by Shanxi Broadcast & TV Network Intermediary Group Co., Ltd. in 2003.

[19] It is not difficult to understand this phenomenon. Most of them had no chance to attend college in their twenties when China experienced the Cultural Revolution in the 1970s.

[20] SANY Group hired Jun Qi, who was former director of the Personnel Department of the State Machinery Industry, as an independent director. SANY Group's main products include concrete machinery, excavator, hoisting machinery, pile driving machinery, road construction machinery, port machinery, and wind turbine. This is an example that government official independent director had relevant work experience. Shanghai Pudong Development Bank hired Qiang Xu, who was former director of the Shanghai Office of Government Legislative Affairs, as an independent director. This is an example that government official independent director had no relevant work experience.

independent directors. Moreover, private firms are also inclined to hire retired government officials with high administrative levels because they have stronger political power and wider social networks. All of these characteristics suggest that a majority of government official independent directors in our sample lack profession knowledge and relevant work experience, which means that they are unable to provide constructive suggestions on the firm's operation and management. In reality, the main reason for hiring them is to take advantage of their social networks accumulated before retirement to help firms obtain economic benefits from the government or banks.

As for independent directors from academia and business circles (designated as academic elite independent directors and business elite independent directors, respectively), most of them received higher education and were comparatively young when hired as independent directors, as shown in Columns (3) and (5) of Table 1. Moreover, most of them had relevant work experience and, once appointed as independent directors, attended all board meetings every year.[21] All of these characteristics indicate that these two types of independent directors have a good deal of knowledge about business and relevant work experience. Therefore, the main reason for hiring them is to make full use of their professional knowledge and work experience to improve firms' economic performance.[22] Since most academic elites or business elites do not have political backgrounds, they are unable to directly bring government-related economic benefits to private firms. In the empirical section, these two types of independent directors can be used as comparison groups to show the importance of political connections for private firms.

Table 1 also shows the characteristics of these three types of independent directors who suddenly died. As shown in columns (2), (4) and (6), the ratios between all sample and sudden death sample are very close, which provides some evidence to confirm that our sample of sudden death is indeed random. Figure 1 demonstrates how these three types of independent directors affect private firms' economic performance. It can be seen that different types of independent directors affect firms' economic performance through different channels. As for retired government officials, they serve as a bridge linking firms and government. They can help private firms obtain various economic benefits and improve their economic performance. Independent directors from academia or business circles, however, affect private firm's economic performance by offering professional advice on operation and management.

3 Hypothesis Development

3.1 How government official independent directors help private firms obtain economic benefits

Political connections not only can be used as an alternative mechanism to protect a firm's property rights and interests from infringement by other market participants but also can help firms obtain economic benefits from the government or banks. Considering the availability and comparative importance of various economic benefits, we focus on only three kinds of economic

[21] In our sample, 72.5% of academic elite independent directors attended all board meetings during their tenure as independent directors. The ratio is 68.3% for business elite independent directors.

[22] The other responsibilities of independent directors from academia or business circles include supervising the behavior of the firm's senior executives or other directors, reminding firms to pursue profit-maximization goal when they deviate from it, protecting the interests of minority shareholders from infringement, etc.

benefits: bank loans, tax preference and government subsidies. According to prior studies, there are two main reasons that explain why retired government officials can help private firms obtain these economic benefits.

First, retired government officials can make full use of their social networks to help private firms obtain economic benefits. Take tax preference, for example.[23] In 2008, the central government issued a document which stated that all certified high-tech enterprises could enjoy tax cuts after 2008. Specifically, the corporate income tax rate decreased from 25% to 15% for three consecutive years if an enterprise was high-tech firm. One of the qualifications to enjoy this tax cut was that the enterprise should have a Certificate of High and New Technology Enterprise (CHNTE), which is issued by the local administrative department of science and technology. If retired government officials employ their social networks to contact someone who is responsible for issuing this certificate, then the enterprises which they work for are more likely to get the certificate.[24] Even if retired government officials don't know anyone in the administrative department of science and technology, they can use their social networks to establish a relationship with someone who works in it. This phenomenon is not uncommon in China.

Another example is government subsidies. In China, there is no specific law to regulate and restrict how local governments allocate subsidies and thus they have great discretion when granting subsidies to firms. Moreover, there is little transparency about how applications for subsidies are reviewed and what criteria are used to determine which firms receive subsidies. Under these circumstances, retired government officials play an important role in helping firms obtain government subsidies. Specifically, they can employ their social networks to contact incumbent government officials and persuade them to subsidize the firms for which they work.

Second, retired government officials sometimes serve as a bridge linking private firms and state-owned banks or government agencies. Private firms can make full use of this bridge to obtain contacts with senior managers (or someone important) of state-owned banks or incumbent government officials. In doing so, retired government officials can reduce the degree of information asymmetry between them. Take bank loans for example. Private firms face complex bureaucratic procedures and strict mortgage conditions when borrowing money from state-owned banks. Asymmetric information is one of the reasons that they are unable to get bank loans in sufficient amounts. With the help of retired government officials, private firms can get to know the bureaucratic procedures and processes of bank lending, which increases their chance to get bank loans. Moreover, retired government officials can also provide state-owned banks with financial information about private firms and help them get to know private firms, which to some extent contributes to reducing credit risk and raising the amount of credit obtained.

Many empirical papers have shown that politically connected firms have access to all kinds of economic benefits. First, political connections help firms obtain bank loans at low interest rates

[23] Chinese tax law endows government, especially local government, with some administrative power to determine the object of taxation, tax category, tax rate, and tax exemption policy. In order to boost the local economy, local governments often implement various tax incentive policies, regrading tax rates, the tax base, and other tax breaks.

[24] Although there are mandatory requirements to get this certificate, in practice some of these requirements can be replaced by flexible indexes with great arbitrariness. For example, one of the requirements is that the scope of business or main product should be in the high-tech fields supported by the state. The government provides a list that shows all high-tech industries. Sometimes, it is hard to determine whether or not an enterprise meets this requirement because the authorities concerned may not fully understand its scope of business or main product.

(Khwaja and Mian, 2005; Faccio, 2006; Claessens *et al*., 2008). For example, Khwaja and Mian (2005) found that politically connected firms borrow 45 percent more and have 50 percent higher default rates. Second, political connections can help firms obtain tax preferences (Adhikari *et al*., 2006; Faccio, 2006; Claessens *et al*., 2008). For example, Adhikari *et al*. (2006) found that firms with political connections pay tax at significantly lower effective rates than other firms and that political connections are an important determinant of effective tax rates in relationship-based economies. Third, politically connected firms are more likely to receive government subsidies (Bertrand *et al*., 2006; Faccio, 2006). For example, Faccio *et al*. (2006) found that financial assistance received by politically connected firms is significantly greater than that received by non-politically connected firms when the World Bank provides financial assistance to the firm's home government.

A politically connected private firm loses political connections after the sudden death of its government official independent director, with the result that it is unable to obtain as many economic benefits as before. Therefore, we present the following hypothesis:

HYPOTHESIS 1: *Sudden death of the government official independent director of a private firm reduces the economic benefits (e.g. bank loans, tax preference, and government subsidies) that it can get from the government or banks.*

Preferential treatment from the government or banks, such as bank loans granted on favorable terms, tax preference, and government subsidies, can greatly reduce private firms' production costs and therefore improve their economic performance (Allen et al., 2005; Li et al., 2008; Yu et al., 2010; Wu et al., 2012). Since we focus on the sudden loss of political connections, the hypothesis is as follows:

HYPOTHESIS 2: *Sudden death of the government official independent director of a private firm reduces its stock price.*

3.2 Effects of sudden loss of academic elites or business elites affects firms' economic performance

As shown in Figure 1, the main purpose of hiring independent directors from academia and business circles is to make full use of their professional knowledge and relevant work experience to improve firms' economic performance. Since most of them do not have political background, they are unable to directly bring economic benefits to private firms in the same way as the retired government officials do. Based on this analysis, we present the following hypotheses:

HYPOTHESIS 3: *Sudden death of the academic elite or business elite independent director of a private firm has no effect on the economic benefits (e.g. bank loans, tax preference, and government subsidies) that it can get from the government or banks.*

HYPOTHESIS 4: *Sudden death of the academic elite or business elite independent director of a private firm reduces its stock price.*

4 Research Design

4.1 Data

The paper uses all private A-share firms trading on the Shanghai Stock Exchange and Shenzhen Stock Exchange from 2003 to 2012 to study the effects of political connections on firms' economic performance.[25] We use financial websites and annual reports of listed firms to search for and collect the events of sudden deaths of three kinds of independent directors. All other variables are collected from the WIND database,[26] the China Stock Market and Accounting Research (CSMAR) database,[27] and the RESSET Financial Research database.[28] These three databases provide detailed financial information about Chinese listed firms. Since we can identify the specific month when sudden death occurs, this paper uses quarterly financial data in the empirical section.[29] Our sample contains 1173 private listed firms. Because we use quarterly data and have data for 10 years, we finally get a sample of 21809 observations.

4.2 Measurement of variables

4.2.1 Measurement of political connections

To identify sudden death, we rely on the medical literature which defines sudden death as an unexpected and non-traumatic death that occurs instantaneously or within a few hours of an abrupt change in the person's previous clinical state.[30] In addition to such deaths, we also include accidental and traumatic deaths that are unanticipated by firms. Recent papers provide detailed information on the identification of sudden deaths (Faccio and Parsley, 2009; Nguyen and Nielsen, 2010). We employ web scraping technique to search for and collect the information on sudden

[25] A listed firm is a firm whose shares are listed (quoted) on a stock exchange for public trading. A-shares, also called RMB ordinary shares, are issued by domestic firms and bought by domestic institutions, organizations or individuals using RMB. There are also B-shares and H-shares traded by foreign investors in the Chinese stock market.

[26] Wind Information Co., Ltd (Wind Info), headquartered in the Lujiazui Financial Center in Shanghai, is a leading integrated service provider of financial data, information, and software. Wind Info has built up a substantial, highly accurate, first-class financial database, which includes stocks, funds, bonds, insurance, derivatives, commodities, and financial news. The website is http://www.wind.com.cn/.

[27] GTA Information Technology Co., Ltd. (GTA) is a national high-tech company providing solutions to education and investment sectors. GTA is a leading domestic financial data service provider, whose *CSMAR* database has gained sweeping recognition in more than one thousand universities and financial institutions around the world. Over 1700 high quality academic papers that have been published in domestic and international top journals have used the *CSMAR* database. The website is http://www.gtarsc.com/.

[28] RESSET Financial Research Database is mainly for colleges and universities, financial research institutions, and research departments of financial enterprises, providing support for empirical research and model testing. RESSET is designed by numerous experts from Tsinghua University, Peking University, and the London School of Economics. It has comprehensive historical data and a wide coverage, including research reports, financial statistics, industry statistics, etc. The website is http://www.resset.cn/cn/.

[29] When using annual data to estimate the effects of sudden loss of political connections on private firms' economic benefits, the results may be inaccurate. For example, if a government official independent director died in January, the private firm for which he or she once worked might take measures to make up for the economic loss in the following months of the year. Therefore, the effects of losing political connections on private firms' economic performance may become smaller and even inaccurate when we use annual data.

[30] In our sample, all sudden deaths occurred within eight hours.

deaths of government official independent directors.[31] The websites we used are Baidu, Google, Sina, Sohu and NetEase (mainly the financial section).[32] The searching processes are as follows: [33]

Step 1: Following Nguyen and Nielsen (2010), we use keyword search terms on independent director ("independent director" or "outside director") and death ("passed away", "died", "deceased", etc.) to search for the events of deceased independent directors from 2003 to 2012. It should be noted that our search terms do not include keywords designed to capture sudden death (e.g., "sudden" or "unexpected"). The general keyword search is important, as many newspaper articles report the medical cause of death, e.g., cerebral hemorrhage (stroke), without explicitly mentioning that the death is sudden. The cost of the general keyword search design is that the search returns a significant number of newspaper articles that are not relevant to sudden death.[34]

Step 2: Based on the sample obtained from the step 1, we use keyword search terms on government official to search for the events of deceased government official independent directors. We don't have to include "retired" in the keywords because incumbent government officials are not allowed to do business or work as independent directors.

Step 3: Based on the sample obtained from the step 2, we identify private firms based on the identity of the ultimate owner (Chen *et al.*, 2009; Berkman *et al.*, 2010). Specifically, private firms are ultimately controlled by nongovernmental units, such as individuals, collective enterprises, etc.

Step 4: Based on the sample obtained from the step 3, we ascertain that the causes of deaths of government official independent directors were sudden. The cause of death is verified by an additional search on news containing the name of the deceased government official independent director in a one-year period surrounding his or her death. We also use annual reports of listed firms, if necessary, as auxiliary materials to determine the cause of death. Specifically, we identify the following cases as sudden death: heart attacks, stroke, all other diseases that cause sudden deaths, accidents, and deaths for which the cause is unreported but the death is described as unanticipated.[35] In cases of inconsistency in the reported cause of death across different sources, our approach is to be conservative and include only events for which we have no conflicting evidence about the sudden, unexpected nature of the death.

Table 2 reports the number of sudden deaths of government official independent directors. As you can see, we identify 91 sudden deaths among 725 deceased government official independent directors according to our strict definition.[36] There are several reasons that explain why many government official independent directors suddenly died in China. First, since 2002, the China

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[31] Web scraping is the process of automatically collecting information from the World Wide Web.

[32] http://www.baidu.com/; http://www.finance.sina.com.cn/; http://www.business.sohu.com/; http://www.money.163.com/.

[33] Since most annual reports of listed firms didn't include obituaries, we mainly rely on financial websites to search for and collect the events of sudden deaths and use annual reports, if necessary, as auxiliary materials to determine the cause of death.

[34] In fact, our sample of 91 sudden deaths of former government official independent directors was identified from more than 20,000 newspaper articles or reports.

[35] Our sudden death sample does not include causes such as, cancer, complications from illness, past strokes, surgery etc. The reason is that, if the independent directors died of these diseases, the firms would be able to anticipate their deaths and take preemptive measures to counteract the negative effects of death on firms' economic performance. We also exclude suicide which may be correlated with the firm's performance.

[36] Originally, we identify 94 sudden deaths. Among them, three private firms hired two and more retired government officials and only one of them sudden died. Since these three private firms still have at least one government official independent director left, we exclude them.

Securities Regulatory Commission (CSRC) has required that at least one-third of the board of directors of a listed company be independent. Accordingly, firms without political connections actively invited retired government officials to become independent directors. Therefore, more and more retired government officials have been hired as independent directors since 2002. Second, retired government officials are usually very old when they are hired as independent directors. In our sample, the average age of retired government officials was 68.5 when they were hired as independent directors. That means that they are susceptible to all kinds of health problems such as heart attacks which might cause sudden death. Third, environmental pollution has become more and more serious, especially in the developed cities in which listed firms abound, which gives rise to various acute diseases.

In addition, we collected data on sudden deaths of independent directors from academia and business circles. The search process was exactly the same. As shown in Table 2, we identify 53 sudden deaths of academic elite independent directors and 86 sudden deaths of business elite independent directors. Because these two types of independent directors have nothing to do with the establishment of political connections, we will use them as comparison groups to show the importance of political connections for private firms in China.

Table 3 describes the characteristics of sudden deaths. Panel A of Table 3 reports the causes of sudden death. It can be seen that heart attack and stroke are the main reasons for the sudden deaths of all three kinds of independent directors. Among all sudden deaths, 79.2% of government official independent directors died of heart attacks or strokes in our sample. The ratios are 67.9% and 68.6% for academic elite independent directors and business elite independent directors because they are comparatively young in our sample. Panel B of Table 3 reports the time of year when the sudden deaths occurred. Obviously, sudden deaths didn't concentrate in a specific quarter for any category of independent directors because the ratios of the number of sudden deaths to the number of all deceased independent directors are approximately equal among four quarters. Panel C of Table 3 reports the place where the sudden death occurred. China has 31 provinces and we divide them into three economic regions: East, Middle, and West.[37] Sudden deaths of any kind of independent directors didn't concentrate in a specific region because the ratios of number of sudden deaths to the number of all decreased independent directors are approximately equal among the three economic regions. Panel D of Table 3 reports the numbers and ratios of sudden deaths of the three kinds of independent directors in both high-tech industries and low-tech industries.[38] Obviously, sudden deaths of any kind of independent directors also didn't concentrate in any industry.

In reality, if deaths occurred unexpectedly, then most of them shouldn't concentrate in a specific quarter, economic region or industry. Therefore, our sample of sudden deaths is consistent with reality and therefore reliable. In the empirical section, we use *Polcon* to denote the sudden loss of political connections. It is a dummy variable which takes a value of one if the government official independent director of a private listed firm suddenly died and takes a value of zero otherwise. We

[37] East includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi, and Hainan. Middle includes Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan. West includes Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Ningxia, Qinghai, and Xinjiang.

[38] In our sample, there are 41 industries. It is unrealistic to calculate the number of sudden deaths in each industry considering that we only have 156 sudden deaths. The reason that I divide industries according to technology is because some argue that the probability of a sudden death may be correlated with the firm's technological level. For example, firms in high-tech industries are inclined to hire comparatively young retired government officials who are willing and able to embrace new technology. If this is the case, then the probability of a sudden death may be lower for these firms.

will discuss this variable more when introducing the regression strategy. Similarly, we use *Professor* and *CEO* to denote the sudden deaths of academic elite and business elite independent directors respectively. Specifically, *Professor* takes a value of one if the academic elite independent director of a private listed firm suddenly died and takes a value of zero otherwise. *CEO* takes a value of one if the business elite independent director of a private listed firm suddenly died and takes value of zero otherwise.

4.2.2 Measurement of economic performance and economic benefits

We employ a standard event study to estimate the value of political connections for private firms. Following the prior studies, we use stock prices to calculate the market-adjusted cumulative abnormal returns (*CAR*s) which is used to measure how private firms respond to the sudden death (Fisman, 2001; Faccio and Parsley, 2009; Acemoglu et al., 2013; Kim, 2014).[39] We will discuss how to calculate *CAR*s in the empirical section.

We use *benefits* to denote the economic benefits that retired government officials help firms to obtain from the government or banks. Considering the availability and importance of various benefits, we focus on only three categories: bank loans, tax preference and government subsidies. First, the bank loan is denoted by *Loanrate* which is equal to the ratio of total bank loans (including short-term loans and long-term loans) to total assets.[40] Second, we use Effective Tax Rate (*ETR*) faced by listed firms to measure preferential income tax. *ETR* takes account of both preferential tax rate and preferential tax base before deductions, and thus can effectively reflect the real tax burden imposed on listed firms. Following Wu *et al*. (2009), we use the following formula to calculate *ETR*:

$$ETR = (TE - DTE) / (PTI + DV - IG + CD + CBI)$$

where *TE* represents income tax; *DTE* represents deferred income tax; *PTI* represents pretax accounting income; *DV* represents current provision for impaired assets [41]; *IG* represents return on investment; and *CD* and *CBI* represent received cash dividend and bond interest, respectively.

Third, government subsidy is denoted by *Subsidy*. It consists of value-added tax return, fiscal subsidy, new product or innovation award, income tax credit, etc. Because the value-added tax return policy is determined by the central government, and local government is unable to change it arbitrarily, we exclude value-added tax return from total subsidies. We define *Subsidy* as the ratio of total subsidies to net profits.

4.2.3 Other control variables

We also include other control variables in the models. They are firm size (*Lasset*), number of quarters since the firm went public (*Listage*), cash flow (*Cashflow*), concentration of top five

[39] Stock price is a forward-looking measurement that can quickly respond to the outside shock like the sudden death of an independent director. Moreover, since we only study how the stock price changes at most ten trading days after the sudden death, we can effectively eliminate the influence of other factors on the stock price. So the stock price is better than other economic performance indexes when we study the effect of the sudden death on the firm's economic performance.

[40] In China, a majority of banks are state-owned banks. So private firms take out loans mainly from state-owned banks.

[41] Impaired assets are the company's assets that are worth less on the market than the value listed on the company's balance sheet. This will result in a write-down of that same asset account to the stated market price.

shareholders (*HHI*5), CEO or senior executive's work experience in government agencies (*Experience*), PC or CPPCC dummy (*PC*),[42] academic elite dummy (*Academia*), business elite dummy (*Business*), industry dummy (*Industry*), region dummy (*Region*), and year dummy (*Year*). The definitions of all variables above are shown Table 4. Because the sample used for the empirical analysis doesn't contain all private firms, we will report the statistical description of all variables after introducing the regression strategy.

4.3 Regression strategy

4.3.1 Event study methodology

An Event study is a statistical method to assess the impact of an event on the market value of a firm. The basic idea is to find the abnormal return attributable to the event being studied by adjusting for the return that stems from the price fluctuation of the market as a whole. Our procedure for calculating abnormal returns follows Campbell, Lo, and MacKinlay (1997). First of all, we calculate abnormal returns using a single factor model as follows:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

where R_{it} is the actual return on firm i for day t, and R_{mt} is the return on the market for day t, represented by the return on the Shanghai Composite Index or Shenzhen Component Index correspondingly. α_i and β_i are estimated using a pre-event period of 250 trading days ending 30 days prior to event day 0.[43] The event day 0 is defined as the trading day of the independent director's death or the first trading day following the death if it occurred on a non-trading day. The abnormal return for firm i on day t is calculated as:

$$AR_{it} = R_{it} - \left(\hat{\alpha}_i + \hat{\beta}_i R_{mt}\right)$$

Then we can calculate cumulative abnormal returns using the market model as follows:

$$CAR(-1,n)_i = \sum_{t=-1}^{n} AR_{it}$$

where $CAR(-1, n)_i$ is the cumulative abnormal return for firm i for days -1 through n. We include one-day prior to the event of sudden death to follow the standard procedure in the event study literature. Since the deaths are sudden, we believe that there is no reason or benefit to extending the event window further prior to the death. n takes values of 0, 1, 2, 5, and 10. That is, we empirically investigate how stock prices respond to the sudden deaths of independent directors based on the (-1, 0), (-1, 1), (-1, 2), (-1, 5), and (-1, 10) event windows.

4.3.2 DID estimation

[42] As mentioned above, there are three main ways for private firms to establish political connections with government. This paper focuses on the third way – hiring retired government officials. Therefore, we construct two dummy variables (*Experience* and *PC*) to control the political connections established in the first two ways. Specifically, *Experience* takes a value of one if the CEO or senior executive once worked for government and *PC* takes a value of one if the CEO or senior executive is elected to be a PC or CPPCC member.

[43] Although the choice of estimation period length is subjective, a length of 250 days corresponds to roughly one year of trading and has been used in other studies such as Jayachandran (2006) and Li and Lie (2006).

In addition to the event study, we also use DID estimation to conduct the empirical analysis. Before constructing a control group, we first need to deal with an important issue. That is, we do not have the same treatment time because sudden death occurred in different quarters for different deceased independent directors. In order to address this issue, we readjust the time variable and define the quarter of a year when the independent director suddenly died as time 0. Moreover, we use negative and positive numbers to represent the time before and after the sudden death. For example, -4 and 2 respectively represent four quarters before and two quarters after the event of sudden death.[44] In doing so, we unify different treatment times. Considering that politically connected firms will take measures to make up for the economic loss caused by the sudden deaths of government official independent directors, the effects of sudden loss of political connections on private firms' economic benefits may become smaller and difficult to determine as time goes on.[45] So, we only study how the economic benefits obtained by private firms change eight quarters before and after the sudden death. That is, the research period is (-8, 8). Here, we exclude time 0, the exact quarter when the sudden death occurred.

Now we construct a control group and match it with the treatment group. Because the treatment is the sudden death of a government official independent director, a treated firm is one whose government official independent director suddenly died at time 0. Ideally, we want to select a firm that is identical to the treated firm except that its government official independent director didn't die at time 0. Based on this analysis, the untreated firm we construct is one whose government official independent director was alive at time 0 and operates in the same industry and geographical region as the treated firm but in a different province from the treated firm. We use the same industry affiliation and geographical region as selection criteria so that both the treated firm and the untreated firm share similar characteristics such as capital-to-labor ratio.[46] But the untreated firm is located in a different province from the treated firm in order to meet the *stable unit value treatment assumption* (SUTVA). SUTVA is often referred to as the "no interference" assumption, which states that a firm's potential outcome is unaffected by whether another firm is treated or untreated. In our paper, the untreated firm might be indirectly affected by the treated firm in many aspects such as market share if they operate in the same province, and therefore SUTVA would not hold.[47] Appendix A1 and Table A1 provide an example to demonstrate how we select the untreated firms.

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[44] Negative and positive numbers refer to quarters in the DID estimation. But they refer to trading days in the event study.

[45] We find that the regression results remain almost unchanged as we extend the pre-treatment period. But the magnitudes of the coefficients of the variables that we are interested in become smaller as we extend the post-treatment period. That is, a politically connected firm indeed takes measure to make up for the economic loss caused by the sudden death of a government official independent director.

[46] China can be divided into seven regions according to geographic characteristics. They are North China (Beijing, Tianjin, Hebei, Shanxi, and Inner Mongolia), Northeast China (Liaoning, Jilin, and Heilongjiang), Eastern China (Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, and Shandong), Central China (Henan, Hubei, and Hunan), Southern China (Guangdong, Hainan, and Guangxi), Southwest China (Chongqing, Sichuan, Guizhou, Yunnan, and Tibet), and Northwest China (Shaanxi, Gansu, Ningxia, Qinghai, and Xinjiang). Of course, China also can be divided into East, Middle and West. But the division into seven regions is more suitable here because provinces in each of these regions share more common characteristics than reflected in the division into three regions.

[47] Our sample includes listed firms which usually are large-scale corporations and occupy a large market share. If the treated firm incurs economic loss and its market share decreases as a result, the market share of the untreated firm might increase. That is to say, one firm might be indirectly affected by whether another firm is treated or untreated if they operate in the same industry and same province.

Using these selection criteria, we identify 304 untreated firms to match 91 treated firms. On average, each treated firm has 3.3 untreated firms as controls. Since there are several controls for each treated firm, we assign weight to each control firm. For simplification, the weight is equal to the inverse of number of untreated firms. For example, if a treated firm has 4 untreated firms, the weight is ¼ for each untreated firms. Finally, we get a sample of 4196 observations.[48] Table 5 reports the statistical description of all variables. It should be noted that, for a treated firm, it might hire another retired government official or its executives were being elected as PC or CPPCC members at time t ($0 < t \leq 8$), then the research period becomes (-8, t - 1). For an untreated firm, if it might hire a retired government official at time t_1 ($-8 \leq t_1 < 0$) and he or she might die or retire when the tenure is over at time t_2 ($0 < t_2 \leq 8$), then the research period becomes ($-t_1 + 1$, $t_2 - 1$). For example, if the government official independent director of an untreated firm was hired at time -3 and died at time 4, then the research period would be (-2, 3). We also identify 198 untreated firms to match 53 treated firms whose academic elite independent directors suddenly died, and 352 untreated firms to match 86 treated firms whose business elite independent directors suddenly died. Since we use quarterly data, we end up with two samples of 2708 and 4610 observations for academic elite independent directors and business elite independent directors.

Now we check whether the untreated firm is a good match for the treated firm. Table 6 reports the pooled firm-quarter mean values of all variables of the treatment and control groups during the pre-treatment period (-8, 0). It can be seen that there are no statistically significant differences in the mean values of any variables between the treatment and control groups prior to the treatment, which indicates that the untreated firms and treated firms are indeed similar prior to the treatment. Therefore, the control group we constructed is a good match for the treatment group.

5 Empirical results

In this section, we empirically estimate the effects of sudden loss of political connections on private firms' economic performance. Specifically, we ask three questions: (1) How does the sudden loss of political connections affect a private firm's market value? (2) Why does the sudden loss of political connection have such effects on the private firm's market value? (3) How does the private firm respond to the sudden loss of political connections?

5.1 Further test the endogeneity of sudden deaths of independent directors

Although the sudden death of a government official independent director is unexpected, some researchers may still argue that the probability of a sudden death may be related to the characteristics of a private firm. For example, firms in high-tech industries are inclined to hire comparatively young retired government officials who are willing and able to embrace new technology. If this is true, then the probability of a sudden death may be lower for these high-tech firms, and therefore political connections would be endogenous. In order to eliminate this possibility, we first regress the following model:

[48] Because the research period are (-8, 8), each firm in the treatment or control group should have 16 observations. However, there are some firms without 16 observations. For example, if a treated firm hired another retired government official at time t ($0 < t \leq 8$), then the research period becomes (-8, t - 1). In this case, this firm doesn't have 16 observations. Moreover, if a sudden death occurred in 2003 or 2012, we would need to collect the firm's financial data in 2001 and 2002 or 2013 and 2014.

$$Polcon_i = \alpha + \beta \boldsymbol{X}_i + \varepsilon_i \quad (1)$$

where *P*olcon is the sudden death dummy variable which takes value of one for treated firms and takes a value of zero for untreated firms. Control variables ***X*** include *Lasset*, *Listage*, *Cashflow*, *ROA*, *HHI*5, *Experience*, *PC*, *Academia*, *Business*, *High-tech Industry* and *Area*.[49] For both types of firms, control variables ***X*** are calculated as average values during the pre-treatment period (-8, 0). Finally, we get a sample of 395 observations.

Using Probit model, the regression results are shown in Column (1) of Table 7. It can be seen that all control variables are insignificant and the P-value of chi2 is larger than 10%, which indicates that the probability of sudden deaths of government official independent directors is not significantly affected by the firm's characteristics. In addition to government official independent directors, we also test the endogeneity of sudden deaths of independent directors from academia or business circles. As shown in Columns (2) and (3), all independent variables are also insignificant and the P-values of chi2 are also larger than 10%. Therefore, this is no significant evidence to show that sudden deaths of independent directors are not exogenous events.

5.2 Effects of sudden deaths of independent directors on private firms' market value: Event Study

5.2.1 Univariate results

We follow standard event study methodology to calculate the market-adjusted *CAR*s. The results are based on the event windows (-1, 0), (-1, 1), (-1, 2), (-1, 5), and (-1, 10), where time 0 is the date of the sudden death. Panel A of Table 8 compares *CAR*s between treated firms and untreated firms in the five event windows.[50] First, no significant difference is reported between *CAR*s of treated firms and untreated firms in the (-1, 0) event window. This result is consistent with reality. Because the government official independent directors died unexpectedly on the event day 0, the stock market didn't have time to respond to the event. Second, the differences in *CAR*s between treated firms and untreated firms become significant and their magnitudes become larger on subsequent event days. For example, the final row of Panel A shows that *CAR*(-1, 10) for treated firms is significantly lower than *CAR*(-1, 10) for untreated firms by 1.47 percentage points. That is, compared with untreated firms, the stock prices of treated firms dropped 1.47% for the (-1, 10) event window. This differential price drop is roughly similar to those estimated by Roberts (1990) (-1.43%), Faccio and Parsley (2009) (-1.68%), and Acemoglu et al. (2013) (-1.57%).

These results support hypothesis 2, which states that treated firms underperform relative to untreated firms after the sudden loss of political connections. This can be explained by our idea that, if the government official independent director suddenly dies, then the private firm might not be able to get the same amount of economic benefits as before and therefore would experience a significantly negative stock price reaction.

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[49] Because the sample used to test the endogeneity problem only has 395 observations, we don't add all the industry dummies and region dummies. Specifically, we only include the *high-tech* industry dummy, and the *East*, *Middle* and *West* region dummies.

[50] Some researchers argue that the price drop might reflect greater local market instability or uncertainty immediately following the death of the former politician. We can address this concern by calculating the difference of *CAR*s between treated firms and untreated firms. Here, the *CAR*s of untreated firms to some extent measure the local market instability or uncertainty immediately following the death of the former politician.

For comparison, we conduct a similar analysis using sudden deaths of independent directors from academia or business circles. The results are shown in Panels B and C of Table 8. Although the differences in *CAR*s between treated and untreated firms are significantly negative, especially after five trading days, their magnitudes are much smaller than the effect of losing political connections. For example, compared with untreated firms, there was only a 0.65% or 0.72% drop in stock prices of treated firms that experienced the sudden death of an academic elite or business elite independent director, respectively, for the (-1, 10) event window.

There are three possible explanations for the smaller price drops. First, unlike government official independent directors who are politically important and well-known in their jurisdiction, the deaths of independent directors from academia or business circles are not sensational events. Second, academic elite independent directors and business elite independent directors are not as scarce as government official independent directors. In our sample, 52% of private firms have hired at least two academic elite independent directors and 87% of private firms have hired at least two business elite independent directors. But only 6% of private firms hired two or more government official independent directors. Therefore, the sudden death of one academic or business elite director may have negligible effects on the firm's market value. Moreover, after the loss of an academic or business elite director, most private firms can hire another director with a similar background to replace the deceased person within a year or two. We will illustrate this point later. Last but not least, academic and business elite independent directors are unable to directly bring economic benefits to private firms in the same way as government official independent directors. We will empirically prove this statement later. Therefore, the sudden deaths of academic and business elite independent directors have much smaller effects on private firms' market value, which further confirms that political connections are indeed very important for private firms in China.

5.2.2 Politician- and province-specific factors affecting the market value of private firms

Although there are strong *a priori* reasons to believe political connections are important, we recognize that the unconditional effect we document may be due to other reasons; for example, politician- and province-specific factors may affect the strength of the political connections, and hence the firm-level response (i.e., its *CAR*s) to the sudden death. Therefore, we need to show that the price drop is even larger for those private firms that are more likely to establish political connections and to have stronger political connections. Put another way, if the stock price reaction we document is not due to political connections, we should not observe larger stock price reactions for those private firms that are more likely (i.e., expected) to have political connections. To address this question, we test the heterogeneity of the value of political connections in the following three ways.

First, China's government administrative levels can be divided into state level, provincial and ministerial level, bureau level, county level, and township level. As shown in Table 1, private firms are inclined to hire retired government officials from high administrative levels because they have stronger political power and wider social networks. If political connections really bring economic benefits to private firms and improve their economic performance, then the sudden deaths of government official independent directors with higher administrative levels will result in a larger drop in stock prices. Based on this analysis, we construct a dummy variable *ADMINI*, which takes

a value of one if the administrative level of a government official independent director is above bureau level (e.g., state level or provincial and ministerial level), and zero otherwise.

Second, one might expect the death of a retired government official to have a larger impact on private firms operating in the province in which he or she had direct jurisdiction before retirement. In our sample, about 32% of private firms hired retired government officials from other provinces. It is likely that few of them had wide social networks in the "new" jurisdiction to which they relocated to become directors. Therefore, their sudden deaths should result in a smaller drop in stock prices. Based on this information, we construct a dummy variable *INFLU*, which takes a value of one if the deceased government official independent director once worked in the province where the private firm is located, and zero otherwise.

Third, several previous papers have documented that private firms are more likely to establish political connections, and thus be treated favorably, in areas lacking market-supporting institutions (Faccio, 2006; Li *et al*., 2008). If this is true, the sudden deaths of government official independent directors should have larger negative effects on the market value of private firms in areas with a lower degree of marketization. In China, although the development of a market economy varies among provinces, the provinces in the eastern part of China usually have a higher degree of marketization than the provinces in the middle or western part of China (Fan *et al*., 2011). Based on this information, we construct a dummy variable *MARKET*, which takes a value of one if the private firm is located in the middle or western part of China, and zero otherwise.

In addition, we address two more types of heterogeneity to rule out two possible politician-specific explanations for the price drop caused by sudden deaths. First, in our sample, about 60% of retired government officials didn't work in business-related jobs before being hired as independent directors, as shown in Table 1. Because these directors do not bring in business experience, we hypothesize that what private firms want is their social networks accumulated before retirement. If this is true, we expect that whether or not a government official independent director has business-related experience doesn't affect the stock price reaction. In order to test this hypothesis, we construct a dummy variable *EXPERIENCE*, which takes a value of one if the retired government official held business-related jobs before being hired as an independent director, and zero otherwise. Second, according to China's Corporate Law, independent directors have a responsibility to attend all board meetings every year. In our sample, however, more than one third of government official independent directors were absent from at least 50% of board meetings during their tenure, as shown in Table 1. We expect these absences to have little effect on firm performance because private firms are more interested in these directors' social networks than in their participation in meetings. Therefore, we expect that attendance at board meetings doesn't affect the stock price reaction. In order to test this hypothesis, we construct a dummy variable *MEETING*, which takes a value of one if the retired government official was absent at least 50% of board meetings during his or her tenure as independent director, and zero otherwise. In both cases, if making use of social networks is not the main reason for hiring government official independent directors, we may observe different stock price reactions based on these politician-specific factors.

Now we divide government official independent directors who suddenly died according to these five politician- and province-specific factors, and then calculate *CAR*s of each subcategory. The results based on the event window (-1, 10) are shown in Panel A of Table 9. It should be noted that, for each factor, we have two dimensional differences. That means we can calculate the

difference in differences of *CAR*s, which makes the results more convincing. Based on the results in Panel A of Table 9, we can draw two conclusions. First, compared with untreated firms, the stock price of treated firms experiences a larger drop if its government official independent director had a higher administrative level, or if the treated firm is located within his or her jurisdiction, or if the treated firm is located in the middle or western part of China where the market economy is comparatively underdeveloped. Specifically, compared with untreated firms, the stock prices of treated firms with those three characteristics significantly dropped 0.89%, 1.20%, and 1.16% respectively for the (-1, 10) event window. These results are consistent with our analysis. Therefore, political connections indeed matter for private firms, especially when they are more likely to establish political connections and to have stronger political connections.

Second, the difference in differences of *CAR*s are not significant when we divide government official independent directors on the basis of whether they held business-related jobs before they were hired as independent directors or whether they missed at least 50% of board meetings during their tenure. These results confirm our hypotheses. The main reason for hiring retired government officials as independent directors is to make full use of their social networks and political power. Having relevant work experience or attending board meetings is not as important as political connections and thus does not affect the stock price reaction.

We can do some comparative analysis of independent directors from academia and business circles. Because academic and business elites do not have administrative levels in most cases, we are unable to divide these types of directors on that basis in order to calculate any difference in *CAR*s. Moreover, we merge academic elites and business elites in order to increase the sample size.[51] The definitions of those four politician- and province-specific factors (excluding *ADMINI*) are similar to those for government official independent directors. For example, *EXPERIENCE* is a dummy variable, which takes a value of one if the academic or business elite held business-related jobs before being hired as independent directors, and zero otherwise. The results based on the event window (-1, 10) are shown in Panel B of Table 9.

We find that the difference in differences of *CAR*s are not significant no matter where the academic elite or business elite came from and no matter where the private firm is located. As discussed above, the main reason for hiring academic or business elites as independent directors is to make full use of their work experience and professional knowledge to improve the firm's economic performance. Both work experience and professional knowledge play roughly equally important roles, no matter where the academic elite or business elite comes from and no matter where the private firm is located. However, academic or business elites are more experienced and knowledgeable if they held business-related jobs before being hired as independent directors, and they have more opportunities to express their opinions and offer constructive suggestions if they attend more board meetings. As shown in Panel B of Table 9, the stock price of treated firms experiences a larger drop after a sudden death if academic or business elite directors held business-related jobs before they were hired as independent directors, or if they attended at least 50% of board meetings during their tenure as independent directors.

[51] As shown in Table 1, for example, only 1.9% of academic elite independent directors who suddenly died didn't hold business-related jobs before they were hired as independent directors. This sample is too small to use for statistical inference.

5.2.3 Robustness checks

Now we perform four tests to assess the robustness of our baseline results reported in Table 8. First, we use another criterion to construct the control group. That is, the untreated firm is one without a government official independent director during the pre-treatment period (-8, 0) and operates in the same industry and geographical region as the treated firm but in a different province from the treated firm.[52] In other words, the untreated firm is a non-politically connected firm. We estimate the value of political connections by comparing *CAR*s between politically connected firms and non-politically connected firms. We also construct control groups for academic elite and business elite independent directors in the same way.

Second, we only use "pure" private firms. Due to China's institutional background, a small proportion of private firms were not privately owned at the beginning. Some of them originally were state-owned firms which were converted into privately owned firms through share transfer. Because they originally were state-owned enterprises, they may have had stronger political connections before converting to private firms. In order to address concern, we exclude all private firms with these characteristics and only study the "pure" private firms. Based on annual reports of listed firms, we can find out the original ownership structure of a listed firm and then determine whether it has been private since establishment.

Third, there may be confounding news surrounding the sudden deaths. Examples of confounding new include announcements of quarterly earnings, merger and acquisition decisions, discovery of new products, etc. Therefore, it is highly possible that the stock price reaction is mainly caused by these news but the sudden death. In order to eliminate this possibility, we exclude firms with important corporate events surrounding the sudden deaths, i.e. one week before and after the sudden deaths.

Last, another valid concern with the sudden death literature relates to the sample selection. To be able to measure empirically the stock price reaction, deaths are required to be both sudden and unexpected by the stock market. Although our definition of sudden deaths attempts to secure that these two conditions are satisfied, director age implies an increased probability of mortality and discontinuation of service. Simply put, a sudden death of an 80-year-old independent director might not be as surprising as the sudden death of a 50-year-old. We address this concern by restricting the sample to independent directors who are 70 or below at the time of death.[53]

The results based on the event windows (-1, 2), (-1, 5), and (-1, 10) are reported in Table 10. Obviously, the main results are basically similar to the baseline results except for slight changes in magnitudes of *CAR*s. That is, after the sudden loss of political connections, private firms would experience a significantly negative stock price drop. To sum up, political connections indeed matter for private firms.

5.3 Effects of sudden deaths of independent directors on the economic benefits obtained by private firms: DID Estimation

[52] If the untreated firm hires a retired government official as an independent director during the period (1, 8), then the research period becomes (-8, t - 1) where t ($0 < t \leq 8$) represents the time when he or she is hired as an independent director.

[53] Our choice of 70 years old as a cut-off level is consistent with the documents issued by the Chinese government on October 2013.

5.3.1 Sudden deaths of government official independent directors

Government official independent directors serve as a bridge linking firms and government, and help firms obtain economic benefits by employing their social networks. If the government official independent director of a private firm suddenly died, it might not be able to get the same amount of economic benefits as before and therefore it experienced a significantly negative stock price reaction, as shown in Table 8. Now we empirically test whether the private firms will be treated unfavorably after the loss of political connections. We regress the following model:

$$Benefit_{it} = \alpha + \beta \boldsymbol{X}_{it} + \theta Polcon_i + \gamma Quarter_t + \delta Polcon_i \times Quarter_t + \varepsilon_{it} \quad (2)$$

where subscript *i* refers to a specific firm and subscript *t* refers to a quarter. Because the research period is (-8, 8), *t* takes integer between (-8, 8) but not including 0. *Benefit* represents the economic benefits obtained by private firms. We use three indexes to measure them: *Loanrate*, *ETR*, and *Subsidy*. *Polcon* is a dummy variable which takes a value of one for the treated firm during the research period (-8, 8) and takes a value of zero for the untreated firm during the research period (-8, 8). $Quarter_t$ is a dummy variable which takes a value of one if $t > 0$ (post-treatment period) and takes a value of zero if $t < 0$ (pre-treatment period). The coefficient of the interaction term, δ, captures the effect of unexpected loss of political connections on the firm's economic benefits. Control variables $\boldsymbol{X}$ include *Lasset*, *Listage*, *Cashflow*, *HHI*5, *Experience*, *PC*, *Academia*, *Business*, *Industry*, *Region*, and *Year*. Since firms are likely to be correlated within provinces, we estimate the clustered standard errors by province to account for the dependence in the residual.

Before employing DID estimation, we need first to check whether or not the average change in the outcome variables of the control group represents the counterfactual change in the outcome variables of the treatment group during the pre-treatment period. This is often referred to as the *parallel trend assumption*. In order to check this assumption, we draw three graphs to show the pre-treatment and post-treatment trends of the outcome variables (*Loanrate*, *ETR*, and *Subsidy*). Figures 2, 3 and 4 show the trends of these three variables of the treatment and control groups during the period (-8, 12). It can be seen that the outcome variables of the treatment and control groups share similar trends prior to the sudden death occurred at time 0, which indicates that our sample satisfies the *parallel trend assumption*. In addition, the differences in the outcome variables between the treatment and control groups become larger after the sudden death, which indicates that the sudden loss of political connections may have a negative effect on the economic benefits obtained by private firms.

The regression results are shown in Table 11. Regardless of which control variables are included in Model (2), it can be seen that the coefficients of the interaction term, *Polcon*×*Quarter*, are always significant, which means that the sudden death of a government official independent director indeed has significant effects on the economic benefits that the private firm can get. Take Columns (3), (6) and (9) for example. If a private firm loses political connections because of the sudden death of its government official independent director, the ratio of total loans to total assets (*Loanrate*) and the ratio of government subsidies to net profits (*Subsidy*) decrease by 1.34 and 1.49 percentage points within two years, while the effective tax rate (*ETR*) faced by the private firm increases by 0.86 percentage points within two years, holding other things constant. Given the sample means of these three variables of the treatment group prior to the sudden death, *Loanrate* and *Subsidy* decrease by 6.18% and 9.87% respectively, while *ETR* increases by 5.06%. Therefore, private firms indeed are unable to obtain as many economic benefits as before, especially

government subsidy, after they lose political connections. These empirical results support hypothesis 1. Since bank loans, preferential tax, and government subsidies have positive effects on firms' market value, a reduction in these three benefits after the sudden loss of political connections provides a reasonable explanation for the negative stock price reaction, as shown in Table 8. Table 11 also reports the coefficients of control variables. Since they are not the focus of this paper, we don't discuss their economic implications.

Now we test for heterogeneous effects of political connections on the economic benefits obtained by private firms. If the reduction in the economic benefits is due to political connections, we should observe a larger decline for those private firms that are more likely to establish political connections and to have stronger political connections. Follow the analysis above, we consider three factors. They are the administrative level of a government official independent director (*ADMINI*), whether the private firm is located within his or her jurisdiction (*INFLU*), and the degree of marketization (*MARKET*). The definitions of these three variables are exactly the same as before. The regression models are as follows (also known as *triple-differences models*):

$$Benefit_{it} = \alpha + \beta \boldsymbol{X}_{it} + \theta Polcon_i + \theta_A Polcon_i \times ADMINI + \gamma Quarter_t + \gamma_A Quarter_t \times ADMINI + \delta Polcon_i \times Quarter_t + \delta_A Polcon_i \times Quarter_t \times ADMINI + ADMINI + \varepsilon_{it} \quad (2')$$

$$Benefit_{it} = \alpha + \beta \boldsymbol{X}_{it} + \theta Polcon_i + \theta_I Polcon_i \times INFLU + \gamma Quarter_t + \gamma_I Quarter_t \times INFLU + \delta Polcon_i \times Quarter_t + \delta_I Polcon_i \times Quarter_t \times INFLU + INFLU + \varepsilon_{it} \quad (2'')$$

$$Benefit_{it} = \alpha + \beta \boldsymbol{X}_{it} + \theta Polcon_i + \theta_M Polcon_i \times MARKET + \gamma Quarter_t + \gamma_M Quarter_t \times MARKET + \delta Polcon_i \times Quarter_t + \delta_M Polcon_i \times Quarter_t \times MARKET + MARKET + \varepsilon_{it} \quad (2''')$$

The regression results are shown in Table 12. It can be seen that the coefficients of $Polcon_i \times Quarter_t \times ADMINI$, $Polcon_i \times Quarter_t \times INFLU$ and $Polcon_i \times Quarter_t \times MARKET$ are significant in all columns. That is, we can observe a larger decline in the economic benefits when the government official independent director has higher administrative level, or when the private firm is located within his or her jurisdiction, or when the private firm is located in the middle or western part of China where the market economy is underdeveloped.

5.3.2 Sudden deaths of independent directors from academia or business circles

As analyzed above, the main reason for hiring academic elites or business elites as independent directors is to make full use of their work experience and professional knowledge to improve firms' economic performance. Since most of them do not have political backgrounds, they are unable to directly bring the economic benefits to private firms in the same way as the retired government officials do, though they may offer some constructive advice on how to obtain those benefits. In order to test this hypothesis, we regress the following models.

$$Benefit_{it} = \alpha + \beta \boldsymbol{X}_{it} + \theta Professor_i + \gamma Quarter_t + \delta Professor_i \times Quarter_t + \varepsilon_{it} \quad (2a)$$

$$Benefit_{it} = \alpha + \beta \boldsymbol{X}_{it} + \theta CEO_i + \gamma Quarter_t + \delta CEO_i \times Quarter_t + \varepsilon_{it} \quad (2b)$$

where *Professor* and *CEO* represent the sudden deaths of academic elite and business elite independent directors, respectively. All other variables are exactly the same as before. Using DID estimation, the regression results are shown Table 13.

Regardless of which control variables are included in the models (2a) and (2b), it can be seen that the coefficients of the interaction term are not significant, which confirms our hypothesis. That

is, the sudden deaths of independent directors from academia or business circles have no significant effects on the economic benefits that private firms can get. Combined with the results in Tables 11 and 13, we can safely draw a conclusion that the main reason for hiring retired government officials as independent directors is to make full use of their social networks and political power, especially considering that most of them do not have relevant work experience and professional knowledge.

5.3.3 Robustness checks

Now we perform three tests to assess the robustness of our baseline results reported in Table 11. First, we use another criterion to construct the control group, as shown in the previous section. Second, as shown in Table 1, a proportion of government official independent directors received higher education or had relevant work experience. They are probably able to provide constructive advice on how to the economic benefits. Therefore, it is possible that the foregoing results are mostly accounted for by these government official independent directors. In order to eliminate this possibility, we exclude these government official independent directors. Third, we only use "pure" private firms. After rerunning all regressions, we find that the empirical results are basically similar to the baseline results except for several slight changes in significance, as shown in Table 14.

5.4 How do politically connected firms respond if they suddenly lose political connections?

We have shown that political connections indeed matter for private firms in China. Naturally, the next question is how politically connected firms respond to the sudden deaths. This question is of practical importance for Chinese private firms. With the increase of anti-bribery efforts and the development of the market economy, maintaining political connections became more and more difficult and costly in the last decade. By studying the extreme case of a sudden death, this paper has shown that the sudden loss of political connections can harm a firm's economic performance. To avoid this harm, firms should adjust their development strategies and take measures to make up for the economic loss caused by the loss of political connections if they want to regain competitive advantage. In order to figure out what measures politically connected firms will take after the loss of political connections, we need first to clarify the true functions of establishing political connections with the government.

Hiring retired government officials as independent directors can help firms obtain various economic benefits from the government or banks. These economic benefits can reduce the production cost and thus increase profits. In this case, potential entrants without political connections are unable to compete with them. So one of the important functions of establishing political connections with the government is to raise entry barriers and prevent potential entrants from entering the market. If a politically connected firm lost its political connections, the entry barrier would gradually disappear. Then the firm probably would lose competitive advantage and even market share if potential entrants enter the market. Therefore, private firms need to take measures to counteract the negative effects of losing political connection.

In reality, there are three main ways for those private firms which lost political connections to regain competitive advantage. The first two ways involve reestablishing political connections by hiring another retired government official or participating in political activities. The third way is

to use capacity accumulation (e.g., an increase in physical capital and R&D investment) as a credible threat to prevent potential entrants from entering the market. Now we analyze these three ways using our sample.

5.4.1 Hiring another retired government official after the loss of political connections

The first and most direct approach is to hire another retired government official. In most cases, however, this doesn't work. The main reason is that retired government officials, especially those with stronger political power and wider social networks, are relatively scarce. Therefore, it is very difficult and costly to search for and hire another retired government official with the same political power as the deceased one in a short period of time. Panel A of Table 15 reports the number of private firms which successfully hired another retired government official after the sudden loss of political connections, for each year. Through observation, we find that only 5 private firms (or 5.49%) successfully hired another retired government official within two years right after the sudden death.[54] Even if we consider all government official independent directors who died non-suddenly, the conclusion doesn't change much. As shown in Panel B of Table 15, only 36 private firms (or 5.68%) successfully hired another retired government official within two years right after the sudden death. Therefore, according to our sample, it is indeed difficult to hire another retired government official after the loss of political connections. To sum up, reestablishing political connections with the government by hiring another retired government official is possible but infeasible for private firms in a short period of time.

Compared with retired government officials, there are a large number of academic elites and business elites available in China. If these two kinds of independent directors suddenly die, private firms can quickly search for and hire another academic elite or business elite to replace them. As usual, we calculate the number of private firms which successfully hired another academic elite or business elite after the firms lost an independent director in one of these two categories. As shown in Table 16, 30 private firms (or 56.60%) hired another academic elite and 45 private firms (or 52.33%) hired another business elite within two years right after the sudden loss of former academic elite and business elite. This observation provides a possible explanation for a smaller drop in the stock prices in response to the sudden deaths of academic elite or business elite independent directors, as shown in Table 8.

5.4.2 Obtaining political status after the loss of political connections

The second approach for private firms is to obtain political status by themselves. Specifically, the CEOs or senior executives of private firms can actively participate in political activities by being elected as PC or CPPCC members.[55] Unlike government officials, they don't have rights to directly allocate resources. Although they can get in touch with incumbent government officials

[54] Since the research period is eight quarters before and after the sudden death in the DID estimation, we focus on two years after the sudden death. Another reason is that we are unable to identify whether private firms hire another retired government official in 2015 and the following years because of unavailability of annul reports.

[55] Of course, private firms also can invite PC or CPPCC members to work for them after the loss of political connections. But this phenomenon is not common in China. The main reason is that most PC or CPPCC members are from the government and army, and they are not allowed to work for firms before retirement. In our sample, only one private firm hired a PC member (who is the CEO from another firm) as an independent director after the loss of political connections.

and express their economic needs, this political status cannot directly help their firms obtain privileges and benefits. Moreover, to be a PC or CPPCC member is comparatively difficult for private entrepreneurs, for reasons we explained earlier. Of course, there are many other ways to obtain political status. For example, private entrepreneurs are allowed to join the Communist Party of China (CPC). But obtaining political status in those ways may not be as effective as being elected as PC or CPPCC members in terms of improving firms' economic performance.

Table 17 reports the number of private firms whose CEOs or senior executives are successfully elected as PC or CPPCC members after the loss of political connections, for each year. Because the general election is held every five years (2002, 2007 and 2012), no CEOs or senior executives can be elected as PC or CPPCC members during the non-election years. That is why many blanks are filled in with zeroes. As shown in Panel A of Table 17, there are only 2 private firms (or 2.20%) whose CEOs or senior executives were successfully elected as PC or CPPCC members within two years right after the sudden death. Even if we consider all government official independent directors who died non-suddenly, the conclusion doesn't change much, as shown in Panel B of Table 17. To sum up, actively participating in political activities is possible but also infeasible for private firms, which indicates that most of them still need to find other ways to make up for the economic loss caused by the loss of political connections.

5.4.3 Increasing physical capital and R&D investments

After the loss of political connections, private firms also can use capacity accumulation (e.g., increasing physical capital and R&D investments) as a credible threat to prevent potential entrants from entering the market. As was analyzed by Spence (1977), production capacity accumulation can be used as a strategic variable to deter entry. A sense of irreversibility makes production capacity accumulation a credible threat to a potential entrant. Spence believed that, in the event of a threat of entry, the incumbent can use all the capacity, thereby reducing the price to a level that makes entry unprofitable. Romer (1994) also pointed out that raising the cost to potential entrants can result in reduced competition and dramatically decrease the set of new goods and technologies introduced into the economy. Using a simple two-period incumbent-entrant model with positive entry cost, Kim (2014) showed that the use of political capital by the incumbent as a barrier to entry implies a clear substitution effect between a firm's investment in political capital and its investment in physical capital. Her empirical results further confirmed that losing political connections induces firms to increase capital expenditure, R&D investment, and patent applications.

With lower production costs, politically connected firms may not have enough incentive to make additional investments in physical capital and innovation, even if it is profitable to do so. However, after the loss of political connections, the entry barriers gradually disappear. The incumbents need to maintain a high level of investment in physical capital and R&D to deter potential entry if they can't reestablish political connections in a short period of time. In this context, political capital and physical capital to some extent are substitutes. Moreover, politically connected firms are more likely to get legal and economic protection from the government (Allen *et al*., 2005; Chen *et al*., 2005; Bai *et al*., 2006). After the loss of political connections, they can become bigger and stronger by increasing investment in physical capital and innovation in order to avoid infringement and suppression by other market participants.

Some researchers, however, argue that political capital and physical capital are complements (Murphy *et al*., 1993; Chen *et al*., 2011). They argue that a firm that has "established lobbies or part of government elites" can invest more since it is easier for it to acquire government produced assets, such as licenses and construction approvals. If this is true, the firm that lost political connections would decrease investment in physical capital and innovation. With lower entry barriers, the incumbent would incur greater economic loss because new entrants now can enter the market and occupy part of the market share. Even if the level of investment maintains unchanged, the incumbent also might lose its competitive advantage after the loss of political connections.

Therefore, we hypothesize that, when a private firm loses political connections, it increases physical capital and R&D investments in order to maintain the barriers to entry. We regress the following model:

$$Inverstment_{it} = \alpha + \beta \boldsymbol{X}_{it} + \theta Polcon_i + \gamma Quarter_t + \delta Polcon_i \times Quarter_t + \varepsilon_{it} \quad (3)$$

where *Investment* represents the private firm's investment. We use two indexes to measure it: physical capital investment (*Capital*) and R&D investment (*R&D*). The definition and statistical description of these two variables are shown in Tables 4 and 5. All other variables are exactly the same as before. Using DID estimation, we regress the Model (3). The regression results are shown in Table 18.

As shown in Panel A of Table 18, regardless of which control variables are included in Model (3), the coefficients of the interaction term, *Polcon*×*Quarter*, are not significant. That is, private firms do not increase the investments in both physical capital and innovation after the sudden loss of political connections. These results seems inconsistent with our hypothesis. But it should be noted that it usually takes time for firms to change investment plans especially R&D investment plans. As shown in Figures 5 and 6, a private firm starts to rapidly increase both physical capital and R&D investments about one and half years after the sudden death. Based on this observation, we extend the post-treatment period by changing research period from (-8, 8) to (-8, 12) and regress the Model (3) again.

As shown in Panel B of Table 18, the coefficients of the interaction term, *Polcon*×*Quarter*, become highly significant in all columns. Specifically, if a private firm sudden lost political connections, the ratio of fixed asset investment to total assets would increase 0.63 percentage points (or 7.24%) and the ratio of R&D investment to total assets would increase 0.15 percentage points (or 4.17%), holding other things constant. That is, after the loss of political connections, the marginal benefits of investment become much larger and the constraint on borrowing is not absolute, so private firm will increase the investment. Therefore, the results confirm our analysis that physical capital is a substitute for political capital.

We can also test this hypothesis from another perspective. That is, we test whether the magnitudes of the negative effects of losing political connections on firms' competitive advantage become smaller as we extend the post-treatment period. In order to test this hypothesis, we regress the following model:

$$Competitive_{it} = \alpha + \beta \boldsymbol{X}_{it} + \theta Polcon_i + \gamma Quarter_t + \delta Polcon_i \times Quarter_t + \varepsilon_{it} \quad (4)$$

where *Competitive* represents the firm's competitive advantage. We use two financial indexes to measure it: *ROA* and *Profitability*. *ROA* represents return on assets which is equal to the ratio of net profits to total assets. *Profitability* represents the firm's profit rate which is equal to the ratio

of main business profit to main business revenue. These two indexes are important measures of the firm's competitive advantage (Porter, 2008). The statistical description of these two variables are shown in Tables 5. The regression results are shown in Panel C of Table 18. First, all coefficients of the interaction term are significantly negative, which indicates that the sudden loss of political connections indeed damages the firm's competitive advantage. Second, the magnitudes of the coefficients gradually become smaller as we extend the post-treatment period. Specifically, the magnitudes of the coefficients decline by more than half as we extend the research period from (-8, 8) to (-8, 12) in both *ROA* and *Profitability* models. That is, private firms indeed use capacity accumulation to counteract the negative effects of losing political connections on the firm's competitive advantage. Therefore, these empirically results further support our hypothesis.

Some researchers argue that the negative effects of losing political connections on the firm's competitive advantage may become smaller as time goes on even if the firm takes no actions to deal with it. In order to address this concern, we consider the effects of sudden deaths of academic elite or business elite independent directors on private firms' investments and competitive advantage. As mentioned above, their sudden deaths have nothing to do with the firm's political capital and thus entry barriers. Therefore, for those private firms whose academic elite or business elite independent directors suddenly died, they had no strong incentive to increase investments in both physical capital and innovation to offset the effects of sudden deaths. Moreover, those private firms can hire another academic elite or business elite within a short period of time. Therefore, we hypothesize that losing academic elite or business elite independent directors won't result in an increase in both physical capital and R&D investments.

The regression results in Panel A of Table 19 confirm our hypothesis. It can be seen that the coefficients of the interaction terms are not highly significant even if we extend the post-treatment period. Then, we further test whether the sudden loss of academic elite or business elite independent director has any effect on the firm's competitive advantage, and, if yes, whether the effect becomes smaller as time goes on. As shown in Panel B of Table 19, losing academic elite or business elite independent director also has negative effects on the firm's competitive advantage but the effects are much smaller than that of losing political connections, especially during the research period (-8, 8). More importantly, the coefficients of the interaction terms maintain almost unchanged as we extend the post-treatment period. Therefore, these results provide another piece of evidence to show that private firms indeed use capacity accumulation to counteract the negative effects of losing political connections on the firm's competitive advantage.

As usual, we perform three tests to assess the robustness of our baseline results reported in Table 18. First, we use another criterion to construct the control group. Second, we exclude government official independent directors who received higher education or had relevant work experience. Third, we only use "pure" private firms. After rerunning all of regressions, we find that the empirical results are basically similar to the baseline results except for several slight changes in significance, as shown in Table 20.

6 Conclusions

Using the sudden deaths of independent directors who are retired government officials, we empirically study the effects of losing political connections on private firms' economic performance in China. Employing an event study, we find that, if a private firm loses political

connections because of the sudden death of a government official independent director, its stock price drops 1.47% on average within ten trading days. This price drop is particularly pronounced when the government official independent director had a higher administrative level, or when the private firm is located within his or her jurisdiction, or when the private firm is located in the middle or western part of China, where the market economy is comparatively underdeveloped. By contrast, the sudden deaths of independent directors from academia or business circles have much smaller effects on their firms' stock prices.

Moreover, after the sudden loss of political connections, the ratio of total loans to total assets and the ratio of government subsidies to net profits decrease by 6.18% and 9.87%, respectively, within two years, while the effective tax rate faced by the private firm increases by 5.06% within two years. The reduction in the economic benefits after the sudden loss of political connections provides a reasonable explanation for the negative stock price reaction. As a comparison, we find that the sudden deaths of independent directors from academia or business circles have no significant effects on these economic benefits.

Last, after the loss of political connections, private firms can regain competitive advantage by hiring another retired government official or by participating in political activities. Through observation, however, we find that these two strategies are theoretically possible but infeasible in China. The third strategy is to use capacity accumulation as a credible threat to prevent potential entrants from entering the market. We find that, when a private firm suddenly loses its political connection, it increases investments in both physical capital and innovation in order to regain its competitive advantage. Losing an academic elite or business elite independent director, however, has no capacity accumulation effect.

With the increase of anti-bribery efforts and the development of market-supporting institutions in China, maintaining political connections has become more and more difficult and costly in the last decade. Under these circumstances, although politically connected firms experience a decline in economic performance after the loss of political connections, they will gradually regain competitive advantage by increasing investments in both physical capital and innovation. During the process of marketization, this is what Chinese private firms have been experiencing. We believe that the evidence from China is also useful for transitional countries that have institutional and economic characteristics that are similar to China.

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Figures and Tables

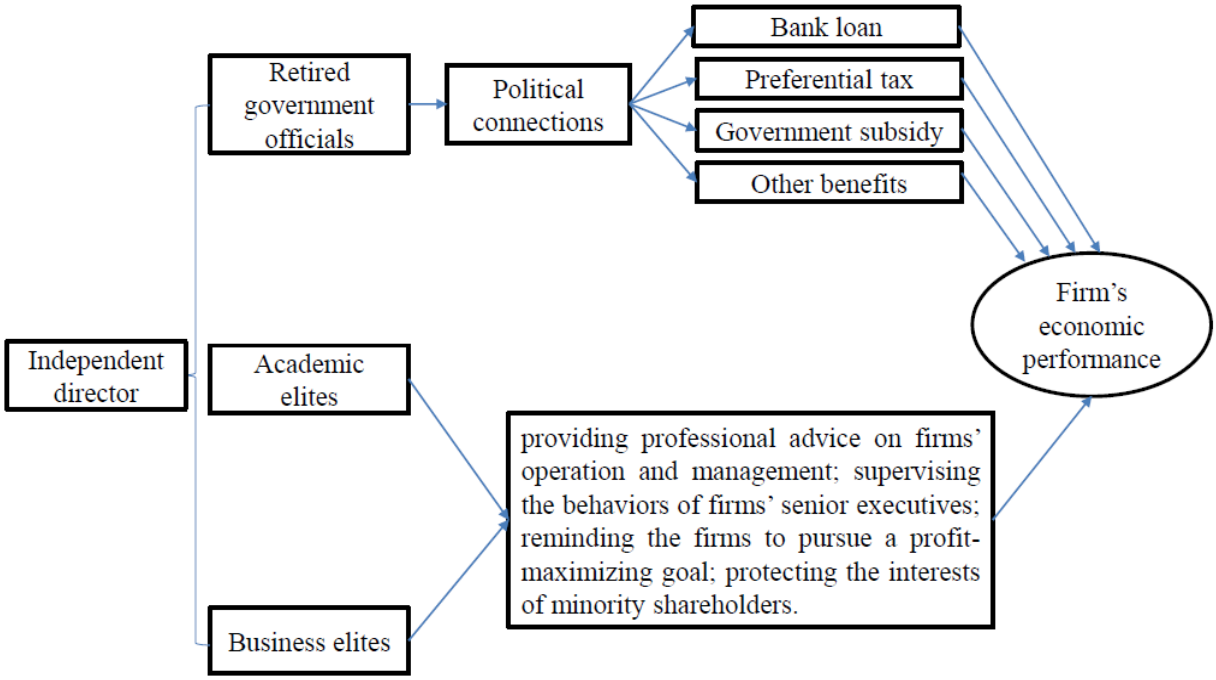

Figure 1 Channels through which independent directors affect firm's economic performance in China

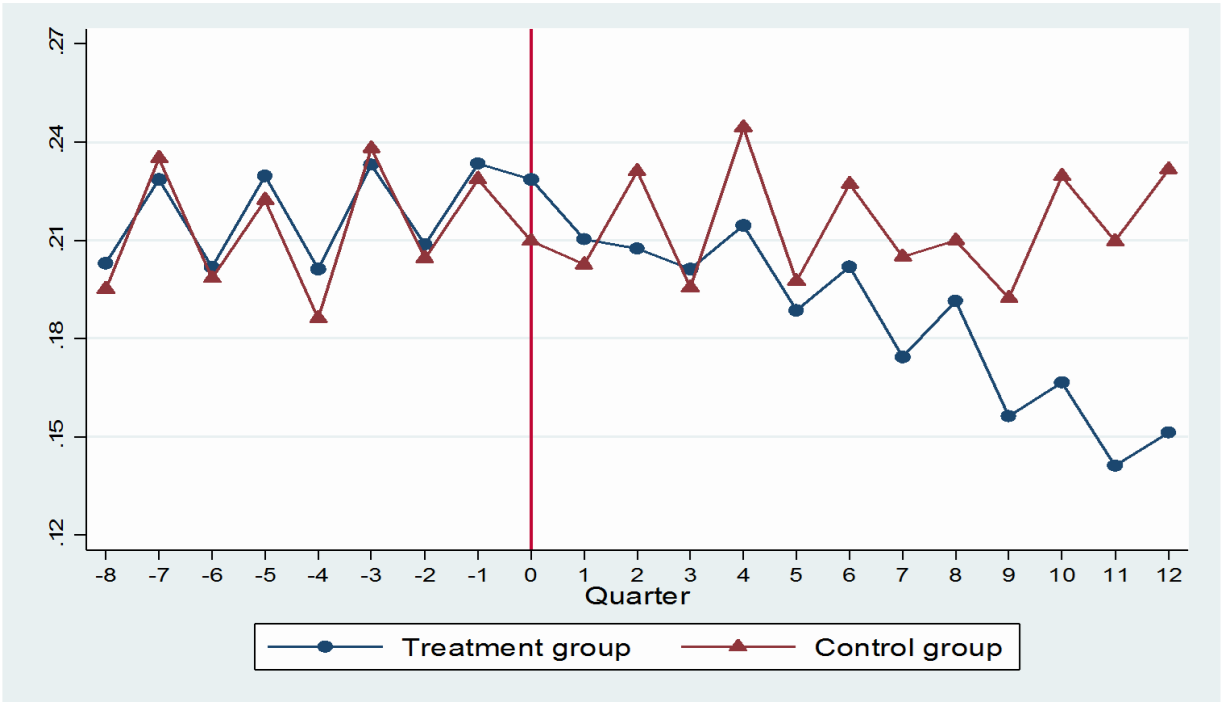

Figure 2 Bank loans (*Loanrate*) obtained by private firms in the treatment and control groups during the period (-8, 12)

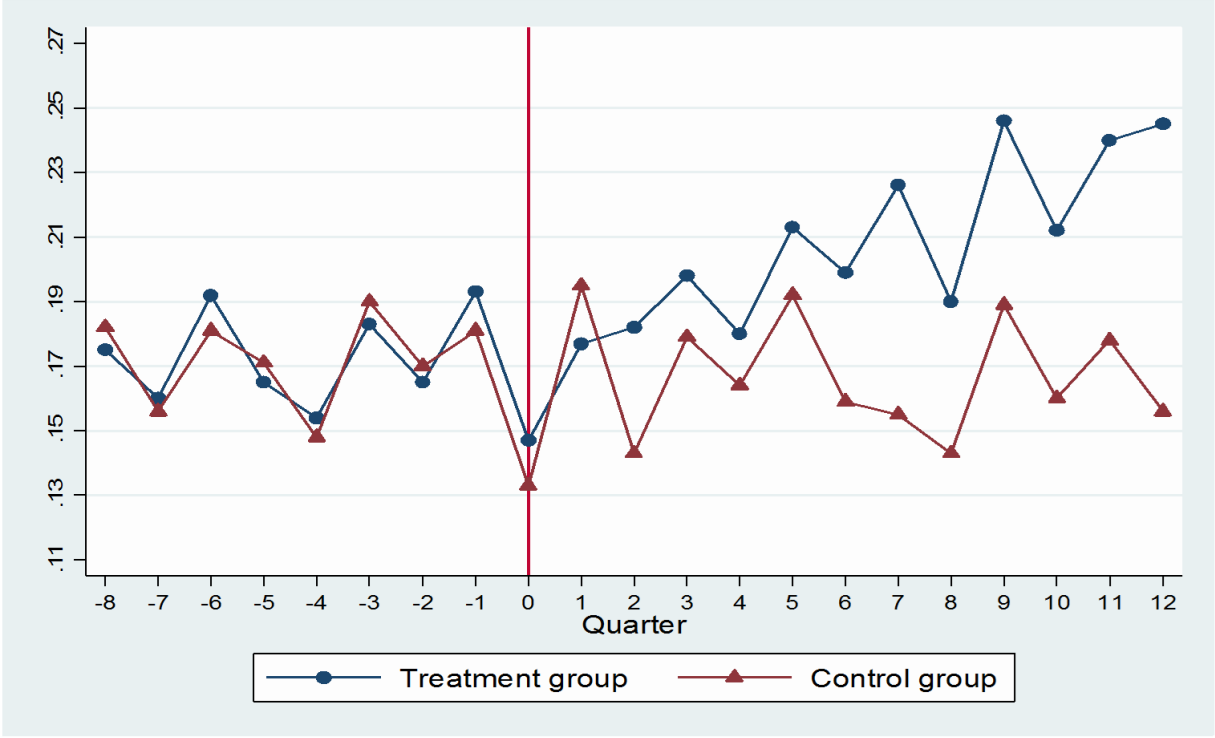

Figure 3 Effective tax rate (*ETR*) faced by private firms in the treatment and control groups during the period (-8, 12)

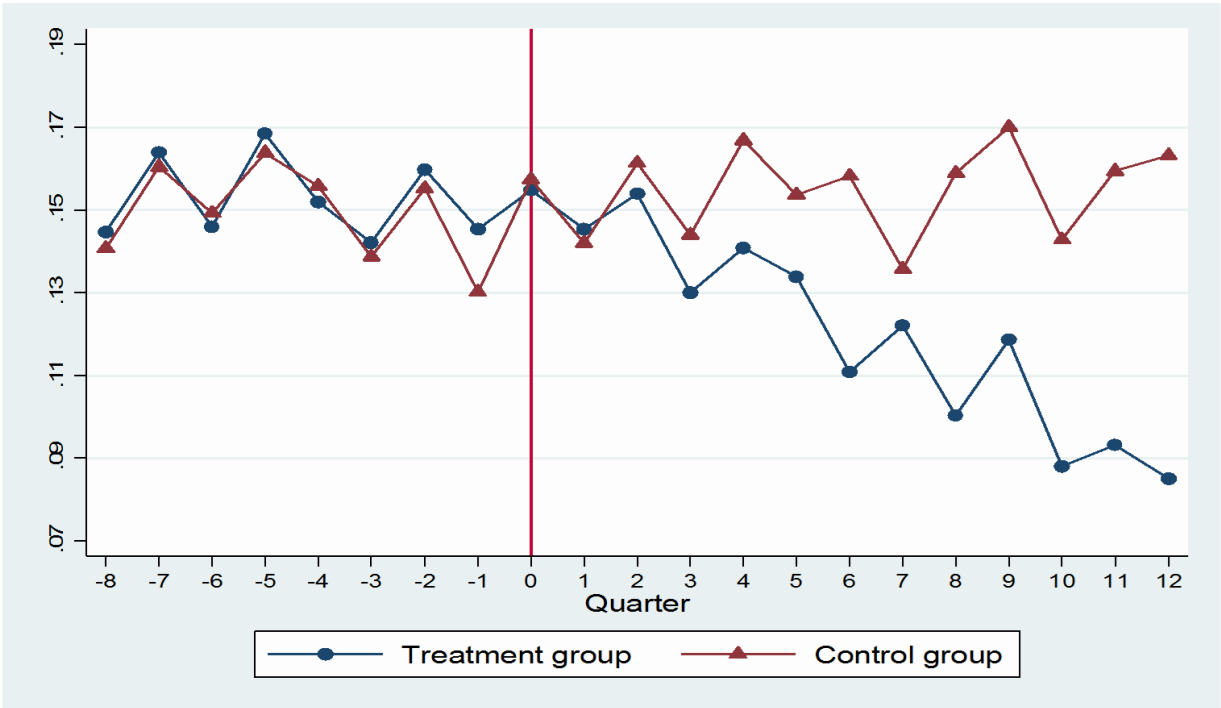

Figure 4 Government subsidy (*Subsidy*) obtained by private firms in the treatment and control groups during the period (-8, 12)

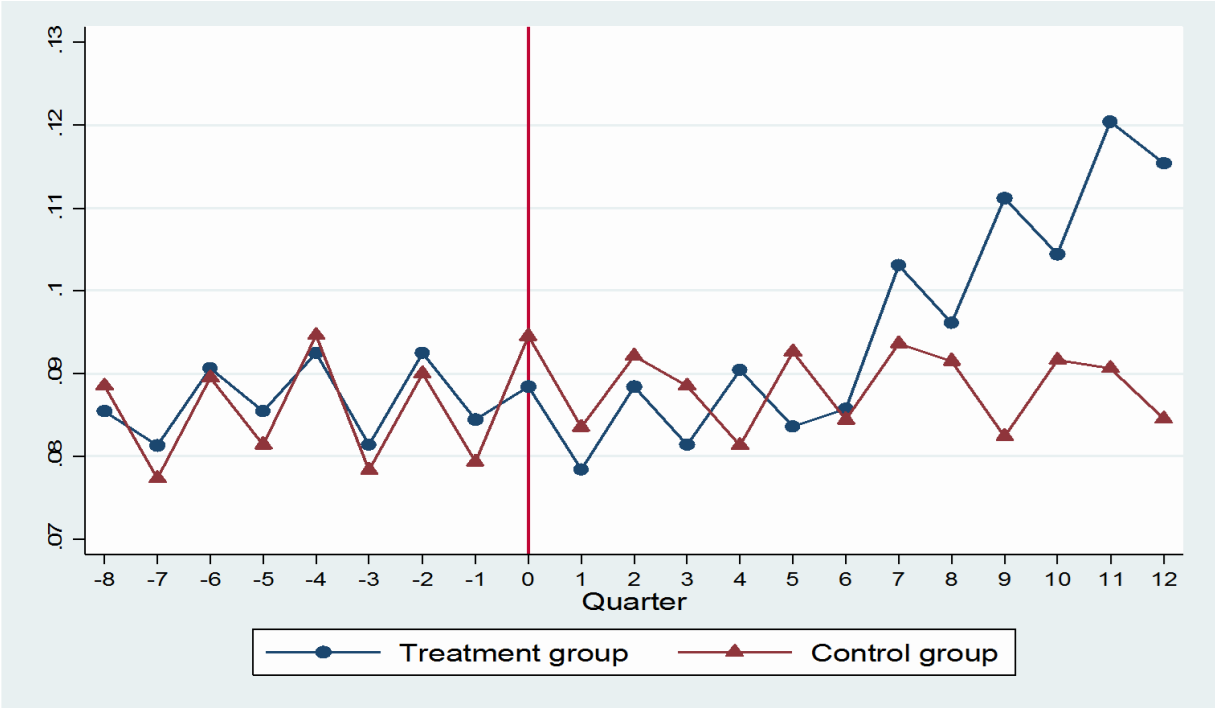

Figure 5 Physical capital investment (*Capital*) of private firms in the treatment and control groups during the period (-8, 12)

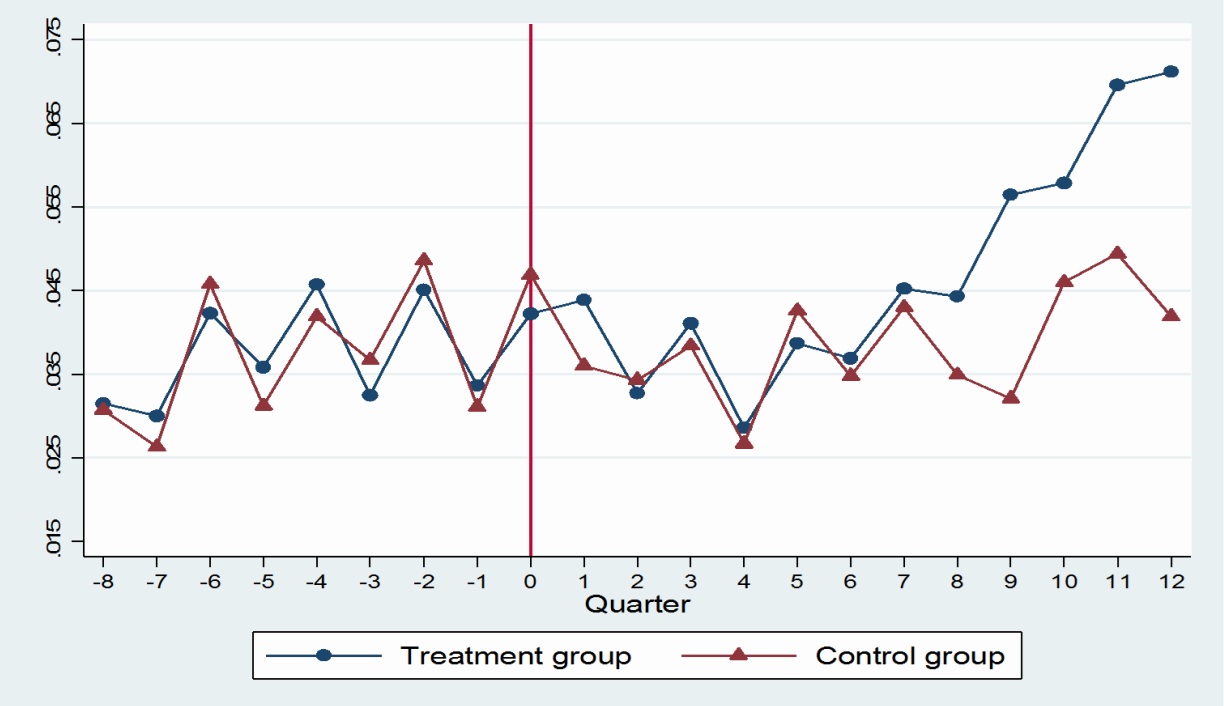

Figure 6 R&D investment (*R&D*) of private firms in the treatment and control groups during the period (-8, 12)

Table 1 Characteristics of three kinds of independent directors

Characteristics of three kinds of independent director		Government official independent director		Academic elite independent director		Business elite independent director	
		All sample	Sudden deaths	All sample	Sudden deaths	All sample	Sudden deaths
		(1)	(2)	(3)	(4)	(5)	(6)
Education level	>= Bachelor	0.228	0.231	0.967	0.962	0.712	0.709
	< Bachelor	0.772	0.769	0.033	0.038	0.288	0.291
Did he or she ever do business-related job before hired as independent director?	Yes	0.390	0.407	0.977	0.981	0.916	0.930
	No	0.610	0.593	0.023	0.019	0.084	0.070
Is his or her work experience related to the firm's main business?	Yes [a]	0.417	0.396	0.852	0.830	0.894	0.907
	No [b]	0.583	0.604	0.148	0.170	0.106	0.093
Government administrative level [c]	> Bureau level	0.649	0.637				
	<= Bureau level	0.351	0.363				
How old is he or she when he or she was hired as an independent director?	>= 65	0.743	0.736	0.406	0.415	0.241	0.233
	< 65	0.257	0.264	0.594	0.585	0.759	0.767
Is he or she absent from 50% and above of board meetings during his or her tenure?	Yes	0.346	0.330	0.089	0.094	0.075	0.081
	No	0.654	0.670	0.911	0.906	0.925	0.919
Number of independent directors		2283	91	3126	53	3975	86

a: For example, SANY Group hired Jun Qi, who was former director of the Personnel Department of the State Machinery Industry, as an independent director. SANY Group's main products include concrete machinery, excavator, hoisting machinery, pile driving machinery, road construction machinery, port machinery, and wind turbine.

b: For example, Shanghai Pudong Development Bank hired Qiang Xu, who was former director of the Shanghai Office of Government Legislative Affairs, as an independent director.

c: China's government administrative levels can be divided into state level, provincial and ministerial level, bureau level, county level, and township level. But most academic elites or business elites do not have administrative levels.

Table 2 Number of sudden deaths of three kinds of independent directors

Year	Government official independent director		Academic elite independent director		Business elite independent director	
	Number of sudden deaths	Number of the deceased	Number of sudden deaths	Number of the deceased	Number of sudden deaths	Number of the deceased
2003	3	27	2	34	4	56
2004	1	18	3	39	6	67
2005	5	37	7	51	8	60
2006	8	52	5	61	12	72
2007	7	58	8	70	7	81
2008	13	76	3	74	9	91
2009	10	98	6	82	11	104
2010	15	109	9	96	8	119
2011	12	116	4	80	7	131
2012	17	134	6	93	14	142
All	91	725	53	680	86	923

Table 3 Characteristics of sudden deaths

Panel A: Cause of sudden death	Government official independent director		Academic elite independent director		Business elite independent director	
	Sudden deaths	Proportion	Sudden deaths	Proportion	Sudden deaths	Proportion
Heart attack	43	0.473	21	0.396	25	0.291
Stroke	29	0.319	15	0.283	34	0.395
All other diseases	8	0.087	10	0.189	15	0.174
Accident	9	0.099	6	0.113	12	0.140
Sudden death, but unspecified cause	2	0.022	1	0.019	0	0
All	91	1	53	1	86	1

Panel B: Time of sudden death	Government official independent director			Academic elite independent director			Business elite independent director		
	Sudden deaths	All deaths	Ratio	Sudden deaths	All deaths	Ratio	Sudden deaths	All deaths	Ratio
First Quarter	22	167	0.132	9	113	0.078	23	249	0.092
Second Quarter	26	205	0.127	12	161	0.075	20	209	0.096
Third Quarter	19	161	0.118	17	220	0.077	25	274	0.091
Fourth Quarter	24	192	0.125	15	186	0.082	18	191	0.094
All	91	725	0.126	53	680	0.078	86	923	0.093

Panel C: Place of sudden death	Government official independent director			Academic elite independent director			Business elite independent director		
	Sudden deaths	All deaths	Ratio	Sudden deaths	All deaths	Ratio	Sudden deaths	All deaths	Ratio
East	33	260	0.127	19	235	0.081	31	328	0.095
Middle	30	234	0.128	16	206	0.078	29	303	0.096
West	28	231	0.121	18	239	0.075	26	292	0.089
All	91	725	0.126	53	680	0.078	86	923	0.093

Panel D: Different industries	Government official independent director			Academic elite independent director			Business elite independent director		
	Sudden deaths	All deaths	Ratio	Sudden deaths	All deaths	Ratio	Sudden deaths	All deaths	Ratio
High-tech industries	48	371	0.129	24	317	0.076	41	432	0.095
Low-tech industries	43	354	0.121	29	363	0.080	45	491	0.092
All	91	725	0.126	53	680	0.078	86	923	0.093

The proportions in Panel A are the ratios of the number of sudden deaths caused by a specific reason to the total number of sudden deaths. Proportions in Panels B, C and D are the ratio of the number of sudden deaths to the total number of deceased independent directors. High-tech industries mainly include the electronic and communication equipment manufacturing industry, computer industry, office equipment manufacturing industry, pharmaceutical industry, medical equipment manufacturing industry, and new material industry. All other industries belong to low-tech industries.

Table 4 Definitions of all variables

Variables	Definition
Polcon	= 1 if the government official independent director suddenly died; = 0 otherwise
Professor	= 1 if the academic elite independent director suddenly died; = 0 otherwise
CEO	= 1 if the business elite independent director suddenly died; = 0 otherwise
CARs	Cumulative abnormal returns: $CAR(-1,n)_i = \sum_{t=-1}^{n} AR_{it}$, where $AR_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{mt})$, and n = 0, 1, 2, 5, and 10.
Loanrate	Ratio of total bank loans (including short-term loans and long-term loans) to total assets
ETR	Effective Tax Rate (*ETR*) is computed as follows: $ETR = (TE - DTE) / (PTI + DV - IG + CD + CBI)$ where *TE* represents income tax; *DTE* represents deferred income tax; *PTI* represents pretax accounting income; *DV* represents current provision for impaired assets; *IG* represents return on investment; *CD* and *CBI* represents received cash dividend and bond interest, respectively.
Subsidy	Ratio of total subsidy (deducting value-added tax return) to net profits (= total profits – income tax)
Lasset	log (total assets)
Listage	Number of quarters since the firm went public
Cashflow	log (cash flow)
*HHI*5	Concentration of top five shareholders (Herfindahl-Hirschman Index). We use the following formula to calculate $HHI = \sum_{i=1}^{N} S_i^2$ where S_i is the shareholding ratio of the top five shareholders, and N is 5. The larger the *HHI*5, the higher the degree of the firm's concentration.
Experience	= 1 if firm's CEO or senior executive once worked in government agencies; =0 if otherwise
PC	= 1 if firm's CEO or senior executive is elected to be PC or CPPCC member; =0 otherwise
Politics	= 1 if the firm hires retired government official as independent director; = 0 otherwise
Academia	= 1 if the firm hires academic elite as independent director; = 0 otherwise
Business	= 1 if the firm hires business elite as independent director; = 0 otherwise
Capital	(Fixed asset investment) / (total assets)
R&D	(R&D investment) / (total assets)
ROA	Return on assets: ratio of net profits to total assets
Profitability	Ratio of main business profit to main business revenue
Industry	Industry dummy (41 industries)
Region	Province dummy (31 provinces)
Year	Year dummy (10 years)

Table 5 Statistical description of all variables (*N* = 4196)

Variables	Mean	Std. Dev.	Min	25th Pctile	Median	75th Pctile	Max
Polcon	0.249	0.432	0	0	0	0	1
Loanrate	0.206	0.024	0	0.185	0.201	0.227	0.312
ETR	0.181	0.019	0	0.162	0.179	0.196	0.384
Subsidy	0.143	0.022	-0.281	0.125	0.146	0.162	2.413
Lasset	21.472	1.154	18.483	20.338	21.264	22.584	26.812
Listage	31.207	8.022	12	25	32	36	61
Cashflow	17.254	1.038	13.841	16.325	17.248	18.162	20.035
*HHI*5	0.360	0.034	0.272	0.335	0.349	0.386	0.517
Experience	0.096	0.295	0	0	0	0	1
PC	0.044	0.205	0	0	0	0	1
Academia	0.541	0.498	0	0	0	0	1
Business	0.918	0.274	0	0	0	0	1
Capital	0.090	0.011	0.024	0.081	0.092	0.098	0.157
R&D	0.042	0.009	0	0.034	0.041	0.050	0.128
ROA	0.106	0.017	0.054	0.091	0.104	0.119	0.168
Profitability	0.149	0.024	0.042	0.126	0.147	0.171	0.217

Table 6 Mean values of all variables of the treatment and control groups during the pre-treatment period (-8, 0)

Variables	Treatment group		Control group		P-value of Diff
	Mean	Std. Dev.	Mean	Std. Dev.	
Loanrate	0.217	0.015	0.214	0.019	0.164
ETR	0.170	0.012	0.172	0.014	0.740
Subsidy	0.151	0.010	0.149	0.011	0.435
Lasset	21.478	1.150	21.484	1.146	0.433
Listage	31.193	8.016	31.197	8.013	0.252
Cashflow	17.258	1.041	17.252	1.045	0.395
*HHI*5	0.357	0.036	0.353	0.032	0.671
Experience	0.091	0.289	0.095	0.293	0.428
PC	0.043	0.203	0.045	0.207	0.612
Academia	0.543	0.498	0.542	0.498	0.732
Business	0.921	0.270	0.924	0.265	0.620
Capital	0.087	0.006	0.085	0.007	0.129
R&D	0.036	0.008	0.037	0.006	0.701
ROA	0.112	0.013	0.115	0.012	0.227
Profitability	0.154	0.019	0.156	0.019	0.314
Observations	536		1778		2314

The null hypothesis in the last column is that the variables of the treatment and control groups are equal to each other.

Table 7 Further test the endogeneity of sudden deaths during the pre-treatment period (-8, 0) *

Variables	Government official independent director [a]	Academic elite independent director	Business elite independent director
	(1)	(2)	(3)
Lasset	0.8241	0.7317	0.5460
	(0.7032)	(0.5021)	(0.3714)
Listage	-0.0075	0.0098	0.0080
	(0.0061)	(0.0105)	(0.0049)
Cashflow	0.6185	0.4903	0.5264
	(0.7801)	(0.3116)	(0.4608)
ROA	0.5914	-0.7462	-0.7836
	(0.3367)	(0.8019)	(0.5230)
*HHI*5	-0.2682	-0.3507	-0.3982
	(0.1811)	(0.2774)	(0.3218)
Experience	-0.0760	-0.0438	0.0559
	(0.0931)	(0.0417)	(0.0384)
PC	-0.0618	-0.0797	-0.0853
	(0.0469)	(0.0578)	(0.0620)
Academia	0.0386	0.0254	0.0286
	(0.0401)	(0.0177)	(0.0199)
Business	0.0311	-0.0348	-0.0373
	(0.0297)	(0.0261)	(0.0305)
High-tech Industry [b]	YES	YES	YES
Area [c]	YES	YES	YES
Prob > chi2	0.4025	0.3184	0.1759
Observations	395	251	438

*: We use Probit model to conduct the empirical analysis. The coefficients are marginal effects.

a: The dependent variables are *Polcon*, *Professor*, and *CEO* in Columns (1) - (3) respectively. The independent variables are calculated as average values during the pre-treatment period.

b: According to the Chinese *High-tech Industry Classification Catalog* (2002), *high-tech* industries mainly include the electronic and communication equipment manufacturing industry, computer industry, office equipment manufacturing industry, pharmaceutical industry, medical equipment manufacturing industry, and new material industry. All other industries belong to low-tech industries.

c: *Area* dummies are *East*, *Middle*, and *West*. East includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi, and Hainan. Middle includes Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan. West includes Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Ningxia, Qinghai, and Xinjiang.

Robust standard errors clustered at provincial level are in parentheses. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Table 8 Effects of sudden loss of political connections on private firms' market value: Event Study

*CAR*s / Event Window	Panel A: government official independent director		
	Treatment	Control	Difference
CAR(-1, 0)	-0.0027	-0.0015	-0.0012
CAR(-1, 1)	-0.0086	-0.0007	-0.0079**
CAR(-1, 2)	-0.0093	0.0010	-0.0103***
CAR(-1, 5)	-0.0105	0.0014	-0.0119***
CAR(-1, 10)	-0.0128	0.0019	-0.0147***
Number of Observations	91	304	395

*CAR*s / Event Window	Panel B: academic elite independent director		
	Treatment	Control	Difference
CAR(-1, 0)	0.0014	0.0016	-0.0002
CAR(-1, 1)	-0.0018	-0.0005	-0.0013
CAR(-1, 2)	-0.0032	-0.0013	-0.0019**
CAR(-1, 5)	-0.0039	0.0009	-0.0048*
CAR(-1, 10)	-0.0054	0.0011	-0.0065**
Number of Observations	53	198	251

*CAR*s / Event Window	Panel C: business elite independent director		
	Treatment	Control	Difference
CAR(-1, 0)	-0.0013	0.0014	-0.0027
CAR(-1, 1)	-0.0025	0.0009	-0.0034
CAR(-1, 2)	-0.0046	-0.0005	-0.0041
CAR(-1, 5)	-0.0076	-0.0012	-0.0064**
CAR(-1, 10)	-0.0087	-0.0015	-0.0072***
Number of Observations	86	352	438

Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Table 9 Politician- and province-specific factors affecting the market value of private firms: *CAR*(-1, 10)

Politician- and province-specific factors	Panel A: government official independent director			Panel B: academic elite and business elite independent director		
	Treatment	Control	Difference	Treatment	Control	Difference
ADMINI = 1	-0.0156	0.0023	-0.0179***			
ADMINI = 0	-0.0076	0.0014	-0.0090*			
	Difference in differences		-0.0089***			
INFLU = 1	-0.0151	0.0031	-0.0182**	-0.0068	0.0002	-0.0070**
INFLU = 0	-0.0079	-0.0017	-0.0062***	-0.0086	-0.0019	-0.0067***
	Difference in differences		-0.0120***	Difference in differences		-0.0003
MARKET = 1	-0.0173	0.0016	-0.0189***	-0.0065	-0.0004	-0.0061**
MARKET = 0	-0.0051	0.0022	-0.0073***	-0.0083	-0.0007	-0.0076**
	Difference in differences		-0.0116**	Difference in differences		0.0015
EXPERIENCE = 1	-0.0135	0.0023	-0.0158***	-0.0073	0.0025	-0.0098***
EXPERIENCE = 0	-0.0124	0.0018	-0.0142***	-0.0075	-0.0021	-0.0054*
	Difference in differences		-0.0016	Difference in differences		-0.0044***
MEETING = 1	-0.0126	0.0018	-0.0144***	-0.0067	-0.0011	-0.0056**
MEETING = 0	-0.0129	0.0021	-0.0150***	-0.0095	-0.0007	-0.0088***
	Difference in differences		0.0006	Difference in differences		0.0032**

ADMINI takes a value of one if the administrative level of a government official independent director is above bureau level (e.g., state level or provincial and ministerial level). *INFLU* takes a value of one if the deceased government official independent director once worked in the province where the private firm is located. *MARKET* takes a value of one if the private firm is located in the middle or western part of China. *EXPERIENCE* takes a value of one if the retired government official held business-related jobs before hired as independent directors. *MEETING* takes a value of one if the retired government official was absent at least 50% of board meetings during his or her tenure as independent director. In Panel B, the definitions of these five variables are very similar except that we replace government official independent director with academic elite or business elite independent director. In China, academic elites and business elites do not have administrative levels. So we are unable to divide these two types of independent directors according to administrative levels and calculate *CAR*s. As for academic elite and business elite independent directors, we merge these two samples into one in order to increase the sample size. Moreover, as for academic elite and business elite independent directors, the definitions of those four politician- and province-specific factors are similar to that of government official independent directors. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Table 10 Effects of sudden loss of political connections on private firms' market value: Robustness checks

Panel A: Using another standard to construct the control group									
Event windows	Government official independent director			Academic elite independent director			Business elite independent director		
	Treatment	Control	Difference	Treatment	Control	Difference	Treatment	Control	Difference
CAR(-1, 2)	-0.0093	0.0015	-0.0108**	-0.0032	-0.0009	-0.0023	-0.0046	-0.0009	-0.0037*
CAR(-1, 5)	-0.0105	0.0018	-0.0123***	-0.0039	0.0005	-0.0044**	-0.0076	0.0002	-0.0078*
CAR(-1, 10)	-0.0128	0.0027	-0.0155***	-0.0054	0.0016	-0.0070***	-0.0087	0.0008	-0.0095**
Observations	91	336	427	53	168	221	86	155	241

Panel B: Using "pure" private firms as sample									
Event windows	Government official independent director			Academic elite independent director			Business elite independent director		
	Treatment	Control	Difference	Treatment	Control	Difference	Treatment	Control	Difference
CAR(-1, 2)	-0.0089	0.0012	-0.0101***	-0.0035	-0.0011	-0.0024**	-0.0042	-0.0007	-0.0035
CAR(-1, 5)	-0.0107	0.0016	-0.0123***	-0.0042	0.0007	-0.0049*	-0.0071	-0.0009	-0.0062**
CAR(-1, 10)	-0.0116	0.0023	-0.0139***	-0.0055	0.0018	-0.0073**	-0.0083	-0.0014	-0.0069***
Observations	85	282	367	49	184	233	83	341	424

Panel C: Excluding firms with important corporate events surrounding the sudden deaths									
Event windows	Government official independent director			Academic elite independent director			Business elite independent director		
	Treatment	Control	Difference	Treatment	Control	Difference	Treatment	Control	Difference
CAR(-1, 2)	-0.0091	0.0014	-0.0105***	-0.0032	-0.0013	-0.0019**	-0.0047	-0.0005	-0.0042
CAR(-1, 5)	-0.0102	0.0018	-0.0120***	-0.0039	0.0009	-0.0048*	-0.0076	-0.0011	-0.0065**
CAR(-1, 10)	-0.0127	0.0019	-0.0146***	-0.0054	0.0011	-0.0065**	-0.0085	-0.0014	-0.0071***
Observations	89	296	385	53	198	251	84	342	426

Panel D: Restricting the sample to independent directors who are 70 or below at the time of death									
Event windows	Government official independent director			Academic elite independent director			Business elite independent director		
	Treatment	Control	Difference	Treatment	Control	Difference	Treatment	Control	Difference
CAR(-1, 2)	-0.0097	0.0011	-0.0108***	-0.0032	-0.0012	-0.0020**	-0.0049	-0.0005	-0.0044
CAR(-1, 5)	-0.0106	0.0014	-0.0120***	-0.0039	0.0009	-0.0048*	-0.0077	-0.0011	-0.0066**
CAR(-1, 10)	-0.0133	0.0017	-0.0150***	-0.0053	0.0011	-0.0064**	-0.0087	-0.0015	-0.0072***
Observations	82	271	353	52	194	246	83	344	427

Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Table 11 How the sudden loss of political connections affects the economic benefits obtained by private firms

Variables	*Loanrate*			*ETR*			*Subsidy*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Polcon	-0.0171***	-0.0167**	-0.0162***	0.0182***	0.0164***	0.0159**	-0.0148*	-0.0144*	-0.0132
	(0.0052)	(0.0083)	(0.0035)	(0.0051)	(0.0043)	(0.0062)	(0.0083)	(0.0076)	(0.0089)
Quarter	-0.0124*	-0.0121	-0.0120	0.0085	0.0082	0.0073*	-0.0041*	-0.0037	-0.0035
	(0.0073)	(0.0118)	(0.0081)	(0.0091)	(0.0074)	(0.0040)	(0.0025)	(0.0029)	(0.0030)
Polcon	-0.0140**	-0.0138***	-0.0134***	0.0098*	0.0093***	0.0086**	-0.0156***	-0.0153***	-0.0149***
×*Quarter*	(0.0067)	(0.0052)	(0.0045)	(0.0052)	(0.0032)	(0.0037)	(0.0044)	(0.0041)	(0.0052)
Lasset		0.0551***	0.0462***		-0.0703	-0.0651		0.0564***	0.0512***
		(0.0207)	(0.0135)		(0.0696)	(0.0427)		(0.0121)	(0.0145)
Listage		0.0008	-0.0005		-0.0013	-0.0015		0.0019	0.0017
		(0.0009)	(0.0004)		(0.0011)	(0.0010)		(0.0018)	(0.0024)
Cashflow		0.0516	0.0488		0.0615	0.0608		-0.0579	-0.0562
		(0.0391)	(0.0325)		(0.0449)	(0.0492)		(0.0418)	(0.0473)
*HHI*5		-0.0702	-0.0628		-0.0824	-0.0793		0.0754	0.0731
		(0.0596)	(0.0537)		(0.0661)	(0.0702)		(0.0642)	(0.0698)
Experience			0.0121**			-0.0056**			0.0064**
			(0.0057)			(0.0023)			(0.0027)
PC			0.0114***			-0.0038***			0.0047***
			(0.0035)			(0.0013)			(0.0016)
Academia			0.0126*			-0.0040**			0.0032
			(0.0068)			(0.0019)			(0.0028)
Business			0.0129**			-0.0052***			0.0035**
			(0.0051)			(0.0017)			(0.0017)
Industry	YES	YES	YES	YES	YES	YES	YES	YES	YES
Region	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES	YES	YES	YES
Obs.	4196	4196	4196	4196	4196	4196	4196	4196	4196

Robust standard errors clustered at provincial level are in parentheses. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Table 12 Heterogeneous effects of political connections on the economic benefits obtained by private firms

Variables	Different administrative levels			Within the jurisdiction			Different degrees of marketization		
	Loanrate	*ETR*	*Subsidy*	*Loanrate*	*ETR*	*Subsidy*	*Loanrate*	*ETR*	*Subsidy*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Polcon×*Quarter*	-0.0121***	0.0063**	-0.0115***	-0.0126***	0.0074**	-0.0128***	-0.0118***	0.0061*	-0.0104**
	(0.0037)	(0.0025)	(0.0034)	(0.0048)	(0.0031)	(0.0039)	(0.0025)	(0.0037)	(0.0053)
Polcon×*Quarter* ×*ADMINI*	-0.0018**	0.0024**	-0.0052***						
	(0.0009)	(0.0011)	(0.00016)						
Polcon×*Quarter* ×*INFLU*				-0.0016***	0.0019***	-0.0041***			
				(0.0004)	(0.0006)	(0.0012)			
Polcon×*Quarter* ×*MARKET*							-0.0029**	0.0035***	-0.0072***
							(0.0013)	(0.0009)	(0.0024)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	4196	4196	4196	4196	4196	4196	4196	4196	4196

ADMINI takes a value of one if the administrative level of a government official independent director is above bureau level (e.g., state level or provincial and ministerial level), and zero otherwise. *INFLU* takes a value of one if the deceased government official independent director once worked in the province where the private firm is located, and zero otherwise. *MARKET* takes a value of one if the private firm is located in the middle or western part of China, and zero otherwise. Control variables not only include ***X*** but also include *Polcon*, *Quarter*, *ADMINI* (*INFLU* or *MARKET*), *Polcon*×*ADMINI* (*Polcon*×*INFLU* or *Polcon*×*MARKET*), and *Quarter*×*ADMINI* (*Quarter*×*INFLU* or *Quarter*×*MARKET*). We omit reporting of the coefficients of control variables for brevity. Robust standard errors clustered at provincial level are in parentheses. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Table 13 How academic elites or business elites affect the economic benefits obtained by private firms

Panel A: Academic elite independent director

Variables	*Loanrate*			*ETR*			*Subsidy*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Professor ×*Quarter*	-0.0142	-0.0138	-0.0131	0.0076	0.0080	0.0072	-0.0121	-0.0113	-0.0101
	(0.0095)	(0.0127)	(0.0119)	(0.0054)	(0.0065)	(0.0049)	(0.0087)	(0.0095)	(0.0073)
Control variables	Partial [a]	Partial [b]	All	Partial	Partial	All	Partial	Partial	All
Observations	2708	2708	2708	2708	2708	2708	2708	2708	2708

Panel B: Business elite independent director

Variables	*Loanrate*			*ETR*			*Subsidy*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CEO×*Quarter*	-0.0127	-0.0126	-0.0123	0.0095	0.0087	0.0084	-0.0110	-0.0106	-0.0097
	(0.0132)	(0.0114)	(0.0075)	(0.0077)	(0.0060)	(0.0063)	(0.0099)	(0.0071)	(0.0084)
Control variables	Partial [a]	Partial [b]	All	Partial	Partial	All	Partial	Partial	All
Observations	4610	4610	4610	4610	4610	4610	4610	4610	4610

a. Control variables only include *Polcon*, *Quarter*, *Industry*, *Region* and *Year*.

b. Control variables only include *Polcon*, *Quarter*, *Lasset*, *Listage*, *Cashflow*, *HHI5*, *Industry*, *Region* and *Year*.

We omit reporting of the coefficients of control variables for brevity. Robust standard errors clustered at provincial level are in parentheses. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Table 14 Effects of sudden deaths of independent directors on the economic benefits: Robustness checks

Panel A: Using another standard to construct the control group									
Variables	Government official independent director			Academic elite independent director			Business elite independent director		
	Loanrate	*ETR*	*Subsidy*	*Loanrate*	*ETR*	*Subsidy*	*Loanrate*	*ETR*	*Subsidy*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Polcon ×*Quarter*	-0.0141**	0.0098***	-0.0156***	-0.0137	0.0064	-0.0115*	-0.0128*	0.0086	-0.0102**
	(0.0057)	(0.0032)	(0.0049)	(0.0098)	(0.0069)	(0.0063)	(0.0075)	(0.0083)	(0.0045)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	4638	4638	4638	2374	2374	2374	2518	2518	2518

Panel B: Ruling out the effects of education and work experience (government official independent director)									
Variables	Educational level < Bachelor [a]			No relevant work experience [b]			Low educational level and no relevant work experience [c]		
	Loanrate	*ETR*	*Subsidy*	*Loanrate*	*ETR*	*Subsidy*	*Loanrate*	*ETR*	*Subsidy*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Polcon× *Quarter*	-0.0126***	0.0078*	-0.0138***	-0.0129**	0.0085**	-0.0126***	-0.0121*	0.0074**	-0.0117***
	(0.0029)	(0.0046)	(0.0035)	(0.0064)	(0.0039)	(0.0042)	(0.0071)	(0.0036)	(0.0029)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3250	3250	3250	2437	2437	2437	2163	2163	2163

Panel C: Using "pure" private firms as sample									
Variables	Government official independent director			Academic elite independent director			Business elite independent director		
	Loanrate	*ETR*	*Subsidy*	*Loanrate*	*ETR*	*Subsidy*	*Loanrate*	*ETR*	*Subsidy*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Polcon× *Quarter*	-0.0135**	0.0082**	-0.0144***	-0.0095**	0.0076	-0.0089	-0.0088	0.0072	-0.0094
	(0.0058)	(0.0040)	(0.0051)	(0.0042)	(0.0061)	(0.0070)	(0.0063)	(0.0064)	(0.0078)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3461	3461	3461	2315	2315	2315	3902	3902	3902

a. We exclude those government official independent directors who received higher education and above.

b. We exclude those government official independent directors who had relevant work experience.

c. We exclude those government official independent directors who received higher education and above or had relevant work experience.

We omit reporting of the coefficients of control variables for brevity. Robust standard errors clustered at provincial level are in parentheses. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Table 15 Number of private firms which successfully hired another retired government official after the loss of political connections

Panel A: Government official independent directors who suddenly died

Year	Number of sudden deaths	First year	Second year	Third year	Fourth year	Fifth year	Sixth year
2003	3	0	0	0	1	0	0
2004	1	0	0	0	0	0	0
2005	5	0	1	1	2	0	0
2006	8	0	0	1	1	3	1
2007	7	0	1	0	1	2	0
2008	13	0	0	1	3	1	3
2009	10	0	0	1	2	0	
2010	15	0	1	1	1		
2011	12	1	0	1			
2012	17	0	1				
All	91	1	4	6	11	6	4

Panel B: Government official independent directors who died non-suddenly

Year	Number of deaths	First year	Second year	Third year	Fourth year	Fifth year	Sixth year
2003	24	1	2	3	7	5	3
2004	17	2	1	4	5	1	1
2005	32	1	1	6	8	4	6
2006	44	2	2	3	11	3	4
2007	51	1	3	4	6	7	5
2008	63	2	1	4	10	6	8
2009	88	2	2	5	15	9	
2010	94	2	3	6	12		
2011	104	1	4	3			
2012	117	1	2				
All	634	15	21	38	74	35	27

Because the annual reports of listed firms are usually issued at the end of the year, we are unable to identify whether private firms hire another retired government official in 2015 and the following years.

Table 16 Number of private firms which successfully hired another academic elite or business elite after their former academic elite or business elite independent directors suddenly died

Panel A: Academic elite independent director

Year	Number of sudden deaths	First year	Second year	Third year	Fourth year	Fifth year	Sixth year
2003	2	1	0	0	1	0	0
2004	3	0	2	1	0	0	0
2005	7	3	1	1	0	0	1
2006	5	1	1	2	0	1	0
2007	8	0	4	2	1	0	0
2008	3	1	0	0	0	1	0
2009	6	2	2	1	0	0	
2010	9	3	2	1	1		
2011	4	1	2	0			
2012	6	1	3				
All	53	13	17	8	3	2	1

Panel B: Business elite independent director

Year	Number of deaths	First year	Second year	Third year	Fourth year	Fifth year	Sixth year
2003	4	1	2	1	0	0	0
2004	6	2	1	2	1	0	0
2005	8	1	3	2	0	1	0
2006	12	3	2	2	2	1	0
2007	7	1	1	3	0	0	1
2008	9	4	2	1	0	1	0
2009	11	2	4	3	0	0	
2010	8	2	0	4	1		
2011	7	4	2	0			
2012	14	3	5				
All	86	23	22	18	4	3	1

Because the annual reports of listed firms are usually issued at the end of the year, we are unable to identify whether private firms hire another retired government official in 2015 and the following years.

Table 17 Number of private firms whose CEOs or senior executives are successfully elected as PC or CPPCC members after the loss of political connections

Panel A: Government official independent directors who suddenly died

Year	Number of sudden deaths	First year	Second year	Third year	Fourth year	Fifth year	Sixth year
2003	3	0	0	0	0	0	0
2004	1	0	0	1	0	0	0
2005	5	0	1	0	0	0	0
2006	8	0	0	0	0	0	1
2007	7	0	0	0	0	0	0
2008	13	0	0	0	1	0	0
2009	10	0	0	2	0	0	
2010	15	0	0	0	0		
2011	12	1	0	0			
2012	17	0	0				
All	91	1	1	3	1	0	1

Panel B: Government official independent directors who died non-suddenly

Year	Number of deaths	First year	Second year	Third year	Fourth year	Fifth year	Sixth year
2003	24	0	0	0	3	0	0
2004	17	0	0	2	0	0	0
2005	32	0	2	0	0	0	0
2006	44	4	0	0	0	0	6
2007	51	0	0	0	0	3	0
2008	63	0	0	0	5	0	0
2009	88	0	0	9	0	0	
2010	94	0	6	0	0		
2011	104	3	0	0			
2012	117	0	0				
All	634	7	8	11	8	3	6

Because the general election is held every five years (2002, 2007 and 2012), no CEOs or senior executives could be elected as PC deputies or CPPCC members during non-election years. That is why many blanks are filled in with zeroes. Because the annual reports of listed firms are usually issued at the end of the year, we are unable to obtain the information about political status in 2015 and the following years.

Table 18 Effects of losing political connections on private firms' capacity accumulation

Panel A: Effects of losing political connections on private firms' investments during the research period (-8, 8) [a]						
Variables	*Capital*			*R&D*		
	(1)	(2)	(3)	(4)	(5)	(6)
Polcon×Quarter	0.0049	0.0047	0.0038	-0.0025	-0.0028	-0.0021
	(0.0034)	(0.0050)	(0.0027)	(0.0019)	(0.0032)	(0.0016)
Control variables	Partial [b]	Partial [c]	All	Partial	Partial	All
Observations	4196	4196	4196	4196	4196	4196

Panel B: Effects of losing political connections on private firms' investments during the research period (-8, 12)						
Variables	*Capital*			*R&D*		
	(1)	(2)	(3)	(4)	(5)	(6)
Polcon×Quarter	0.0072***	0.0069**	0.0063***	0.0022*	0.0017***	0.0015**
	(0.0025)	(0.0030)	(0.0018)	(0.0012)	(0.0004)	(0.0006)
Control variables	Partial [b]	Partial [c]	All	Partial	Partial	All
Observations	5274	5274	5274	5274	5274	5274

Panel C: Effects of losing political connections on private firms' competitive advantage						
Variables	*ROA*			*Profitability*		
	(-8, 8)	(-8, 10)	(-8, 12) [d]	(-8, 8)	(-8, 10)	(-8, 12)
	(1)	(2)	(3)	(4)	(5)	(6)
Polcon×Quarter	-0.0062***	-0.0054***	-0.0029***	-0.0098***	-0.0073**	-0.0042***
	(0.0021)	(0.0019)	(0.0011)	(0.0026)	(0.0034)	(0.0015)
Control variables	All	All	All	All	All	All
Observations	4196	4852	5274	4196	4852	5274

a. Research period (-8, 8) represents eight quarters before and after the sudden death.

b. Control variables only include *Polcon*, *Quarter*, *Industry*, *Region* and *Year*.

c. Control variables only include *Polcon*, *Quarter*, *Lasset*, *Listage*, *Cashflow*, *HHI5*, *Industry*, *Region* and *Year*.

d. If the private firm hired another retired government official or its senior executives were being elected as PC or CPPCC members at time t ($0 < t \leq 12$) after the loss of political connections, then the research period becomes (-8, t - 1).

We omit reporting of the coefficients of control variables for brevity. Robust standard errors clustered at provincial level are in parentheses. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Table 19 Effects of losing academic elites or business elites on private firms' capacity accumulation

Panel A: Effects of losing academic elites or business elites on private firms' investments								
Variables	Academic elite independent director				Business elite independent director			
	Capital		*R&D*		*Capital*		*R&D*	
	(-8, 8) [a]	(-8, 12) [b]	(-8, 8)	(-8, 12)	(-8, 8)	(-8, 12)	(-8, 8)	(-8, 12)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Professor× *Quarter*	0.0049	0.0032	-0.0024	-0.0045*				
	(0.0043)	(0.0027)	(0.0019)	(0.0026)				
CEO×*Quarter*					0.0054	0.0067*	-0.0029	-0.0036
					(0.0038)	(0.0035)	(0.0022)	(0.0031)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
Observations	2708	3469	2708	3469	4610	5894	4610	5894

Panel B: Effects of losing academic elites or business elites on private firms' competitive advantage								
Variables	Academic elite independent director				Business elite independent director			
	ROA		*Profitability*		*ROA*		*Profitability*	
	(-8, 8)	(-8, 12)	(-8, 8)	(-8, 12)	(-8, 8)	(-8, 12)	(-8, 8)	(-8, 12)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Professor× *Quarter*	-0.0016**	-0.0014***	-0.0029**	-0.0023**				
	(0.0007)	(0.0005)	(0.0014)	(0.0010)				
CEO×*Quarter*					-0.0021**	-0.0025**	-0.0036***	-0.0038**
					(0.0009)	(0.0012)	(0.0011)	(0.0017)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
Observations	2708	3469	2708	3469	4610	5894	4610	5894

a. Research period (-8, 8) represents eight quarters before and after the sudden death.

b. If the private firm hired another academic elites or business elite at time t ($0 < t \leq 12$) after the loss of the former academic elite or business elite independent director, then the research period becomes (-8, t - 1).

We omit reporting of the coefficients of control variables for brevity. Robust standard errors clustered at provincial level are in parentheses. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Table 20 Effects of losing political connections on private firms' capacity accumulation: Robustness checks

Panel A: Using another standard to construct the control group								
	Capital		*R&D*		*ROA*		*Profitability*	
Variables	(-8, 8) [a]	(-8, 12)	(-8, 8)	(-8, 12)	(-8, 8)	(-8, 12)	(-8, 8)	(-8, 12)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Polcon×Quarter	0.0051*	0.0072***	-0.0016	0.0022***	-0.0047***	-0.0026**	-0.0082***	-0.0061***
	(0.0030)	(0.0028)	(0.0013)	(0.0007)	(0.0015)	(0.0011)	(0.0024)	(0.0019)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
Observations	4638	5821	4638	5821	4638	5821	4638	5821

Panel B: Ruling out the effects of education and work experience [b]								
	Capital		*R&D*		*ROA*		*Profitability*	
Variables	(-8, 8)	(-8, 12)	(-8, 8)	(-8, 12)	(-8, 8)	(-8, 12)	(-8, 8)	(-8, 12)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Polcon×Quarter	0.0042	0.0056**	0.0011	0.0035**	-0.0032**	-0.0020**	-0.0054**	-0.0048***
	(0.0037)	(0.0024)	(0.0009)	(0.0016)	(0.0013)	(0.0008)	(0.0022)	(0.0017)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
Observations	2163	2988	2163	2988	2163	2988	2163	2988

Panel C: Using "pure" private firms as sample								
	Capital		*R&D*		*ROA*		*Profitability*	
Variables	(-8, 8)	(-8, 12)	(-8, 8)	(-8, 12)	(-8, 8)	(-8, 12)	(-8, 8)	(-8, 12)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Polcon×Quarter	0.0046	0.0069**	-0.0015	0.0028*	-0.0038***	-0.0027*	-0.0065**	-0.0052*
	(0.0031)	(0.0035)	(0.0014)	(0.0017)	(0.0012)	(0.0016)	(0.0030)	(0.0027)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3461	4438	3461	4438	3461	4438	3461	4438

a. (-8, 8) represents eight quarters before and after the sudden death.

b. We exclude those government official independent directors who received higher education and above or had relevant work experience.

We omit reporting of the coefficients of control variables for brevity. Robust standard errors clustered at provincial level are in parentheses. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Appendices

A1: An example of the sample matching method

Jiangsu HEILAN Group Co., Ltd. is a listed private firm in the textile industry (stock code 600398). It hired Xiaoyong Sun as an independent director on July 18th, 2003. He served as deputy mayor of Jiangyin city from 1990 to 1998. Unfortunately, he died of a heart attack on January 30th, 2007. According to his obituary, he died within half an hour after he suffered the heart attack. So HEILAN Group can be regarded as a treated firm. The first quarter of 2007 is redefined as time 0.

Now, we construct the control group and match it with the treatment group. According to the selection criteria, an untreated firm is one whose government official independent director who was alive at time 0 and operates in the same industry and geographical region as the treated firm but in a different province from the treated firm.

Step 1: Since HEILAN Group operates in the textile industry, we find all private listed firms that operate in this industry. As shown in Table A1, there are 18 private listed firms in the textile industry.

Step 2: Exclude private listed firms that are located at the same province as HEILAN Group or in a different geographical region. HEILAN Group is located in Jiangsu province which belongs to Eastern China (Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, and Shandong). We have 11 private listed firms left.

Step 3: Exclude private listed firms that didn't hire government official independent director during the pre-treatment period (-8, 0). Since the sudden death occurred in the first quarter of 2007, the research period is (first quarter of 2005, first quarter of 2007). We have 6 private listed firms left.

Step 4: Exclude private listed firms whose government official independent director died before and at the time 0 (the first quarter of 2007). We have 4 private listed firms left. They are Shandong Luthai Textile Co., Ltd., Shandong Huafang Co., Ltd., Fujian Fynex Textile Science & Technology Co., Ltd., and Shanghai Dragon Co., Ltd. We use these four untreated firms as a control group for HEILAN Group.

In the robustness check, we use another criterion to identify the control group. That is, an untreated firm is one without a government official independent director during the pre-treatment period (-8, 0) and operates in the same industry and geographical region as the treated firm but in a different province from the treated firm. As shown in Table A1, there are 5 private listed firms which meet this selection criterion. They are Semir Group Co., Ltd., Ningbo Veken Group Co., Ltd., Youngor Group Co., Ltd., Fujian Nanfang Textile Co., Ltd., and Wensli Group Co., Ltd. We use them as a control group for HEILAN Group. In this matching method, if an untreated firm hired a retired government official at time t ($0 < t \leq 8$), then the research period becomes (-8, t - 1).

Table A1 An example of the sample matching method

Firm's name	Province	Stock code	Same region but different province [a]	Did it hire retired government official during the period (-8, 0)? [b]	Was he or she alive before and at time 0?	Is it chosen as untreated firm? [c]
HEILAN Group Co., Ltd.	Jiangsu	600398	Sudden death occurred at the first quarter of 2007 (time $t = 0$)			
LUTHAI Textile Co., Ltd.	Shandong	000726	YES	YES	YES	YES
TIANSHAN Wool Tex Stock Co., Ltd.	Xinjiang	000813	NO	——	——	——
LANDING Holding Co., Ltd.	Hubei	000971	NO	——	——	——
ZHONGYIN Textile Co., Ltd.	Ningxia	000982	NO	——	——	——
SEMIR Group Co., Ltd.	Zhejiang	002563	YES	NO	——	——
FURUN Co., Ltd.	Zhejiang	600070	YES	YES	NO	——
VEKEN Group Co., Ltd.	Zhejiang	600152	YES	NO	——	——
YOUNGOR Group Co., Ltd.	Zhejiang	600177	YES	NO	——	——
SUNSHINE Co., Ltd.	Jiangsu	600220	NO	——	——	——
HUAFANG Textile Co., Ltd.	Jiangsu	600273	NO	——	——	——
CHINA EASTERN SILK MARKET Co., Ltd.	Jiangsu	000301	NO	——	——	——
HODO Group Co., Ltd.	Jiangsu	600400	NO	——	——	——
HUAFANG Co., Ltd.	Shandong	600448	YES	YES	YES	YES
NANFANG Textile Co., Ltd.	Fujian	600483	YES	NO	——	——
FYNEX Textile Science & Technology Co., Ltd.	Fujian	600493	YES	YES	YES	YES
WENSLI Group Co., Ltd.	Zhejiang	600617	YES	NO	——	——
DRAGON Co., Ltd.	Shanghai	600630	YES	YES	YES	YES
SANDING Holding Group Co., Ltd.	Zhejiang	601113	YES	YES	NO	——

a: Jiangsu province is located in the Eastern China (Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, and Shandong).

b: If an untreated firm hired a retired government official at time t ($-8 \leq t < 0$), then the research period becomes $(-t + 1, 8)$.

c: For an untreated firm, its government official independent director might die during the post-treatment period. If the government official independent director of an untreated firm died at time t ($0 < t \leq 8$), then the research period becomes $(-8, t - 1)$.

Abstract

Does the expansion of Chinese state-owned enterprises affect the innovative behavior of private enterprises?

by

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Using Chinese Industrial Enterprises Database and Patent Application Database from 2004 to 2007, we found that the expansion of state-owned enterprises (SOEs) negatively affected innovation by private enterprises. We further distinguished the SOEs along two dimensions: holding type and affiliation type. Based on the first dimension, we divided the SOEs into absolutely controlled SOEs (ASOEs) and relatively controlled SOEs (RSOEs). Based on the second dimension, we divided the SOEs into those belonging to higher-level governments (central or provincial) (HSOEs) and those belonging to lower-level governments, such as municipal governments (LSOEs). We found that only RSOEs and LSOEs expanded rapidly from 2004 to 2007, and that it is the expansion of RSOEs and LSOEs that led to a decrease in innovation by private enterprises. Moreover, we found that the expansion of SOEs increased the average interest rate faced by private enterprises and that the increase in the average interest rate was the primary reason for the decrease in innovation by private enterprises.

1 Background

Since the 1997 Asian financial crisis, the Chinese government has implemented various economic policies to maintain economic development. One important policy was to reform state-owned enterprises (SOEs) to improve their productivity. Specifically, former premier Zhu Rongji put China's money-losing SOEs on a strict three-year schedule, during which they were instructed to implement a "modern enterprise system" and convert losses to surpluses. After the introduction of this new policy, many SOEs entered a period of accelerated reform, and three noticeable quantitative changes occurred during the late 1990s. First, the number of SOEs rapidly declined. Many industrial SOEs were restructured via mergers or acquisitions, conversion of ownership status, or outright liquidation. Although the direct sale of SOEs was largely limited to small enterprises (as reflected in the policy of "grasping the large, letting go of the small"), a substantial number of large and medium-sized SOEs also exited the ranks of state industry. Second, the employment levels within surviving SOEs also declined. By the end of the decade, the policy of furloughs (*xia gang*), introduced in 1996, had led to layoffs of approximately 6 million workers (out of a total of 44 million) in the industrial SOE workforce (Rawski, 2002). Third, other types of enterprises developed rapidly in the late 1990s. The number of ownership classifications expanded from 16 in 1985 to 23 in 1999. According to China's National Bureau of Statistics (CNBS), over 95% of the large and medium-sized enterprises were classified as state-owned in 1985, but this percentage declined to 50.6% in 1999. To sum up, these phenomena can be referred to as "privatization."

However, this trend did not continue for very long. After joining the WTO in 2002, China continued to open up, making the country more susceptible to economic influences from around the world. In order to mitigate worldwide economic fluctuations and maintain China's economic growth, the Chinese government gradually strengthened its control of the economy. In particular, state-owned enterprises, which were used as a tool to maintain economic control by Chinese municipal and provincial governments, expanded rapidly in almost every industry. This expansion was present in many highly competitive industries, from which many private enterprises were eventually forced to withdraw because they were unable to compete financially. Chinese SOEs have grown stronger and more monopolistic ever since.

In this context, this paper attempts to answer the following question: Does the expansion of Chinese state-owned enterprises affect the innovative behavior of private enterprises? This question is extremely important for China's current economic development. China has maintained an average annual economic growth rate of 9.7% since it implemented the "reform and opening-up" policy in 1978. One significant reason is that China has the advantage of cheap labor. This "demographic dividend," as it is often called, has long been considered an important aspect of China's remarkable economic performance. Because of this, China is often referred to as the "world's factory." However, because this "demographic dividend" will gradually disappear in the near future, the Chinese government has been urged to change its developmental strategy from relying on its labor advantage to supporting technological innovation and enhancing the technological content of its products. In other words, China would benefit from a transformation from a "Made in China" economy to an "Innovated in China" economy. Private enterprises driven by profits have a strong incentive to innovate; indeed, private enterprises, not SOEs, are usually referred to as the "engines of innovation." If the expansion of SOEs discourages private enterprises from innovating, then this expansion may have detrimental effects on China's economy. In order

to test this hypothesis, Chinese Industrial Enterprises Database and Patent Application Database was utilized to empirically study the effect of the expansion of SOEs on the innovation of private enterprises.

The rest of this paper is organized as follows. Section 2 provides an overview of the economic literature on the relationship between the expansion of SOEs and the innovative performance of private enterprises. Section 3 describes the research data, while Section 4 presents the main empirical results and several robustness checks. Finally, Section 5 summarizes our conclusions.

2 Literature review

2.1 Whether SOEs expanded rapidly since 2003

In this paper, Chinese enterprises are divided into three subgroups: SOEs, private enterprises, and other kinds of enterprises (See Appendix 1). The main purpose of this paper is to investigate how the innovation strategy of private enterprises changes in response to the expansion of SOEs. In order to determine if the expansion of SOEs affects the innovative behavior of private enterprises, we must first demonstrate that SOEs indeed have expanded rapidly since 2003. From the past literature, there are two conflicting opinions about the expansion of SOEs. Some economists and almost all policymakers in China have maintained that SOEs did not expand rapidly over the last decade (Liu and Wang, 2010; Xiang, 2011). They have stated that SOEs only expanded in a few key industries that are crucial to China's economic safety, and seldom entered into industries dominated by other types of enterprises. They have also held that the expansion of SOEs occurred in these industries in order to facilitate the recovery of China's economy because other types of enterprises did not have incentives to invest during the economic crisis. Ma Jiantang, the commissioner of China's National Bureau of Statistics, pointed out that the number of private enterprises actually increased and the number of SOEs decreased according to the economic census conducted in 2008. Based on these statistics, he did not believe that an expansion of SOEs had occurred over the last decade.

However, other economists and many entrepreneurs of private enterprises have argued that SOEs did expand rapidly in almost every industry, including highly competitive industries dominated by other types of enterprises, which was harmful to the development of private enterprises (Ge, 2010; Deng, 2010). Many SOEs became bigger and stronger by merging with or absorbing private enterprises. Starting with the reform and opening-up policies instituted in 1978, macroeconomic controls led to rapid growth of the state-owned economy and depression of the private economy; SOEs received generous subsidies and loans, but private enterprises were mostly unable to get government subsidies or borrow money from commercial banks at low interest rates. For example, the Chinese central government implemented the "Ten Industries Revitalization Plan" in 2009, whose goal was to help some SOEs to become bigger and stronger through mergers and acquisitions. It even listed specific names of certain SOEs that it planned to support. However, private enterprises received hardly any assistance from this plan.

Therefore, we hypothesize that SOEs began to expand and the economic atmosphere surrounding private enterprises started to deteriorate in 2003. Previous studies have mainly used proportion of sales revenue of SOEs to measure its development. Figure 1 depicts the average proportion of sales revenue of private enterprises and SOEs from 1998 to 2007. As shown in Figure

1, the average proportion of sales revenue of SOEs decreased until 2003, and then it increased rapidly. Although the average proportion of sales revenue of private enterprises also increased, it increased very slowly after 2003. Moreover, the gap in market share between SOEs and private enterprises gradually widened starting in 2003. Therefore, Figure 1 confirms our hypothesis to some extent.

In general, there were four ways in which SOEs expanded and became bigger and stronger. First, because of their significant financial advantages, SOEs extended their scope of business by investing in non-specialized businesses. For example, Grid Corporation invested in power equipment manufacturing, and State Grain Reserves Corporation engaged in food processing. Second, SOEs expanded by merging or absorbing other types of enterprises. The iron and steel industry is a good example. The largest private enterprise in China, Shandong Sunshine Iron and Steel Corporation, was forcibly merged by state-owned Shandong Iron and Steel Group in 2009. The newly established enterprise was a relatively controlled SOE. In another example, the government of Shanxi province integrated and closed many small private coal enterprises in 2010 in order to improve working conditions and safety. Third, SOEs expanded through unfair market competition or administrative licensing. Chinese central or local governments often conducted procurement or investment in infrastructure through bidding. Large SOEs usually got access to government procurement or good investment projects because they had capital and human resource advantages, as well as good credit. Moreover, many industries (e.g., telecommunications) had strict market access policies, and only SOEs could enter into these industries. Fourth, many SOEs gained extensive financial support from the government. For example, the government heavily subsidized state-owned Eastern Airlines, which had suffered massive losses, but refused to help privately-owned East Star Airlines in 2008. In the end, Eastern Airlines survived and East Star Airlines went bankrupt. As mentioned previously, the "Ten Industries Revitalization Plan" in 2009 subsidized numerous SOEs but very few private enterprises. To sum up, SOEs increased in size and scope through a variety of ways, and the expansion of SOEs since 2003 was a real economic phenomenon.

2.2 Expansion of SOEs and innovation of private enterprises

Considering this economic fact that SOEs expanded rapidly since 2003, the paper attempts to answer the following question: How does the expansion of SOEs affect the innovative performance of private enterprises? From the past literature, only a few researchers directly studied the relationship between the expansion of SOEs and private enterprises' innovation (Ge, 2010; Deng, 2010). They pointed out that the expansion of SOEs was harmful to the innovative performance of private enterprises because the economic environments in which private enterprises operate deteriorated rapidly since 2003. Most researchers mainly focused on how the economic atmosphere faced by private enterprises deteriorated when state sector expanded rapidly. They studied this question from the following three aspects. Firstly, some researchers found that it became much more difficult for private enterprises to obtain loan from state-owned banks after state sector expanded rapidly (Khwaja and Mian, 2005; Li *et al*., 2006). Chinese government usually possesses monopolistic control over input and product markets. One of the most important resources, credit, is tightly controlled by state-owned banks. In order to strengthen their control of the economy and maintain economic growth after 2003, Chinese governments implemented various policies to support the development of SOEs. One of the important policies is to make

loans to SOEs at low interest rate. Li *et al*. (2006) also found that private enterprises face complex bureaucratic procedures and strict mortgage conditions when borrowing money from state-owned banks.

Figure 2 depicts the average interest rate available to private enterprises and SOEs. As illustrated in Figure 2, the average interest rate available to private enterprises increased starting in 2003. The possible reason is that a large proportion of the banks' loanable funds was lent to SOEs as they expanded rapidly. Since the loanable funds in the banks were limited, the average interest rate at which private enterprises received bank loans increased. In addition, Figure 2 shows the average interest rate faced by private enterprises was much higher than that of SOEs every year from 1998 to 2007. In summary, the financing environment became progressively worse for private enterprises because of the expansion of SOEs.

Secondly, the profit rates earned by private enterprises might decrease if SOEs extended their scope of business and compete with them directly (Lin *et al*., 1998; Fan *et al*., 2007). Lin *et al*. (1998) pointed out that if private enterprises are forced to compete with SOEs which have financial support from the government, this could certainly be construed as unfair competition. Figure 3 depicts the average profit rate earned by private enterprises and SOEs. From Figure 3, we can see that the average profit rate earned by private enterprises indeed decreased since 2003. That means, the expansion of SOEs may have a negative effect on the profitability of private enterprises. On the contrary, as seen in Figure 3, the average profit rate earned by SOEs increased since 2003 because of their expansion. In addition, the average profit rate earned by SOEs was much higher than that of private enterprises, which to some extent reflects the fact that the SOEs have many advantages, such as monopoly status in some industries, and can get substantial support from governments. As discussed before, sales profit is one of important financial resources for innovation. Therefore, the decrease in profit rates must have detrimental effect on the innovative behavior of private enterprises.

Lastly, private enterprises hardly received any government support or subsidies especially during the expansion of SOEs since 2003. In China, financial resources are scarce and governments are unable to support all kinds of firms. Since SOEs are in a close relationship with governments and regarded as financial tools that government relies on to control the economy, they are favored by governments and can receive huge amount of subsidies (Faccio, 2006; Afsal, 2007). Under these circumstances, private enterprises are put at a serious disadvantage and unable to receive enough subsidies to invest in innovation. As mentioned previously, the "Ten Industries Revitalization Plan" in 2009 subsidized numerous SOEs but very few private enterprises. Under these circumstances, private enterprises might be unable to raise enough money to conduct economic activities like innovation. To sum up, the expansion of SOEs could be seen as having a negative effect on the innovation of private enterprises in China.

The expansion of SOEs, however, also might lead to an increase in innovation of private enterprises. For example, if private enterprises were able to anticipate a rise in the market share of SOEs, they could apply preemptively for patents in order to protect as many existing processes, products, and techniques as possible. Alternatively, they could direct more resources toward new innovative activities in order to diversify their operations and protect their market share, or increase their market share in adjacent sectors.

This paper wants to examine the expansion of SOEs and its effects on the innovation of private enterprises. As shown in Table 1, no matter what index we use to measure innovative performance, private enterprises usually have more innovative input and output than that of SOEs especially for medium-sized and small enterprises. Compared to SOEs, therefore, private enterprises are the real engines of innovation. If the expansion of SOEs discourages private enterprises from innovating, then it may have detrimental effects on China's economic transition. In this paper, I will empirically study the effects of the expansion of SOEs on the innovation of private enterprises and further investigate the specific reasons why private enterprises may have reduced their innovative activities under the expansion of SOEs using Chinese Industrial Enterprises Database and Patent Application Database.

3 Data description and model specification

3.1 Dataset

The data I use in this paper comes from two sources. This first source is Chinese Industrial Enterprises Database which originally contains 2,228,727 Chinese industrial enterprises whose annual sales revenues were greater than 5,000,000 RMB from 1998 to 2007. It includes 41 industries from 31 different provinces in China, and it is an unbalanced panel dataset. The second source is Chinese Patent Application Database from China's State Intellectual Property Office (SIPO). It provides a rich description of patent application that have been filed at SIPO since 1985, when China formally instituted its patent law. The application data provides useful information on firms' patenting behavior and regional/industrial level patenting activity.

Following Cao *et al*. (2012) and He *et al*. (2013), I merge these two databases using firm's name and other firm's information such as firm's address.[1] After merging these two databases and deleting enterprises with abnormal or extreme values, I get a sample of 2,212,472 observations from 1998 to 2007. It contains all types of enterprises (See Appendix 1). In this paper, we only uses private enterprises from 2004 to 2007 to investigate the effects of the expansion of SOEs on the innovative behavior of private enterprises. So the final sample contains 434,624 private enterprises.[2] It should be noted that we use all of observations (including SOEs and other types of enterprises) in each year when we calculate some variables such as *SHARE*. Using the number of patent application for each private enterprise, now I can investigate the effects of the expansion of SOEs on the innovation of private enterprises.

3.2 Model specification

The following model is estimated:

$$INNOV_{it} = \alpha + \gamma SHARE_{it\text{-}1} + \beta X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

[1] He *et al*. arranged Chinese Patent Database which collects the number of patent application and patent authorization of all private listed firms and their subsidiaries during the period from 1990 to 2010. They provide me with a reliable and useful method to arrange and merge Chinese patent database.

[2] Number of observation in the regression results may be from 434624 because we use lag term of *SHARE* in the regression model.

where subscript *i* refers to a specific enterprise; subscript *t* refers to the year; *INNOV* signifies the innovation of the enterprise; *SHARE* is the variable of interest and signifies the expansion of SOEs (defined later); *X* contains all other variables that influence the innovation of the enterprise; μ is the unobserved individual effect; λ is the time effect; and ε is error term. In the next subsection, we will discuss specifically how we measure the dependent and independent variables in model (1) and explain why we choose them as regressors.

3.2.1 Dependent variable — Innovation

The dependent variable *INNOV* measures the innovation of a private enterprise. However, there exists no measure of innovation that permits readily interpretable cross-industry comparisons. Most empirical studies of innovation and technical change in industry generally measure innovation in one of two ways. One approach is to measure innovative input, such as the number of R&D employees and the amount of R&D expenditures. Davelaar (1991) concluded that the majority of empirical studies have used input measures due to the limited availability of output data. The obvious drawback of input measures is that R&D input often produces no tangible innovation output (Mansfield, 1984), and it tends to underestimate the innovative activity of small firms by concentrating on the work of formal R&D laboratories (Kleinknecht, 1987). The other approach is to measure innovative output, such as the number of patents applied for or granted, or new products generated. Griliches (1990) found that the patent indicator has natural limitations, because whether an enterprise decides to apply for a patent or use trade secrets to protect intellectual property is affected by many factors. The fact that a given enterprise has no patents does not mean that it has no innovative input; it may invest resources in R&D but without successfully inventing new products, or it might successfully invent new products without applying for patents. However, since the number of patents is a directly measurable innovative outcome for an enterprise, the patent indicator is still a fairly reliable way to measure innovative activities (Acs *et al*., 2002). Sales revenue of new products is another indicator that is used to measure innovation output. It reflects the eventual value realization of an enterprise's technological innovation, and is thus a good representation of technological innovation. However, not all technological innovations aim to increase sales revenue; some are designed to save energy or reduce production costs or protect the environment. Therefore, the sales revenue of new products cannot accurately reflect innovation.

Considering the advantages and disadvantages of each indicator and the availability of relevant data, we decided to use the number of patent applications to measure the innovative activity of private enterprises.[3] Here, "patent application" means that an enterprise has filed for a patent, even though the patent office may not have necessarily granted it. Although the enterprise does not know whether the patent application will be approved by the patent office, the enterprise must undoubtedly have invested some resources to invent something new that it wants to protect with a patent (otherwise, it would have no reason to apply for the patent). It follows that the larger the number of patent applications, the more resources the enterprise has invested; this is why we chose the number of patent applications to measure the extent of innovative activity.

[3] In our dataset, patent mainly refers to invention patent filed by private enterprises.

3.2.2 Variable of interest — *SHARE*

We first define state-owned enterprises and private enterprises according to ownership classifications in the dataset. Both state-owned enterprises and private enterprises are divided into four categories which are shown in Appendix 1. Then, we use the average proportion of sales revenue of SOEs to measure their expansion. We call this *SHARE*, which is defined as follows[4]:

$$SHARE = \frac{sum(sales\ revenue\ of\ all\ state-owned\ enterprises\ in\ a\ given\ industry,province\ and\ year)}{sum(sales\ revenue\ of\ all\ enterprises\ in\ a\ given\ industry,province\ and\ year)} \quad (2)$$

As shown in Figure 1, the average proportion of sales revenue of SOEs decreased until 2003, and then it increased rapidly. Therefore, there was an expansion of SOEs since 2003 to some extent. As mentioned previously, because private enterprises had difficulty earning enough money for innovation when SOEs expanded in the years after 2003, we expected *SHARE* to have a negative effect on the innovation of private enterprises. As shown in equation (1), the lag term of *SHARE* was included in the models, and the effect of the change in *SHARE* in period *t*-1 on the innovation of private enterprises in period *t* was examined. When SOEs expanded in certain industries, it usually took several months or even one year for private enterprises to adjust their innovation strategies, and it also took considerable time to conduct these innovative activities. Meanwhile, lagged *SHARE* also are used to mitigate its endogeneity.

3.2.3 Control variables

Many factors affect the innovative activity of enterprises, and they all need to be included to estimate the regression model as accurately as possible. The model is expressed as follows:

$$INNOV_{it} = \alpha + \gamma SHARE_{it\text{-}1} + \beta_1 Asset_{it} + \beta_2 Asset^2_{it} + \beta_3 Concentration_{it} + \beta_4 Concentration^2_{it}$$
$$+ \beta_5 Age_{it} + \beta_6 Age^2_{it} + \beta_7 Liability_{it} + \beta_8 Export_{it} + \beta_9 Wage_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (3)$$

The variable *Asset* represents firm size. From past literature, neither theoretical nor empirical studies on the effect of firm size on innovation have arrived at a unified conclusion. Some studies have shown that firm size has a positive effect on innovation because a large firm size indicates economies of scale, smaller risk, greater market share, and better opportunities for appropriation (Cohen and Klepper, 1996; Blundell *et al*., 1999). Other studies have emphasized the advantage of a small firm size because of greater flexibility, better communication, greater specialization possibilities, and both informal and strategic control (Acs and Audretsch, 1988; Kraft, 1989; Scherer and Ross, 1990). They pointed out that as firms grow large, efficiency in R&D is undermined through loss of managerial control. Many researchers also found that there may exist an "inverted-U" relationship between innovation and firm size or between innovation and market concentration (Scherer, 1965b; Kamien and Schwartz, 1982; Levin *et al*., 1985). In order to test the effect of total asset on firm's innovative performance, *Asset* and its quadratic term are included in the model. In the empirical part, we use normalized total asset to measure firm size. [5]

[4] In our dataset, there are 41 2-digit industries, 31 provinces and 10 years.

[5] I normalize total asset using the following formula: Asset = (total asset – μ) / σ. Total asset represents a private enterprise's total asset. μ represents the mean of total asset and σ represents the standard deviation of total asset.

The variable *Concentration* is the Herfindahl-Hirschman Index (HHI) [6], which usually measures market power in one industry (the larger the HHI, the higher the degree of market concentration). Economists have offered ambiguous predictions about the effects of market concentration on innovation. Some have supported Schumpeter's position that firms in concentrated markets can more easily appropriate the returns from inventive activity (Lunn, 1986; Lee, 2009). Others have demonstrated that a firm's gains from innovation are larger in competitive industries than in monopolistic industries by assuming perfect ex post appropriability (Blundell *et al*., 1999; Lerner, 2006). In order to test the effect of market concentration on firm's innovative performance, *Concentration* and its quadratic term are included in the model.

The variable *Age* shows the firm's age or maturity, and is calculated as the number of years since the firm was founded. This variable has been widely studied as a determinant of a firm's innovative activity. A firm's age indicates the experience and knowledge it has accumulated throughout its history, and it seems to be linked to better management of communication systems, higher levels of creativity required for innovation, and greater capacity to absorb new information (Galende and de la Fuente, 2003). Most studies have verified a positive impact of age on innovative activity (Kumar and Saqib, 1996; Kuemmerle, 1998). The quadratic term of *Age* is included in the model in an attempt to capture the parabolic effect of age on innovation.

The variable *Liability* is the ratio of total liability to total asset, which indicates a private enterprise's level of debt. A number of studies examining the economics of asymmetric information lend further support to the belief that liquidity constraints can limit the ability of firms to invest in R&D. Bougheas (2004) demonstrated that debt financing induces managers who are acting in their shareholders' best interests to abandon positive net present value projects, and in some cases, a high level of debt financing can create a situation of "underinvestment." However, an enterprise can undoubtedly invest more financial resources in innovation if it is capable of borrowing money from banks. Thus, the effect of *Liability* on innovation is somewhat ambiguous.

The variable *Export* is the ratio of export delivery value to industrial output value, and it is used to measure the export-oriented scope of an enterprise. In China, many enterprises are export-oriented. On one hand, they need to engage in at least some innovation activity to increase their exports because the international market is very competitive. On the other hand, most of these companies are labor-intensive and usually export low-value products, so they are often not compelled to engage in innovative behavior. Therefore, the effect of *Export* on innovation is also ambiguous. The variable *Wage* is the ratio of total payable wages to total revenue. Wages represent one aspect of cost, and an increase in total payable wages will lead to a decrease in profit (given total revenue). Therefore, the R&D investment from profit will decrease, which means that the ratio of total payable wages to total revenue have a negative effect on the innovative activity of enterprises.

Lastly, μ is the unobserved individual effect that captures the heterogeneity of each enterprise, and λ is the time effect that controls for factors that do not change across each enterprise but that change every year (e.g., economic situations, policy changes in applications for patents, *etc*.).

[6] The calculation formula for HHI is as follows:

$$HHI = \sum_{i=1}^{N} (X_i / X)^2 = \sum_{i=1}^{N} S_i^2$$

where S_i is the market share of firm i in the market, and N is the number of firms.

Table 2 lists the descriptive statistics related to the variables in equation (3). In order to provide more information about dataset, I also report the mean and standard deviation of all variables sorted by ownership and size in Appendix 2.

4 Empirical results

4.1 Expansion of SOEs and innovation of private enterprises

4.1.1 Basic model: one *SHARE*

In this section, we investigate the effect of the expansion of SOEs on the innovative activity of private enterprises using Chinese Industrial Enterprises Database and Patent Application Database. In the basic model, sales revenue is used to define the variable *SHARE*. Since the dependent variable *INNOV* is the number of patent application, which are integers greater than or equal to zero, we will use regression models for count data such as Poisson model to conduct regression analysis. Specifically, we will use fixed-effects Poisson model to regress Equation (3), which can partially correct endogeneity problem caused by omitted variables that don't change within the group. In addition, using lag term of *SHARE* to some extent can alleviate its endogeneity caused by reverse causality because the innovative behavior of a private enterprise in t period hardly affected the share of sales revenue of SOEs in t-1 period. Even if there is some correlation between the innovative behavior of a private enterprise in t-1 period and in t period, the innovative behavior of a single firm is unable to explain the industry-level change in the proportion of sales revenue of SOEs as a whole especially considering there are more than 30,000 SOEs each year. Therefore, both lag term of *SHARE* and fixed-effects Poisson model can alleviate the endogeneity problem of *SHARE* and make estimators consistent. The regression results are shown in Table 3. Regardless of which control variables are included in the model, it can be seen in columns 1 to 3 of Table 3 that the variable lag (*SHARE*) is significantly negative. This empirical result shows that the expansion of SOEs indeed impeded the innovative behavior of private enterprises from 2004 to 2007.

Unlike SOEs, Chinese private enterprises usually do not have extensive assets or strong ability to obtain debt financing, and thus are less likely to resist the economic shock from the expansion of SOEs and maintain high levels of investment in R&D. The rapid development of SOEs through mergers or acquisitions, or by entering highly competitive industries, made it difficult for private enterprises to compete with them because governments and commercial banks directly supported the SOEs. It turned out that the profit rate earned by private enterprises decreased, and they could not borrow money at the same interest rates as SOEs. Therefore, private enterprises had to cut R&D expenditures and thus decreased their patent applications.

China is a developing country in which private enterprises didn't regain its legitimacy until 1978. In spite of the speed with which the private sector developed after 1978, the path was by no means free of obstructions. As shown in Table 1, however, no matter what index we use to measure innovative performance, private enterprises usually have more innovative input and output than that of SOEs especially for medium-sized and small enterprises. Moreover, Figure 4 shows the number of patent per worker applied by private enterprises and SOEs. As you can see, the number of patent per worker applied by private enterprises fell sharply since 2002. The number of patent per worker applied by SOEs, however, maintained almost unchanged and was much lower than

that of private enterprises since 2003. What's more important, the average number of patent per worker applied by all privates fell sharply since 2003. The part of reason may be the decrease in the number of patent applications of private enterprises. Therefore, private enterprises are the main contributors of innovation in China. If the expansion of SOEs had a detrimental effect on the innovation of private enterprises, it would hinder the innovative development of China as a whole.

Moreover, considering that the independent variable *INNOV* contains a large number of zero, we also attempt to use other models to regress Equation (3) for robustness check.[7] There are Tobit model and Heckman Two-step model. The results are shown in column 4 to 5 of Table 3. As you can see, lag (*SHARE*) is still significantly negative in Tobit model and Heckman Two-step model. Both models further confirm our hypothesis. To sum up, our results are robust to other regression models, which indicates that the expansion of SOEs indeed had a negative effect on the innovation of private enterprises from 2004 to 2007.

Since control variables are not the main focus of this paper, it is unnecessary to consider their effects on the innovation of private enterprises. In the following regression, we do not report the results of control variables for the sake of brevity.

4.1.2 Extended model: two *SHARE*s

As mentioned in previous section, there are two conflicting opinions about the expansion of SOEs. Some economists and almost all policymakers in China have maintained that there was no major expansion of SOEs over the last decade. At most, SOEs expanded only in certain industries that are crucial to China's economic safety, and seldom entered industries dominated by other types of enterprises. Other economists and many entrepreneurs of private enterprises have argued that SOEs did expand rapidly, even in highly competitive industries, which was harmful to the development of private enterprises. Many SOEs became bigger and stronger by merging or absorbing private enterprises. The "Ten Industries Revitalization Plan" implemented in 2009 is a good example of this phenomenon.

In order to resolve the conflict between the two opinions, we further subdivided SOEs according to two standards: holding status and affiliation. We first look at holding status. SOEs can be divided into two categories: absolutely controlled state-owned enterprises (ASOEs) and relatively controlled state-owned enterprises (RSOEs). An absolutely controlled state-owned enterprise means that the percentage of paid-up capital from the state is greater than 50%. A relatively controlled state-owned enterprise means that although the percentage of paid-up capital from the state is less than 50%, it is greater than the percentage of paid-up capital from any other economic component. The average proportion of sales revenue is calculated for these two types of state-owned enterprises, and Figure 5 shows the two $SHARE_s$ defined according to sales revenue. The average proportion of sales revenue of RSOEs ($SHARE_2$) clearly increased, especially from 2003 to 2006. In general, starting in 2003, SOEs began to expand and enter new industries by way of

[7] The final sample contains 434,624 private enterprises. Among them, there are 163,846 private enterprises with patent application which approximately account for 37.7% of all private enterprises. Although private enterprises with patent application account for small portion of all private enterprises, the private enterprises with patent application aren't systematically different from the ones without patent application. Appendix 3 shows the difference between key variables of private enterprises with and without patent application. Except variable *SHARE*, the key variables aren't significantly different between private enterprises with and without patent application.

purchasing or merging with other existing enterprises. The newly established enterprises were usually RSOEs, which is why $SHARE_2$ increased starting in 2003. However, the average proportion of sales revenue of ASOEs ($SHARE_1$) decreased during almost the entire period because the number of ASOEs remained almost unchanged (and even decreased at times), but the overall number of enterprises in all industries increased rapidly. These two $SHARE_s$ correspond to the conflicting opinions mentioned above. $SHARE_1$ represents those who did not believe in the expansion of SOEs, and $SHARE_2$ represents those who did. Each opinion makes sense but is clearly one-sided. So, which share has an effect on the innovation of private enterprises? In order to answer this question, we use sales revenue to define *SHARE*s and include both of them into the model. As usual, we use fixed-effects Poisson model to conduct regression analysis (hereinafter as well). The regression results are shown in column 1 of Table 4.

The column 1 in Table 4 shows that these two $SHARE_s$ are both negative and highly significant. This means that both shares have negative effects on the innovation of private enterprises. There are two important points that should be noted. First, the negative effect of $SHARE_1$ on innovation is greater than that of $SHARE_2$. It is easy to explain this result. Since ASOEs can receive more support from governments and borrow money at lower interest rates from banks, their expansion has a greater effect on private enterprises. Second, $SHARE_1$ was basically unchanged and $SHARE_2$ increased from 2004 to 2007 as shown in Figure 5. Although both *SHARE*s have negative effects on the innovation of private enterprises, the effect of $SHARE_2$ is dominant. Therefore, the decrease in innovation of private enterprises was mainly caused by the expansion of RSOEs.

SOEs can also be subdivided according to affiliation. The dataset indicates the affiliation of each SOE; specifically, an SOE can be affiliated to the central government, a provincial government, a municipal government, a county government, and others. Based on this standard, SOEs can be divided into HSOEs (belonging to the central government or to provincial governments) and LSOEs (belonging to governments lower than the provincial level, such as county or municipal governments). In general, HSOEs are more important than LSOEs because they are the main financial tools that the Chinese government relies on to control the economy. From Figure 6, it can be seen that the average proportion of sales revenue of HSOEs ($SHARE_1$) remained almost unchanged from 2004 to 2007. However, the average proportion of sales revenue of LSOEs ($SHARE_2$) increased sharply during this period. These two $SHARE_s$ are included in the models, and the results are shown in column 5 of Table 4. Column 5 demonstrates similar results as before, i.e., $SHARE_2$ is dominant in discouraging the innovation of private enterprises.

By dividing SOEs into subcategories, we find that not all SOEs expanded rapidly from 2004 to 2007, and only the expansion of RSOEs and LSOEs led to a decrease in innovation of private enterprises. Although ASOEs and LSOEs also had negative effects on innovation, they hardly expanded from 2004 to 2007 and thus their effects were negligible.

4.2 Robustness check

4.2.1 Using different financial indexes to define *SHARE* or *SHARE*s

In the previous section, sales revenue was used to define *SHARE*, and we found that *SHARE* does have a negative effect on the innovation of private enterprises. Now, we will use several different financial indexes to define *SHARE* using equation (2) and check the robustness of the results. We calculate *SHARE* according to the indexes of total industrial output, total profit, and

total number of employees. As shown in Figures 7-9, the three *SHARE*s increased sharply from 2004 to 2007. These figures show that SOEs indeed expanded rapidly during this period, even if we use different financial indexes to define *SHARE*s. The models are regressed using different *SHARE*s, and the results are shown in Table 5; we can see that the expansion of SOEs had a negative effect on the innovation of private enterprises in each category. These results are similar to previous results.

We further divide SOEs into ASOEs and RSOEs or HSOEs and LSOEs, and define two *SHARE*s according to these three indexes. Figures 10-15 confirm that from 2004 to 2007, ASOEs and HSOEs basically remained unchanged, while RSOEs and LSOEs increased rapidly. The regression results are shown in Table 4, and are also similar to previous results. Taking total industrial output as an example, Table 4 shows that although the absolute value of the coefficient of lag ($SHARE_1$) is greater than that of lag ($SHARE_2$) in both column 2 and column 6, the effect of the expansion of RSOEs and LSOEs is dominant in discouraging the innovation of private enterprises. Therefore, no matter what the financial indexes are used to define *SHARE* or *SHARE*s, we arrive at the same conclusion.

4.2.2 Innovation of private enterprises from 1998 to 2007

Since it was determined that SOEs expanded rapidly starting in 2003, we studied the effect of expansion of SOEs on innovation of private enterprises using data from 2004 to 2007. Now, we will extend the period to 1998 by using data from 1998 to 2007 and data from 1998 to 2003 to regress the models and check the robustness of the previous results. Using sales revenue to define *SHARE*, we regress the models using one *SHARE* and two *SHARE*s. The regression results are shown in Table 6. From column 1, it can be seen that the expansion of SOEs had a negative effect on the innovation of private enterprises even when data from 1998 to 2007 are used. The expansion of SOEs discouraged private enterprises from engaging in innovative activity from 2004 to 2007, as the average proportion of sales revenue of SOEs rapidly increased during this period. This result is consistent with the previous analysis. Moreover, the average proportion of sales revenue of SOEs continuously decreased from 1998 to 2003, as shown in Figure 1. This can be referred to as the privatization of SOEs. According to the results shown in Table 6, the privatization of SOEs contributed to the innovation of private enterprises; the results listed in column 4 also confirm this finding.

As we mentioned before, the Chinese government implemented various economic policies in order to maintain economic development after the 1997 Asian financial crisis. An important policy was to reform SOEs to improve their productivity. Between 1997 and 2003, many SOEs entered a period of accelerated reform, and other types of enterprises faced less competitive pressure from them. In this context, private enterprises were inclined to increase their R&D expenditures. Moreover, when we included two $SHARE_s$ in the models and regressed them again, we found that the results were the same. The results in Table 6 further confirm the robustness of our previous conclusion.

4.2.3 Innovation of private enterprises in different industries

Different industries have different characteristics, especially in terms of technological level. A number of studies have found that the effect of market power on innovative activity is different in industries of different technological levels (Mansfield, 1964; Adams, 1970; Globerman, 1973). Therefore, it is important to study the heterogeneous effects of the expansion of SOEs on the innovation of private enterprises in different industries. According to *High-tech Industry Classification Catalog* issued by China's National Bureau of Statistics in 2002, we subdivided industries into high-tech industries and low-tech industries. High-tech industries are usually knowledge-intensive or technology-intensive and produce high value-added goods, such as the IT industry. [8] Low-tech industries produce goods with less technological content, such as the food manufacturing industry. The models are regressed using these two subsamples, and the results are shown in Table 7. For high-tech industries, the expansion of SOEs had a negative effect on the innovation of private enterprises. In general, high-tech industries are highly competitive, and enterprises in these industries usually invest significant resources to carry out innovations every year in order to increase market share and earn greater profits. If SOEs enter these industries, private enterprises will be unable to compete with the SOEs because of their advantages in getting bank loans and government subsidies. Therefore, the expansion of SOEs leads to a decrease in profits earned by private enterprises and further decreases their investment in innovation. For low-tech industries, innovation was not affected by the expansion of SOEs. Private enterprises in low-tech industries have little incentive to innovate because it is often unprofitable to do so.

When we investigated the effect of market power on the innovation of private enterprises before, we found that market power has no effect on innovation if we include *Concentration* and its quadratic term in the model. The variable *Concentration* (HHI) usually measures the level of competition in an industry (the larger the HHI, the higher the degree of market concentration and monopolization). In order to study the expansion of SOEs on the innovation of private enterprises in industries with different market concentrations, we divided industries into highly competitive industries (*Concentration* < 0.05) and minimally competitive industries (*Concentration* > 0.3) based on guidelines from the American Department of Justice. From Table 7, it can be seen that the expansion of SOEs had a negative effect on the innovation of private enterprises in highly competitive industries, but had no effect on those in minimally competitive industries. In other words, SOEs should be prevented from entering highly competitive industries because they will severely discourage the innovation of private enterprises in these industries. In reality, SOEs entered into highly competitive industries in order to earn greater profits, as private enterprises had less incentive to innovate because of a lack of financial resources. Minimally competitive industries usually include one or several enterprises in a monopolistic position. If private enterprises have a monopoly within a minimally competitive industry, then they will be largely unaffected by the shock from the expansion of SOEs. If SOEs have a monopoly within a minimally competitive industry, private enterprises simply have no incentive to innovate. Therefore, the expansion of SOEs has no effect on the innovation of private enterprises in minimally competitive industries.

[8] In our dataset, high-tech industries mainly include electronic and communication equipment manufacturing industry, computer and office equipment manufacturing industry, pharmaceutical industry, medical equipment manufacturing industry, and new material industry. Low-tech industries include all other industries that are not in the high-tech industries.

4.3 Reasons why the expansion of SOEs impeded the innovation of private enterprises

4.3.1 Expansion of SOEs and the economic atmosphere faced by private enterprises

Now we will investigate the channels through which the expansion of SOEs impeded the innovation of private enterprises. As we mentioned in the literature review, the expansion of SOEs might lead to a decrease in the profit rate earned by private enterprises and an increase in the interest rate for private enterprises. Therefore, these two effects should be examined first. The regression models are as follows:

$$\begin{aligned} Average\ profit\ rate_{jt} = {} & \alpha + \gamma SHARE_{jt} + \beta_1 Asset_{jt} + \beta_2 Asset^2_{jt} + \beta_3 Concentration_{jt} \\ & + \beta_4 Concentration^2_{jt} + \beta_5 Age_{jt} + \beta_6 Age^2_{jt} + \beta_7 Liability_{jt} \\ & + \beta_8 Export_{jt} + \beta_9 Wage_{jt} + \mu_j + \lambda_t + \varepsilon_{jt} \end{aligned} \quad (4)$$

$$\begin{aligned} Average\ interest\ rate_{jt} = {} & \alpha + \gamma SHARE_{jt} + \beta_1 Asset_{jt} + \beta_2 Asset^2_{jt} + \beta_3 Concentration_{jt} \\ & + \beta_4 Concentration^2_{jt} + \beta_5 Age_{jt} + \beta_6 Age^2_{jt} + \beta_7 Liability_{jt} \\ & + \beta_8 Export_{jt} + \beta_9 Wage_{jt} + \mu_j + \lambda_t + \varepsilon_{jt} \end{aligned} \quad (5)$$

where subscript *j* refers to an industry; subscript *t* refers to the year. Instead of calculating the profit rate and interest rate faced by each private enterprise, we use *average profit rate* and *average interest rate* at the industry level as independent variables. The main reason is that the variable *SHARE* represents industry-level data, and the profit rate and interest rate faced by each private enterprise are unable to reflect the economic atmosphere of industry as a whole. In addition, *average profit rate* and *average interest rate* at the industry level can be regarded as private enterprises' economic expectations. We aggregate firm-level data into industry-level data and regress the models with *average profit rate* and *average interest rate* as independent variables.[9] The other control variables are the same as those in equation (3) and also aggregated into industry-level data. Finally, we get a sample of 4762 observations. The regression results are shown in Table 8.

For *average profit rate*, *SHARE* is negative but only significant at 10% level, which indicates that the expansion of SOEs had a negative effect on the profitability of private enterprises. In reality, private enterprises could also benefit from the development of SOEs from trading or cooperating with them, such as providing them with accessories. If the positive effect of the

[9] We aggregate firm-level data into industry-level data. Specifically,

$$average\ profit\ rate = \frac{sum(profit\ of\ all\ private\ enterprises\ in\ a\ given\ industry, province\ and\ year)}{sum(sales\ revenue\ of\ all\ private\ enterprises\ in\ a\ given\ industry, province\ and\ year)}$$

$$average\ interest\ rate = \frac{sum(interest\ of\ all\ private\ enterprises\ in\ a\ given\ industry, province\ and\ year)}{sum(liability\ of\ all\ private\ enterprises\ in\ a\ given\ industry, province\ and\ year)}$$

Other control variables are calculated as arithmetic average of all private firms' values in a given industry, province and year. For example,

$$average\ total\ asset = \frac{sum(total\ asset\ of\ all\ private\ enterprises\ in\ a\ given\ industry, province\ and\ year)}{Number\ of\ private\ enterprises\ in\ a\ given\ industry, province\ and\ year}$$

expansion of SOEs partially offsets its negative effect, then the coefficient of *average profit rate* may not be very significant. The empirical result confirms this hypothesis to some extent. For *average interest rate*, *SHARE* is positive and highly significant, as shown in Table 8. In other words, the expansion of SOEs led to an increase in the industry-level interest rate available to private enterprises. This result is consistent with the previous analysis. SOEs owned by governments could easily get loans from commercial banks at low interest rates. The commercial banks were also willing to provide loans to the SOEs because the banks would not get into trouble if some of the SOEs did not have the ability to pay back their debts. Compared to SOEs, private enterprises rarely got bank loans at the same interest rates. In summary, the financing environment became progressively worse for private enterprises because of the expansion of SOEs.

4.3.2 Reasons why the expansion of SOEs impeded the innovation of private enterprises

We already found that the expansion of SOEs not only led to an increase in *average interest rate* faced by private enterprises but also had a negative effect on the innovation of private enterprises. We then included *average profit rate* and *average interest rate* in equation (3) and tested whether the increase in *average interest rate* was the real reason for the decrease in innovation of private enterprises. It should be noted that the lag terms were included because private enterprises usually require several months to one year to adjust their investments in innovation when profit rates or interest rates change. The regression model is as follows:

$$\begin{aligned} INNOV_{it} = {} & \alpha + \gamma SHARE_{it\text{-}1} + \delta_1 Average\ profit\ rate_{it\text{-}1} + \delta_2 Average\ interest\ rate_{it\text{-}1} + \beta_1 Asset_{it} \\ & + \beta_2 Asset^2_{it} + \beta_3 Concentration_{it} + \beta_4 Concentration^2_{it} + \beta_5 Age_{it} + \beta_6 Age^2_{it} \\ & + \beta_7 Liability_{it} + \beta_8 Export_{it} + \beta_9 Wage_{it} + \mu_i + \lambda_t + \varepsilon_{it} \end{aligned} \quad (6)$$

The regression results are shown in Table 9. From columns 1, 4 and 5 of Table 9, it can be seen that the *average interest rate* is significantly negative. This means that an increase in *average interest rate* would decrease the investment in innovation of private enterprises, and thus discourage them from innovating. Furthermore, the variable *SHARE* becomes insignificant when we include *average interest rate* in the model. In other words, the variable *SHARE* negatively affected the innovation of private enterprises entirely through the increase in the interest rate available to them. This result confirms that an increase in *average interest rate* was the real reason for the decrease in innovation of private enterprises. In addition, we also found that the decrease in innovation of private enterprises had nothing to do with their *average profit rate*, as shown in columns 1, 3 and 5 of Tables 9.

5 Conclusions

SOEs have expanded rapidly in China since 2003. One of the detrimental effects of the expansion of SOEs on the Chinese economy was to discourage private enterprises from innovating. Through an empirical study using Chinese Industrial Enterprises Database and Patent Application Database from 2004 to 2007, we found that the expansion of SOEs negatively affected the innovation of private enterprises. Chinese private enterprises usually do not have extensive assets or strong ability to obtain debt financing, and thus are less likely to resist the economic shock from

the expansion of SOEs and maintain high levels of investment in R&D. Considering private enterprises are the main contributors of innovation in China, we should not undervalue the negative effect of the expansion of SOEs on the innovation of private enterprises.

We further distinguished SOEs according to two standards: holding type and affiliation type. Based on the former standard, we divided SOEs into absolutely controlled SOEs (ASOEs) and relatively controlled SOEs (RSOEs). Based on the latter standard, we divided SOEs into those belonging to the central government or to provincial governments (HSOEs) and those belonging to governments lower than the provincial level, such as municipal governments (LSOEs). According to Figures mentioned before, we found that only RSOEs and LSOEs expanded rapidly from 2004 to 2007. After including the two pairs of SOEs in the models, we found that the expansion of RSOEs and LSOEs led to a decrease in innovation of private enterprises. Several robustness checks further confirmed these results. Moreover, we found that the expansion of SOEs increased the *average interest rate* faced by private enterprises. After including *average interest rate* in the model, we found that the variable *SHARE* measuring the expansion of SOEs became insignificant. These results indicate that the increase in *average interest rate* was the real reason for the decrease in innovation of private enterprises.

It is recommended that the Chinese government pay careful attention to this detrimental effect of the expansion of SOEs on the innovation of private enterprises. As we have already mentioned, private enterprises are the main contributors of innovation in China. If China wants to change its developmental strategy from a “Made in China” economy to an “Innovated in China” economy, it must encourage the innovation of all kinds of enterprises, especially private enterprises. The empirical analysis in this study revealed that the major obstacle that prevented private enterprises from innovating was their inability to get loans from banks at affordable interest rates, which increased the cost of innovation. In order to stimulate the innovation of private enterprises, the Chinese government should improve the economic atmosphere and treat private enterprises and SOEs equally. In addition, commercial banks and other financial institutions should explore feasible ways for private enterprises to obtain the substantial financial resources required for innovation.

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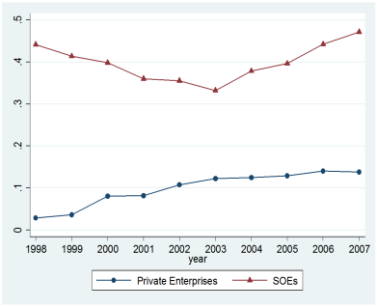

Figure 1 Average proportion of sales revenue of private enterprises and SOEs

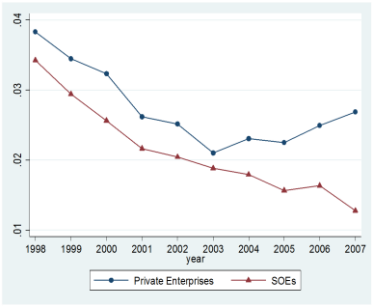

Figure 2 Average interest rate available to private enterprises and SOEs

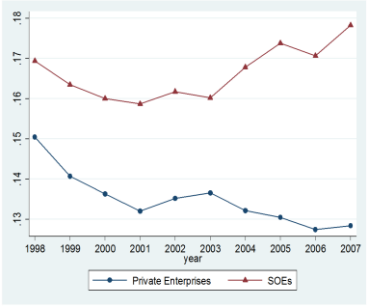

Figure 3 Average profit rate earned by private enterprises and SOEs

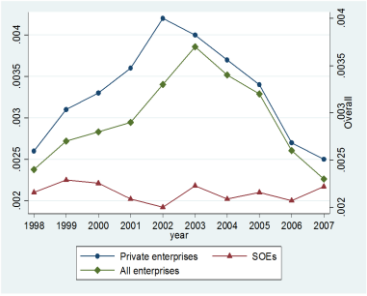

Figure 4 Number of patent applications per worker of private enterprises and SOEs

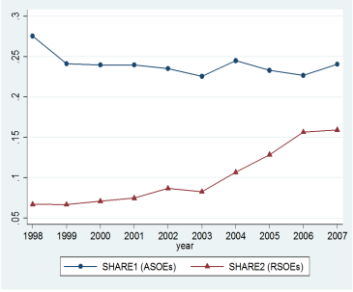

Figure 5 Average proportion of sales revenue of ASOEs and RSOEs

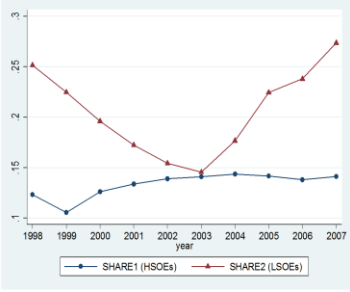

Figure 6 Average proportion of sales revenue of HSOEs and LSOEs

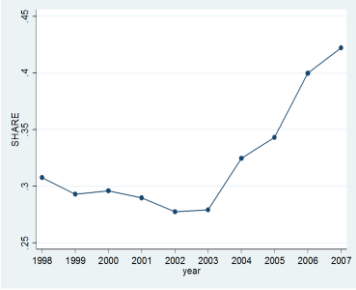

Figure 7 Average proportion of total industrial output of SOEs

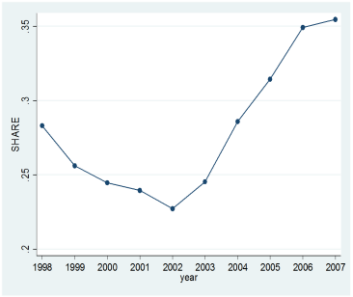

Figure 8 Average proportion of total profit of SOEs

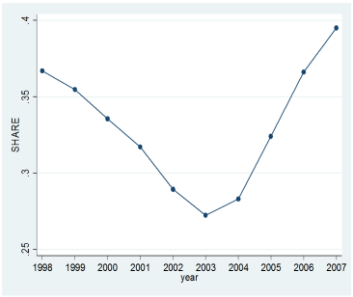

Figure 9 Average proportion of total total number of employees of SOEs

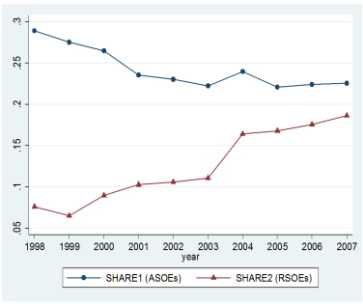

Figure 10 Average proportion of total industrial output of ASOEs and RSOEs

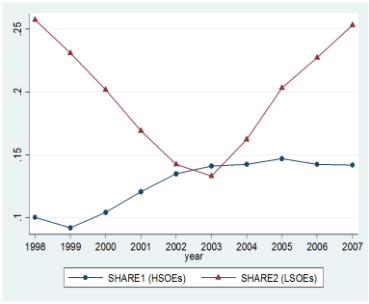

Figure 11 Average proportion of total industrial output of HSOEs and LSOEs

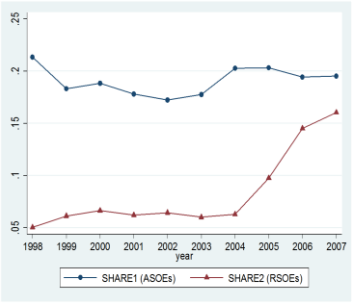

Figure 12 Average proportion of total profit of ASOEs and RSOEs

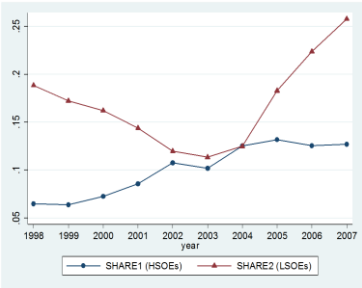

Figure 13 Average proportion of total profit of HSOEs and LSOEs

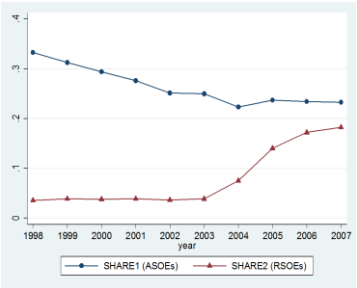

Figure 14 Average proportion of total employees of ASOEs and RSOEs

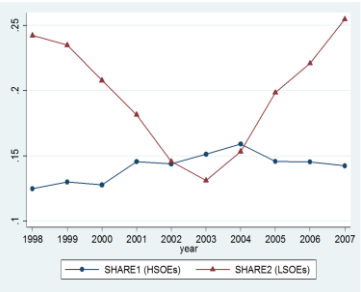

Figure 15 Average proportion of total employees of HSOEs and LSOEs

Table 1 Comparison of innovative performance between private enterprises and SOEs

Panel A	R&D expenditure per worker (2004 – 2007)			
	Overall	Large	Medium-sized	Small
Private enterprises	5.597	3.572	3.481	8.840
SOEs	2.704	3.895	2.394	4.178
All enterprises	4.662	3.724	3.015	6.114
Panel B	**Number of patent applications per worker (2004 – 2007)**			
	Overall	Large	Medium-sized	Small
Private enterprises	0.0033	0.0012	0.0010	0.0043
SOEs	0.0021	0.0015	0.0007	0.0026
All enterprises	0.0029	0.0013	0.0009	0.0033

R&D expenditure per worker = (R&D expenditure) / (total number of employees)
Number of patent applications per worker = (number of patent applications) / (total number of employee)
The unit in Panel A is one thousand RMB.

Table 2 Descriptive statistics

Variables	Definition	Private enterprises (2004 – 2007)				
		Observation	Mean	Std. Dev.	Min	Max
INNOV	Number of patent applications	434624	0.442	6.270	0	537
SHARE	Average proportion of sales revenue of SOEs	434624	0.391	0.254	0.076	1
Asset	Total asset (one thousand RMB)	434624	31676	34985	5037	15365796
Concentration	Herfindahl-Hirschman Index (HHI)	434624	0.177	0.195	0.038	0.971
Age	Number of years since being founded	434624	10.458	9.492	4	62
Liability	(total liability) / (total asset)	434624	0.306	0.247	0	0.830
Export	(export value) / (industrial output value)	434624	0.157	0.229	0	1
Wage	(total payable wages) / (total revenue)	434624	0.297	0.105	0.098	0.553

We use all of observations (including SOEs and other types of enterprises) in each year when we calculate *SHARE* and *Concentration*. In the empirical part, we use normalized total asset to measure firm size.

Table 3 Effects of the expansion of SOEs on innovation of private enterprises

Dependent variable: *INNOV*	Fixed-effects Poisson model			Tobit model	Heckman Two-step
	(1)	(2)	(3)	(4)	(5)
lag (*SHARE*)	-0.1749**	-0.1481**	-0.0963***	-0.0994**	-4.0694**
	(0.0823)	(0.0601)	(0.0313)	(0.0504)	(1.8632)
Asset		0.3173***	0.4564***	0.1868***	1.6344
		(0.0875)	(0.1139)	(0.0618)	(14.6837)
$Asset^2$		-0.0080	-0.0069	0.0005	-0.5488**
		(0.0183)	(0.0190)	(0.0049)	(0.2782)
Concentration		0.2938	0.4688	-0.0098	-0.7120
		(0.9265)	(0.9322)	(0.1821)	(9.9198)
$Concentration^2$		-1.2951	-1.3979	0.2684	9.8791
		(1.0897)	(1.0966)	(0.2316)	(21.7441)
Age			-0.2335***	-0.0167***	-0.6035
			(0.0557)	(0.0046)	(1.1498)
Age^2			0.0007	0.0002	0.0056
			(0.0014)	(0.0001)	(0.0147)
Liability			0.0304	-0.0405**	-1.8548
			(0.0398)	(0.0161)	(2.8577)
Export			0.4182**	-0.0823*	-3.6607
			(0.1910)	(0.0443)	(5.9913)
Wage			-0.2358***	0.0310*	1.5332
			(0.0433)	(0.0163)	(2.2449)
λ					18.9732*
					(10.7025)
Individual Effect	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES
Number of Obs.	406658	406658	406658	406658	406658

We use sales revenue to define *SHARE*. We do not report the results of first-step regression in the Heckman Two-step model for the sake of brevity. Number of observation is less than 434624 because we use lag term of *SHARE*. As for Tobit model, the number of left-censored observations is 254097. As for Heckman Two-step model, the number of observations in step 1 is 406658 and the number of observations in step 2 is 152561. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels. Robust standard errors are in parentheses.

Table 4 Effects of the expansion of SOEs on innovation of private enterprises (Two *SHARE*s)

Dependent variable: *INNOV*	Holding Type				Affiliation Type			
	Sales revenue	Total output	Profit	Employees	Sales revenue	Total output	Profit	Employees
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lag ($SHARE_1$)	-0.1268***	-0.1176***	-0.0840***	-0.1243***	-0.1569***	-0.1382**	-0.0984***	-0.1088**
	(0.0407)	(0.0228)	(0.0214)	(0.0441)	(0.0548)	(0.0553)	(0.0350)	(0.0439)
lag ($SHARE_2$)	-0.0854***	-0.0941**	-0.0624**	-0.0795***	-0.0909**	-0.0710***	-0.0467**	-0.0625***
	(0.0327)	(0.0436)	(0.0251)	(0.0203)	(0.0437)	(0.0198)	(0.0224)	(0.0210)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES
Individual Effect	YES	YES	YES	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES	YES	YES	YES
Number of Obs.	406658	406658	406658	406658	406658	406658	406658	406658

In columns 1-4, $SHARE_1$ is the proportion of sales revenue of ASOEs, and $SHARE_2$ is the proportion of sales revenue of RSOEs. In columns 5-8, $SHARE_1$ is the proportion of sales revenue of HSOEs, and $SHARE_2$ is the proportion of sales revenue of LSOEs. We do not report the results of control variables for the sake of brevity (hereinafter as well). Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels. Robust standard errors are in parentheses.

Table 5 Using different financial indexes to define *SHARE*

Dependent variable: *INNOV*	Total output	Profit	Employees
	(1)	(2)	(3)
lag (*SHARE*)	-0.1168***	-0.0749***	-0.0921**
	(0.0441)	(0.0275)	(0.0394)
Control Variables	YES	YES	YES
Individual Effect	YES	YES	YES
Time Effect	YES	YES	YES
Number of Obs.	406658	406658	406658

Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.

Robust standard errors are in parentheses.

Table 6 Innovation of private enterprises during different periods

Dependent variable: *INNOV*	1998 - 2007			1998 - 2003		
	Sales Revenue	Holding Type	Affiliation Type	Sales Revenue	Holding Type	Affiliation Type
	(1)	(2)	(3)	(4)	(5)	(6)
lag (*SHARE*)	-0.1285***			-0.1175***		
	(0.0419)			(0.0428)		
lag ($SHARE_1$)		-0.1533***	-0.1846***		-0.1417***	-0.1330***
		(0.0496)	(0.0664)		(0.0248)	(0.0524)
lag ($SHARE_2$)		-0.1129***	-0.1023**		-0.0994***	-0.1278***
		(0.0357)	(0.0410)		(0.0315)	(0.0471)
Control Variables	YES	YES	YES	YES	YES	YES
Individual Effect	YES	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES	YES
Number of Obs.	954270	954270	954270	547612	547612	547612

We use fixed-effects Poisson model to conduct regression analysis. In columns 2 and 4, $SHARE_1$ is the proportion of sales revenue of ASOEs, and $SHARE_2$ is the proportion of sales revenue of RSOEs. In columns 3 and 6, $SHARE_1$ is the proportion of sales revenue of HSOEs, and $SHARE_2$ is the proportion of sales revenue of LSOEs. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels. Robust standard errors are in parentheses.

Table 7 Innovation of private enterprises in industries

Dependent variable: *INNOV*	Technology		Competitiveness	
	High	Low	High	Low
	(1)	(2)	(3)	(4)
lag (*SHARE*)	-0.0948***	-0.1132	-0.1360***	-0.1106
	(0.0224)	(0.0791)	(0.0358)	(0.1253)
Control Variables	YES	YES	YES	YES
Individual Effect	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES
Number of Obs.	107116	299542	168873	84206

We use fixed-effects Poisson model to conduct regression analysis. Models 3 and 4 do not include *Concentration* and its quadratic term. We divided industries into highly competitive industries (*Concentration* < 0.05) and minimally competitive industries (*Concentration* > 0.3) based on guidelines from the American Department of Justice. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels. We use sales revenue to define *SHARE*. Robust standard errors are in parentheses.

Table 8 Effect of *SHARE* on average profit rate and average interest rate for private enterprises

Dependent variable	*Average profit rate*	*Average interest rate*
	(1)	(2)
SHARE	-0.0278*	0.0165***
	(0.0151)	(0.0048)
Asset	-0.0467***	-0.0125
	(0.0173)	(0.0089)
Asset^2	0.0037***	0.0011**
	(0.0009)	(0.0004)
Concentration	-0.0173	-0.0082
	(0.0268)	(0.0140)
Concentration^2	0.0201	0.0173
	(0.0323)	(0.0167)
Age	-0.0019	-0.0010
	(0.0013)	(0.0007)
Age^2	0.0000	0.0000
	(0.0000)	(0.0000)
Liability	-0.0115***	-0.0348***
	(0.0016)	(0.0012)
Export	0.0088	0.0003
	(0.0056)	(0.0034)
Wage	-0.0025	0.0060***
	(0.0018)	(0.0011)
Industry Effect	YES	YES
Time Effect	YES	YES
Number of Obs.	4762	4762

All variables are aggregated into industry-level data. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels. Robust standard errors are in parentheses.

Table 9 Innovation of private enterprises (including *average profit rate* and *average interest rate*)

Dependent variable: *INNOV*	(1)	(2)	(3)	(4)	(5)
lag (*SHARE*)		-0.0963***	-0.1129**	-0.0764	-0.0873
		(0.0313)	(0.0485)	(0.0558)	(0.0605)
lag (*average profit rate*)	-0.0735		-0.0427		-0.0684
	(0.0608)		(0.0596)		(0.0772)
lag (*average interest rate*)	-0.0327***			-0.0245***	-0.0289***
	(0.0114)			(0.0079)	(0.0090)
Control Variables	YES	YES	YES	YES	YES
Individual Effect	YES	YES	YES	YES	YES
Time Effect	YES	YES	YES	YES	YES
Number of Obs.	406658	406658	406658	406658	406658

We use fixed-effects Poisson model to conduct regression analysis. We use sales revenue to define *SHARE*. Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels. Robust standard errors are in parentheses.

Appendix 1 Concordance of Ownership Category

Register Type	Code	Category
State-owned	110	State-owned enterprises
	141	State-owned jointly operated enterprises
	143	State-owned and collective-owned jointly operated enterprises [a]
	151	Wholly state-owned companies
Private	171	Private wholly owned enterprises
	172	Private-cooperative enterprises
	173	Private limited liability companies
	174	Private shareholding companies
Collective-owned	120	Collective-owned enterprises
	130	Shareholding cooperatives
	142	Collative jointly operated enterprises
HMT-owned	210	Overseas joint ventures
	220	Overseas cooperatives
	230	Overseas wholly owned enterprises
	240	Overseas shareholding limited companies
Foreign-owned	310	Foreign joint ventures
	320	Foreign cooperatives
	330	Foreign wholly owned enterprises
	340	Foreign shareholding limited companies
Shareholding	159	Other limited liability companies
	160	Shareholding limited companies
Other domestic	149	Other jointly operated enterprises
	190	Other enterprises

Note: a. State-owned and collective-owned jointly operated enterprises are either state-owned enterprises or collective-owned enterprises. We classify this kind of enterprise as state-owned enterprises if its state-owned equity is greater than its collective-owned equity.

Appendix 2 Descriptive statistics (Cont.)

Variables	Ownership (2004 – 2007)		Private enterprises (2004 – 2007)		
	Private enterprises	SOEs	Large	Medium-sized	Small
INNOV	0.442 (6.270)	0.586 (15.052)	2.963 (14.698)	0.561 (6.173)	0.309 (1.535)
SHARE	0.391 (0.254)	0.539 (0.295)	0.562 (0.327)	0.414 (0.283)	0.373 (0.267)
Asset	31676 (34985)	75874 (42187)	89812 (38512)	54462 (30420)	16681 (26201)
Concentration	0.177 (0.195)	0.254 (0.207)	0.292 (0.267)	0.181 (0.199)	0.173 (0.182)
Age	10.458 (9.492)	12.884 (10.653)	16.237 (12.369)	13.459 (10.981)	8.530 (8.304)
Liability	0.306 (0.247)	0.647 (0.152)	0.575 (0.116)	0.334 (0.250)	0.283 (0.269)
Export	0.157 (0.229)	0.188 (0.164)	0.179 (0.195)	0.212 (0.118)	0.124 (0.238)
Wage	0.297 (0.105)	0.413 (0.129)	0.276 (0.397)	0.316 (0.205)	0.289 (0.361)
Observation	434624	128478	6674	159632	268318

We use all of observations (including SOEs and other types of enterprises) in each year when we calculate *SHARE* and *Concentration*. The unit for total asset is one thousand RMB. In the empirical part, we use normalized total asset to measure firm size.

Appendix 3 Descriptive statistics (Cont.)

Variables	Private enterprises (2004 – 2007)		
	Without patent application	With patent application	P-value of Difference
SHARE	0.426 (0.269)	0.333 (0.250)	0.000***
Asset	28815 (35872)	36404 (32641)	0.745
Concentration	0.174 (0.191)	0.182 (0.201)	0.916
Age	12.213 (10.667)	7.558 (9.228)	0.743
Liability	0.320 (0.259)	0.283 (0.230)	0.945
Export	0.141 (0.207)	0.183 (0.236)	0.991
Wage	0.320 (0.145)	0.259 (0.122)	0.827
Observation	270778	163846	——

We use all of observations (including SOEs and other types of enterprises) in each year when we calculate *SHARE* and *Concentration*. The unit for total asset is one thousand RMB.

Abstract

Expansion of Income Gap and Insufficiency of Consumption Demand in China

by

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Doctor of Philosophy in Agricultural and Resource Economics

University of California, Berkeley

Professor Brian D. Wright, Chair

The expansion of the income gap directly results in the reduction in the average propensity to consume and thus leads to the insufficiency of the consumption demand. This paper first constructs a theoretic model to demonstrate how the expansion of the income gap affects the consumption demand. Based on the Cointegration test and Vector Error Correction Model, this paper then empirically studies the effects of three kinds of the income gap variables on the consumption demand using Chinese time-series data during the period from 1978 to 2014. We find that the residents' consumption rate decreases by 0.115, 0.057, and 3.8 percentage points if the urban Gini Coefficient rises by 1 percentage points, the rural Gini Coefficient rises by 1 percentage points, and the income ratio of urban residents to rural residents rises by 1 respectively. Moreover, the paper also finds that the urban Gini Coefficient, the rural Gini Coefficient, and the income ratio can explain 30.9%, 11.3% and 44.6% of the extent of the reduction in the residents' consumption rate in China respectively.

1 Introduction

Consumption, investment and export are the three key factors that improve China's economic growth. With the help of these factors, China has maintained an average annual economic growth rate of 9.7% since reform and opening in 1978. With the outbreak of financial crisis, however, countries around the world experienced different degrees of economic recession since 2008 and China has also faced severe financial crisis. Although China could continue to rely on the expansion of domestic investment to stimulate economy, it cannot bear the consequences of an overheated economy such as severe inflation. Furthermore, relying on export to drive economic growth is also unrealistic because of economic recession faced by importing countries like America. Therefore, stimulating domestic consumption demand seems to be the only way to maintain sustained and stable development of China's economy. Figure 1 shows that the consumption rate declined from 48.8% in 1978 to 37.9% in 2014 (National Bureau of Statistics, NBS).[1] Obviously, Chinese people has low inclination to consume and thus the domestic consumption demand hasn't been strong.[2]

In order to stimulate the domestic demand and promote the economic development, we need to focus on and find the real reasons for the insufficiency of the domestic consumption demand. In fact, there are various reasons that account for the insufficiency of the domestic consumption demand. Some studies point out that that Chinese economic structure is experiencing rapid changes and China's security system are not perfect. Under these circumstances, Chinese people are uncertain about future income and expenditure, and thus take precautionary savings to cope with all kinds of risks in the future (Meng, 2001; Liu, 2001; Li and Knight, 2002; Luo, 2004). Some other studies maintain that changes in age structure of population may be an important reason that account for the insufficiency of the domestic consumption demand (Modigliani and Brumberg, 1954; Samuelson, 1958; Cutler *et al*., 1990; Weil, 1999; Hock and Weil, 2006; Zheng, 2007; Li, 2008; Li, 2009). They argue that consumers will rationally arrange their expected lifetime income according to the characteristics of different age in order to maximize their lifetime utility. Specifically, young people save part of income for their children and retirement except consumption. Therefore, the proportion of the labor force increases will result in a rise in the saving rate and thus a reduction in the consumption rate. Furthermore, Chinese infrastructures that are seriously lagging behind social development may also be an important reason for the insufficiency of the domestic consumption demand, especially in the vast rural areas in China (Lin, 2000; Li, 2003; Ju, 2006; Wang, 2008; Liu, 2010).

In addition to the above reasons, are there any other factors that may result in the insufficiency of the domestic consumption demand in China? This paper believe that the gradual expansion of the income gap may be an important reason for the insufficiency of the domestic consumption demand. A few people will possess a large proportion of wealth when the income distribution is inequitable. Although they have higher consumption capability, their marginal propensity to consume is very low. For low-income groups, their consumption demand is very high, but low income limit their consumption capacity. Consequently, the aggregate average propensity to consume declines, which leads to the insufficiency of the domestic consumption demand. Figure

[1] The consumption rate equals to the ratio of aggregate consumption to GDP.

[2] During the same period, the consumption rate of America, Britain, Japan, India and Russia approximately were 71%, 65%, 56%, 60% and 55% respectively. All of them are much higher than the consumption rate of China.

2 shows the average propensity to consume (*APC*) of urban family and rural family during 1978—2014. Obviously, the *APC* is decreasing over time for both urban family and rural family. We further divide residents into ten categories according to the income levels and then draw the *APC*s of each income group.[3] As shown in Figure 3, no matter for urban family or rural family, the *APC* is decreasing as the average income increases. If the above analysis is correct, then these two conclusions demonstrate that the income gap in both urban and rural areas is expanding. Moreover, we can compute and draw the income ratio of urban residents to rural residents, as shown in Table 4. It indicates that the income gap between urban and rural areas is also expanding. Therefore, the expansion of the income gap actually reduces the *APC* and results in the insufficient domestic demand of consumption. Using Vector Autoregression (*VAR*) Model, this paper will empirically study the effects of the expansion of income gap on the domestic consumption demand.

The results suggest that the residents' consumption rate decreases by 0.115 percentage points if the urban Gini Coefficient rises by 1 percentage points. The residents' consumption rate decreases by 0.057 percentage points if the rural Gini Coefficient rises by 1 percentage points. The residents' consumption rate decreases by 3.8 percentage points if the income ratio of urban residents to rural residents rises by 1. The paper also finds that the urban Gini Coefficient, the rural Gini Coefficient, and the income ratio can explain 30.9%, 11.3% and 44.6% of the extent of the reduction in the residents' consumption rate respectively in China during the period from 1978 to 2014. Moreover, the effects of the three types of the income gap variables on the consumption demand are different in the short run. Specifically, in the short run, the expansion of the urban income gap will decrease the consumption demand of the residents and the expansion of the rural income gap has no significant effect on the consumption demand of the residents, and the expansion of the urban-rural income gap will promote the consumption demand but the positive effect is not quite obvious.

The paper is organized as follows. Section 2 reviews the literature in this field. Section 3 constructs a theoretical model to demonstrate how the expansion of income gap affects the domestic consumption demand. Section 4 describes the data and test stationarity of them. Section 5 conducts the empirical analysis. Section 6 concludes.

2 Literature Review

2.1 Theoretical studies on the income gap and the consumption demand

The first economist who studied the relationship of the income distribution and the consumption demand is Sismondi (1803). He thought that the consumption dominates the production of wealth. In other words, the consumption is more important than the production. However, a large proportion of wealth will be possessed by the rich because of the unjust mechanism of income distribution. Most people are unable to consume because of low income and thus there is an insufficient consumption in the society as a whole.

From an angle of capitalist economic crisis, Carl Marx (1867) studied the relationship of the income distribution and the consumption demand. He believed that the disparity of income distribution leads to the insufficient demand for final commodities and then the imbalance between social reproductions. Finally, there is generally an overproduction in the society as a whole.

[3] According to NBS, there are 10 different income groups in both urban area and rural area.

Although Marx pointed out that the disparity in income is the reason for insufficiency of consumption demand, he didn't demonstrate how the income gap affects the consumption demand.

The systematic research on the relationship of the income gap and the consumption demand is Absolute Income Hypothesis proposed by Keynes (1936). This hypothesis maintained that the current consumption depends on current income but the marginal propensity to consume (*MPC*) is decreasing. Therefore, if the income gap is expanding, a large proportion of wealth will be possessed by a few people, which results in a rapid decline in *MPC* and thus the insufficiency of the consumption demand. However, this hypothesis mainly focused on short-term analysis and rarely discussed the long-term relationship of the income distribution and the consumption demand.

In order to analyze the long-term relationship of the income distribution and the consumption demand, Modigliani (1954) proposed Life-Cycle Hypothesis (*LCH*). *LCH* pointed out that it is not current income but long-term income that determines the consumption. In Generalized Life-Cycle Hypothesis, Modigliani further argued that the bequest behavior which is correlated with the income gap also decreases the consumption demand. *LCH* makes up the deficiency of Absolute Income Hypothesis but it needs many assumptions to get it.

Based on the researches mentioned above, Campbell and Mankiw (1991) proposed "λ Hypothesis". This hypothesis mentioned that some people will consume according to the long-term income but others will arrange consumption according to the current income. If the consumption demand is determined by the long-term income, the income gap will lead to a reduction in the consumption demand through the bequest behavior. If the consumption demand is determined by the current income, the income gap will lead to reduction in the consumption demand because of the decline in the *APC*.

In addition, many Chinese scholars have made contributions in this field. Most of them employed the Keynes' consumption theory to study the negative relationship between the income gap and the *APC* or the consumption demand. They believed that the expansion of the income gap is one of the reasons accounting for the insufficiency of the domestic consumption demand in China (Zhang, 2002; Zhang, 2004; Chen, 2005; Guo, 2006; Liu and Cao, 2006; Liao, 2009).

2.2 Empirical studies on the income gap and the consumption demand

Many researchers empirically studied the effects of the income gap on the consumption demand. For example, Blinder (1975) theoretically proposed that the income redistribution would increase the aggregate consumption and designed two econometric approaches to test this hypothesis. He found that the income redistribution contributes to enhancing the consumption demand. Using the cross-sectional data of 37 countries, Dellavalle and Oguchi (1976) found that the Gini Coefficient isn't significant when both the income variable and the Gini Coefficient are included in the model while the Gini Coefficient is highly significant when the income variable is excluded. Musgrave (1980) employed panel data from many countries and empirically studied the relationship between the income gap and the consumption demand. By dividing people's income into the basic living expense and the excess income above living expense, he found that the income redistribution is only affected by the excess income above living expense. Stock (1986) argued that the form and the parameter of the macro-consumption function is not only determined by the form and the parameter of the micro-consumption function but also determined by the characteristics of the income distribution in a society, which strongly supports the fact that the income distribution

indeed matters in terms of the consumption demand. To sum up, all the researchers basically maintained that the income gap has negative effects on the consumption demand and the reduction in the income gap would promote the consumption demand.

Many Chinese scholars also have did lots of empirical researches in this field. For example, Sun and Zhong (2000) empirically found that the growth of the household consumption in rural areas primarily depends on the increase in income but the expansion of the income gap reduces the average propensity to consume at a certain income level. Li (2003) found that the expansion of the income gap isn't the main reason for the insufficiency of the consumption demand. Qiao and Kong (2005) found that the effects of the income gap on the propensity to consume depends on the stage of the economic development. When the economy develops into advanced stage, the income gap has no significant effect on the propensity to consume, but beyond that stage the propensity to consume would decrease as the widening of the income inequality. Therefore, they held that the main reason for the lower propensity to consume is the widening inequity of the household income in recent years. Zeng and Hu (2006) analyzed the relationship between the income gap and the propensity to consume in Chinese urban area and found that the expansion of the income gap is the main reason for the decline in the propensity to consume in the urban area. Yang and Hou (2009) empirically found that even if the proportion of the income of the middle and low income groups increases slightly in China, the total consumption demand would increase by ten billion RMBs. Therefore, they suggested to shorten the income gap in order to stimulate the consumption demand.

Through carefully analysis, we observe that prior studies basically supported the negative effects of the income gap on the consumption demand by showing that the average propensity to consume decreases as the income increases. The theoretical core of these studies is the law of "the decrease in Marginal Propensity to Consume". However, most of them didn't theoretically show the channel through which the expansion of the income gap negatively affects the consumption demand. In other words, these studies do not have micro foundation for the relationship between the income gap and the consumption demand. This paper constructs a market exchange model based on asymmetric information to show the channel through which the expansion of the income gap negatively affects the consumption demand and then conducts the empirical analysis.

In addition, there are several weaknesses of the empirical papers mentioned above. First, the indexes measuring the income gap are not consistent. Some of the papers used Gini coefficient but others used the income ratio of urban residents to rural residents to measure the income gap. The former cannot reflect the change of the income gap in various income groups and isn't sensitive to the change of income proportion of the low-income group. The latter is too simple to accurately reflect the change of income distribution between the various income groups. Moreover, many papers didn't explain how to calculate the Gini Coefficient. Second, considering the availability of the data, most papers have used time-series data to conduct the empirical analysis. Therefore, the regression results are usually biased because the sample size is too small or because there are spurious regression problems. Third, most paper didn't discuss the dynamic relationship between the income gap and the consumption demand, and thus cannot determine the long-term and short-term causal relationship between them.

Using time-series data in China during the period from 1978 to 2014, this paper empirically studies the effects of the income gap on the consumption demand by employing the VAR model. Different from prior studies, this paper contributes to the existing literature in this field in the

following five aspects. First, we construct a theoretical model to show how the income gap affects the consumption demand. Second, this paper uses three indexes to measure the income gap in China. There are urban Gini Coefficient, rural Gini Coefficient, and the income ratio of urban residents to rural residents. Third, we employ the *VAR* model to conduct the empirical analysis in order to overcome the autocorrelation and spurious regression problems. Fourth, the paper uses Granger Causality test to determine the long-term and short-term causal relationship between the income gap and the consumption demand. Last, the paper uses the Impulse Response Function and Variance Decomposition to further explore the dynamic relationship between the income gap and the consumption demand.

3 Theoretical Model

3.1 Hypotheses

Before constructing the theoretical model, we make several assumptions to simplify the real economy. It should be noted that each assumption that either other scholars have proved or is an empirical fact is justified.

1. Considering a transaction between a buyer and a seller, where the seller does not know exactly how much the buyer is willing to pay for the good because of asymmetric information.[4]

2. The buyer's preferences are represented by the utility function

$$u(q, T, \theta) = \int_0^q P(x, \theta)dx - T \tag{1}$$

where q is the number of units of goods purchased, T is the total amount paid to the seller, and $P(x, \theta)$ is the inverse demand curve of a buyer with preference characteristics θ. Throughout this part we shall consider the following special and convenient functional form for the buyer's preferences (Maskin and Riley, 1984a):

$$u(q, T, \theta) = \theta v(q) - T \tag{2}$$

where $v(0) = 0$, $v'(q) > 0$, and $v''(q) < 0$ for all q. Apparently, $v(q)$ is a monotonically increasing concave function through the origin. The characteristics θ are private information to the buyer. The seller knows only the distribution of θ, $F(\theta)$.

The parameter θ is the key to this paper so we need to explain it in detail. The parameter θ represents the type of the buyer and it can be any value. In order to make the research easy, we only assigns θ two values: θ_L and θ_H, where $\theta_L < \theta_H$. According to utility function, the greater θ is, the higher the utility is when q and T remain unchanged. In other words, the greater θ is, the more the consumer surplus is, as illustrated in Figure 4. According to the Figure 4, we find that the outcome derived from the utility function is consistent with the outcome derived from the Figure 4 only when the inverse demand curve of a buyer of θ_H is in the upper right of the inverse demand curve of a buyer of θ_L. Under these circumstances, the number of goods purchased by a buyer of type θ_H is greater than that of type θ_L if the price that this two types of buyer pay are the same, or the price that a buyer of type θ_H is willing to pay is more than that of type θ_L if the number of goods purchased by this two types of buyer are the same. Therefore, we define the buyer of type

[4] The transaction objects can be goods or services. In order to simplify the analysis, the paper focuses on the goods.

θ_H as rich people and buyer of type θ_L as poor people because, generally speaking, the number of goods purchased by the rich is greater than the poor in the same price or the price that the rich is willing to pay is more than the poor in the same amount purchased by them. To sum up, the parameter θ actually measures the level of people's wealth. The higher θ is, the richer the buyer is.

3. The consumer is of type θ_L with probability $\beta \in [0, 1]$ and of type θ_H with probability $(1-\beta)$. The probability β can also be interpreted as the proportion of consumers of type θ_L.[5] It should be noted that because of asymmetric information, the consumers know exactly what type they are but the seller do not know that and he just knows the proportion of the rich and the poor respectively.

4. Assuming that the seller's unit production costs are given by $c > 0$, his profit from selling q units against a sum of money T is given by $\pi = T - cq$.

3.2 Payoff Function and Constraints

Since the seller does not observe the type of the buyer, he is forced to offer the buyer a set of choices independent of the buyer's type. Without loss of generality, a set of choices can be described as $[T(q_L), q_L]$ and $[T(q_H), q_H]$. The two types of buyers will pick the appropriate choice that maximizes their payoff. If we define $T(q_i)=T_i$ for $i=L, H$, the problem of the seller is to solve

$$\max_{T_i, q_i} \pi = \beta(T_L - cq_L) + (1-\beta)(T_H - cq_H)$$

In order to ensure that the buyer picks the corresponding schedule, we need to add two incentive-compatibility constraints:

$$\theta_H v(q_H) - T_H \geq \theta_H v(q_L) - T_L \tag{3}$$

$$\theta_L v(q_L) - T_L \geq \theta_L v(q_H) - T_H \tag{4}$$

In addition, we also need to add two individual-rationality constraints: [6]

$$\theta_H v(q_H) - T_H \geq 0 \tag{5}$$

$$\theta_L v(q_L) - T_L \geq 0 \tag{6}$$

The last two constraints ensure that both the rich and the poor will participate in the market transaction.

3.3 Optimal Solutions

First of all, (5) will indeed be satisfied automatically because of (3) and (6):

$$\theta_H v(q_H) - T_H \geq \theta_H v(q_L) - T_L \geq \theta_L v(q_L) - T_L \geq 0$$

where the inequality in the middle comes from the fact that $\theta_H > \theta_L$.

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[5] We don't plan to further discuss the distinction between the rich and the poor and just assume the proportion of the poor to simplify the analysis in the next part.

[6] We assume that the reservation utility of the buyer is zero. In other words, if the buyer does not participate in market transaction, the utility that he will receive is zero.

Secondly, the strategy now is to relax the problem by deleting one incentive constraint, solve the relaxed problem, and then check that it does satisfy this omitted incentive constraint. In order to choose which constraint to omit, consider the optimal solution in the complete information. [7] It involves efficient consumption and zero surplus for both types of buyers, that is,

$$\theta_i v'(\tilde{q}_i) = c \tag{7}$$

$$\theta_i v(\tilde{q}_i) = \tilde{T}_i \tag{8}$$

Intuitively, under the complete information, the seller finds it optimal to maximize total surplus by having the buyer select a quantity such that marginal utility equals marginal cost and then setting the payment so as to appropriate the full surplus and leave no surplus to the buyer above zero.

This outcome is not incentive compatible, because the θ_H buyer will prefer to choose $(\tilde{T}_L, \tilde{q}_L)$ rather than her own optimal allocation: while this inefficiently restricts her consumption, it allows her to enjoy a strictly positive surplus equal to $(\theta_H - \theta_L)\tilde{q}_L$, rather than zero surplus. Instead, type θ_L will not find it attractive to raise her consumption to the level $\tilde{q}_H$: doing so would involve paying an amount $\tilde{T}_H$ exhausts the surplus of type θ_H and would therefore imply a negative payoff for type θ_L, who has a lower valuation for this consumption. Therefore, we choose to omit constraint (4).

Finally, it should be noted that these two constraints (3) and (6) will bind at the optimum; otherwise, the seller can raise T_i until it does bind: this process leaves the constraints unaffected while improving the maximand.

Substituting for the values of T_H and T_L that derive from (3) and (6) in the seller's objective function, we obtain the following unrestricted optimization problem:

$$\max_{q_L,\, q_H} \pi = \beta[\theta_L v(q_L) - cq_L] + (1-\beta)[\theta_H v(q_H) - cq_H - (\theta_H - \theta_L)v(q_L)]$$

The following first-order conditions characterize the unique interior solution $(\bar{q}_L, \bar{q}_H)$ to the relaxed program, if this solution exists: [8]

$$\theta_H v'(\bar{q}_H) = c \tag{9}$$

$$\theta_L v'(\bar{q}_L) = \frac{c}{1-(\frac{1-\beta}{\beta})(\frac{\theta_H-\theta_L}{\theta_L})} \tag{10}$$

3.4 Theoretical Analysis

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[7] The seller is perfectly informed about the buyer's type in the complete information. The seller can then treat each type of buyer separately and offer her a type-specific contract, that is, (T_i, q_i) for type θ_i $(i=H, L)$. In this case, the seller will solve

$$\max_{T_i, q_i} \pi = \beta(T_L - cq_L) + (1-\beta)(T_H - cq_H)$$

subject to

$$\theta_H v(q_H) - T_H \geq 0$$

$$\theta_L v(q_L) - T_L \geq 0$$

In this problem, these two constraints will bind at the optimum; otherwise, the seller can raise T_i until it does bind. The solution to this problem will be the contract $(\tilde{T}_i, \tilde{q}_i)$ that satisfies the eqs. (7) and (8).

[8] If the denominator of the second expression is not positive, then the optimal solution involves $\bar{q}_L = 0$, while the other consumption remains determined by the first-order condition.

When the income gap is gradually expanding, the rich people will become more and wealthier and the poor people will relatively become more and poorer, although the poor people's income is also increasing compared with the previous status. In other words, θ_H will become larger and although θ_L also become larger, the distance between θ_H and θ_L is gradually expanding. Based on this analysis, we can arrive at three conclusions:

First, according to the equation (9), when the θ_H becomes larger the optimal quantity of the rich people, namely $\bar{q}_H$, will increase because $v(q)$ is a monotonically increasing concave function. This result is consistent with the common sense that the consumption demand of the rich people will naturally increase if they become richer.

Second, rearranging the equation (10), we can find that

$$v'(\bar{q}_L) = \frac{c\beta}{\theta_L - \theta_H(1-\beta)} \tag{11}$$

According to the analysis above, $\theta_L - \theta_H(1-\beta)$ is gradually decreasing because θ_H is growing faster than θ_L. As a result, the optimal quantity of the poor people, namely $\bar{q}_L$, will decrease. In other words, the expansion of the income gap between the rich and the poor makes the latter unable to consume and thus leads to the insufficiency of the consumption demand by the poor.

Last, considering the increased consumption of the rich and the decreased consumption of the poor, the aggregate consumption demand may increase or decrease. We hypothesize that the aggregate demand decreases as the income gap expands. In the next sections, we empirically studies the effects of the income gap on the consumption demand using Chinese time-series data during the period from 1978 to 2014.

4 Regression Strategy and Data Description

4.1 Regression Strategy

Since the paper uses time-series data which may produce "spurious regression", we plan to employ the Vector Autoregression (*VAR*) model to study the relationship between the income gap and the consumption demand. *VAR* isn't rigidly confined to the framework of economic theory and its approach is that a limited number of current variables is regressed on the lagged values of both the variable itself and other variables, which means that "let the data speak for itself" (Gujarati, 2000). In other word, this approach explores the short-term and long-term equilibrium relationship between variables based on the inherent characteristics of data itself. In the following empirical analysis, we will first test the data's stationarity. If these data are integrated to same orders, we will conduct Cointegration test and Granger Causality test to obtain the long-term equilibrium relationship between these variables and to determine the causal relationship between them. Based on the Cointegration, the paper will further construct Vector Error Correction Model to obtain the short-term relationship between these variables. Finally, the paper will use Impulse Response Function and Variance Decomposition to explore the dynamic relationship between the income gap and the consumption demand.

4.2 Data Description

The paper uses time-series data in China from 1978—2014 to conduct the regression analysis. In the regression model, we use the percentage of residents' aggregate consumption in GDP, named the consumption rate (C), to measure residents' consumption demand. The trend of the consumption rate is shown in Figure 1. It should be noted that both resident consumption and GDP are adjusted so as to eliminate the effects of price factor. The income gap is the key variable in the paper. In order to accurately measure the income gap, the paper uses three indexes: the urban Gini Coefficient (G_1), the rural Gini Coefficient (G_2), and the income ratio of urban residents to rural residents (G_3). All variables are collected from the National Bureau of Statistics of China (NBS).[9]

4.2.1 Gini Coefficient

Gini Coefficient is an important indicator of the income inequality. Although there are many criticisms about the Gini Coefficient, it is generally regarded as one of the best indicators of the income inequality. Due to data limitations and different methods of calculation, researchers obtained different values of the Gini Coefficient in the past. This paper uses the most common method to calculate the Gini Coefficient (Chen, 1991). Before calculating it, we make several assumptions:

① Let P_i be a proportion of the population of i's group to the total population

② Let I_i be a proportion of the income of i's group to the total income

③ Let M_i be a accumulative proportion of the population from the first group to the i's group, namely

$$M_i = P_1 + P_2 + \cdots + P_i$$

④ Let Q_i be a accumulative proportion of the income from the first group to the i's group, namely

$$Q_i = I_1 + I_2 + \cdots + I_i$$

The formula to calculate the Gini Coefficient is

$$G = \sum_{i=1}^{n-1}(M_i Q_{i+1} - M_{i+1} Q_i) \tag{12}$$

Based on this formula, we calculate the urban and rural Gini Coefficients in China during 1978—2014, which is shown in Figure 5. It can be seen that these two Gini Coefficients basically increased from 1978 to 2014. It indicates that the income gap in both urban and rural areas indeed expanded during 1978—2014.

4.2.2 Income Ratio of Urban Residents to Rural Residents

Now we calculate the income gap between urban and rural areas in China which is also the important reason for the insufficiency of the consumption demand. Although China has maintained an average annual economic growth rate of 9.7% since reform and opening in 1978, rural residents didn't enjoy the achievement of high speed development, which results in the decline in the

[9] National Bureau of Statistics of China: http://db.cei.gov.cn. http://www.stats.gov.cn/.

proportion of the total income earned by rural residents to GDP. Moreover the welfare system hasn't fully established in the rural areas and thus rural residents are cautious of the consumption and even reluctant to consume. In this paper, we use the income ratio of urban residents to rural residents to measure the income gap between the urban and the rural areas, which is shown in Figure 6.[10] It can be seen that this income ratio first decreased and then increased a lot. In 2014, the income ratio of urban residents to rural residents reached 3.84.

Table 1 shows the definition and statistical description of all variables. In the empirical section, we include all these three variables into the model and estimate the effects of the income gap on the consumption demand in China.

4.2.3 Testing Stationarity of Data

Before constructing *VAR* model and estimating Cointegration relationships, we need to test data's stationarity because the Cointegration relationships exist only if these variables are integrated to same orders. We use the Augmented Dickey-Fuller (ADF) test and the lag length is determined by Akaike Info Criterion (AIC). As shown in Table 2, the Augmented Dickey-Fuller tests suggest that C, G_1, G_2 and G_3 are all $I(1)$. Therefore, the Cointegration relationships exist.

5 Regression Analysis

5.1 *VAR model*

We first construct the *VAR* model to conduct the empirical researches. The *VAR* model adopts the form of simultaneous equations. In order to estimate the dynamic relationships of all endogenous variable, each endogenous variable is regressed on the lagged value of all endogenous variables in the equations.

The representation of the *VAR* model is as follows: [11]

$$\boldsymbol{y}_t = \boldsymbol{\Phi}_1\boldsymbol{y}_{t-1} + \boldsymbol{\Phi}_2\boldsymbol{y}_{t-2} + \cdots + \boldsymbol{\Phi}_p\boldsymbol{y}_{t-p} + \boldsymbol{\varepsilon}_t \quad t = 1, 2, \cdots, T \tag{13}$$

where $\boldsymbol{y}_t$ is the k-dimensional column vector of the endogenous variables, and p and T represent the lag length and the size of sample respectively. $\boldsymbol{\Phi}_1, \cdots, \boldsymbol{\Phi}_p$ are the coefficient matrixes to be estimated. $\boldsymbol{\varepsilon}_t$ is the k-dimensional column vector of disturbances which can be correlated with each other in the same period but cannot be correlated with themselves in the lagged values. There are two things needed to determine in the construction of the *VAR* model. First of all, which variables should be included in the column vector $\boldsymbol{y}_t$? Since the paper studies the effects of the income gap on the consumption demand, $\boldsymbol{y}_t$ includes four variables: C, G_1, G_2 and G_3. Secondly, we need to determine the lag length p. On the one hand, the lag length p should be long enough to accurately reflect the dynamic relationships among the variables. On the other hand, the longer the lag length is, the more the coefficients needed to estimate is, and the less the degree of freedom of the model

[10] In the NBS, the income of urban residents is measured by the per capita disposable income, but the income of rural residents is measured by the per capita net income.

[11] This model originally includes a column vector of the exogenous variables but the paper doesn't involve the exogenous variables and thus they are excluded from the model.

is. According to the Likelihood Ratio test, AIC and SIC, the optimal lag order is 2 in the unrestricted *VAR* model.

5.2 Cointegration Test and Granger Causality Test

There are usually two approaches for testing for Cointegration. The first approach proposed by Engle and Granger (1978) is based on assessing whether the single-equation estimates of the equilibrium errors appear to be stationary. The Engle-Granger approach is usually applied to test Cointegration in the single equation. The second approach, due to Johansen (1988, 1991), is based on the *VAR* model and has a relatively high power of test. Considering the *VAR* model used in the paper, we will use the Johansen's approach to conduct the Cointegration test.

Cointegration test model is actually obtained by constraining the unrestricted *VAR* model and its lag length is the same as the lag length of the first-difference variable in the unrestricted *VAR* model. Therefore, the lag length of the Cointegration test model is 1. In addition, the paper assumes that there is an intercept but no deterministic trend in the Cointegration test model. The results of the Johansen Cointegration Test is shown in Table 3. It can be seen from the Table 3 that there is at least a Cointegration relationship among variables in the *VAR* model, which indicates that there indeed exists long-term equilibrium relationships between the consumption demand variable and three types of the income gap variables.

Through the Cointegration test, we has proved the existence of the long-term equilibrium relationships among the variables. Naturally, the next question is: what are the causal relationships among them? We use Granger Causality test to determine the long-term causal relationships between the consumption demand and three types of the income gap. The basic principle of the Granger Causality test is that if the past and present information about X contribute to forecasting the value of Y, then Y is caused by X' Granger reason. According to the results of the Granger Causality test shown in Table 4, the three types of the income gap variables are indeed the long-term reasons for the insufficiency of the consumption demand. However, the consumption demand in turn is not the Granger reason for G_1 and G_2 and only has significant effect on G_3 in the long run. Based on this analysis, we can obtain the Cointegration relationship among these variables. That is,

$$C = 5.684^{***} - 0.115^{***} \times G_1 - 0.057^{*} \times G_2 - 0.038^{***} \times G_3 \quad (14)$$

Based on the Cointegration relationship (14), we find that the three kinds of the income gap variables are negatively correlated with the consumption demand in the long run, which indicates that the expansion of the income gap indeed decreases the consumption demand of residents in China. Specifically, the residents' consumption rate decreases by 0.115 percentage points if the urban Gini Coefficient rises by 1 percentage points. The residents' consumption rate decreases by 0.057 percentage points if the rural Gini Coefficient rises by 1 percentage points. The residents' consumption rate decreases by 3.8 percentage points if the income ratio of urban residents to rural residents rises by 1. These results confirm our hypothesis. When the income gap gradually expands, the rich people become richer and the poor people become poorer. Since the rich people's *MPC* is decreasing as the wealth increases, a large proportion of wealth cannot be converted into consumption. Furthermore, the majority of low-income people has no enough money to spend. As a result, the expansion of the income gap results in the decline in aggregate *APC*. Moreover, the expansion of the income gap also reduces the low-income people's expectation of the permanent

income and all kinds of welfare systems haven't fully established in China. These two factors make the low-income people save more money for the future consumption and thus reduce the current consumption demand.

We can also estimate the respective contributions of the income gap variables to the decline in the residents' consumption rate during the period from 1978 to 2014. From the Figure 5, we observe that the urban and rural Gini Coefficient rise by 29.2 percentage points and 21.5 percentage points respectively during the period from 1978 to 2014. According the Cointegration relationship (14), the increase of the urban and rural Gini Coefficients makes the residents' consumption rate decreases by 3.36 percentage points and 1.23 percentage points respectively. From the Figure 6, we observe that the income ratio of urban residents to rural residents rises by 1.27 during the period from 1978 to 2014. According the Cointegration relationship (14), the residents' consumption rate will decrease by 4.85 percentage points. During this period, the residents' consumption rate actually decreased by 10.87 percentage points. Therefore, the urban Gini coefficient, the rural Gini coefficient, and the income ratio of urban residents to rural residents can explain 30.9%, 11.3% and 44.6% of the extent of the decline in the residents' consumption rate respectively. Obviously, the income ratio of urban residents to rural residents is the most important reason for the insufficiency of the consumption demand in China.

5.3 Vector Error Correction Model

The Cointegration test proves that there indeed exists a long-term stable equilibrium relationship between the three types of the income gap variables and the consumption demand in China. However, whether there exists a short-term dynamic relationship between them needs to be further confirmed. Now we use Vector Error Correction Model (*VECM*) to discuss the short-term dynamic relationship between the three types of the income gap variables and the consumption demand in China. Since the lag length of *VECM* is the same as the lag length of the first-difference variable in the unrestricted *VAR* model, the lag length of *VECM* is 1. The regression results are shown in Table 5.

It can be seen from the Table 5 that the all the Error Correction Terms (*ECT*s) are statistically significant in the Error Correction Equations. The magnitudes of the *ECT*s reflect the extent of adjustment to deviation from the long-term equilibrium. The economic implication is that when the short-term fluctuations deviate from the long-term equilibrium, the *ECT*s will make an adjustment of –0.07, –0.11, –0.05 and –0.13 so as to return to the long-term equilibrium again.

In addition, the effects of three types of the income gap variables on the consumption demand are different in the short run. As shown in the Column (1) in the Table 5, the urban Gini Coefficient is negative and significant, which indicates that the expansion of the income gap of urban residents decreases the consumption demand in the short run. The rural Gini Coefficient is negative but not significant, which indicates that the expansion of the income gap of rural residents has no significant effect on the consumption demand in the short run. The possible reason is that in the short run the increase in the consumption by the high-income group is roughly equal to the decrease in the consumption by the low-income group in the China's rural area. The coefficient of the income ratio of urban residents to rural residents, however, is significantly positive, which indicates that the increase in the income ratio promotes the consumption demand in the short run. To some extent, this empirical result is consistent with the China's actual conditions. At present,

China still has typically dual economic characteristics and the urban-rural division still exists. Under these circumstances, the consumption behaviors of the urban and rural residents cannot synchronize. In other words, the urban residents can afford the relatively expensive and high-quality commodities but the rural residents who are usually low-income people only purchase the relatively cheap and unfashionable commodities. Therefore, appropriately widening the income gap between the urban and rural areas just matches with their respective consumption behaviors, which to some extent can effectively promote the consumption demand and stimulate the economic development. Specifically, the residents' consumption rate would increases by 0.18 percentage points if the income ratio of urban residents to rural residents rises by 1 percentage point. However, since the income ratio cannot considerably change in the short run, the effects of the expansion of the income gap between the urban and rural residents on the consumption demand can be neglected in the short run.

5.4 Impulse Response Function and Variance Decomposition

Both Cointegration equation and Vector Error Correction Model give a perfect description of the long- and short-term relationships between the three types of the income gap and the consumption demand in China. Next, we use Impulse Response Function (*IRF*) and Variance Decomposition (*VD*) to further explore the dynamic relationships between them.

Previous researches often use Cholesky Orthogonal Decomposition method proposed by Sims (1987) to study the Impulse Response Function. But changing the order of the variables may obtain different impulse response functions using this method. In order to overcome this disadvantage, we use Generalized Impulse Response Function proposed by Pesaran and Shin (1996, 1998). Figure 7 describes the impulse response function curves of the income gap variables and the consumption demand. As shown in the Figure 7, the horizontal axis represents the number of lag period under the impulse (unit: year) and the vertical axis represents the response of variables to innovation. The solid line represents the actual values and the dotted line represents twice the standard deviation interval of the response values. From the Figure 7, it is not difficult to find that the dynamic relationship between the income gap and the consumption demand is roughly consistent with the previous analysis. In the long run, these three types of the income gap variables indeed have negative effects on the consumption demand. But in the short run, the negative effect of the rural Gini Coefficient is not obvious and the expansion of the urban-rural income gap promotes the consumption demand.

Figure 8 describes the result of variance decomposition of the residents' consumption rate. Variance decomposition describes the contribution of the income gap variables to the decrease in the residents' consumption rate. Obviously, the contribution of the urban-rural income gap is the largest one among the three indexes and the contribution of the rural income gap is the smallest one among them in the long run. This conclusion is consistent with the previous analysis. In addition, the consumption demand itself also can explain part of the insufficiency of the consumption demand. According to the Relative Income Hypothesis proposed by Duesenberry (1949), the current consumption is not only affected by the people's current income but also is affected by the past income and consumption, which is called "ratchet effect" or irreversibility of the consumption. As shown in the Figure 8, although the contribution of the consumption demand

itself is declining, its contribution is greater than that of the urban-rural income gap. This result shows that changing the consumption habits takes a long time.

6 Conclusions

6.1 Conclusions

The paper firstly constructs a theoretic model to demonstrate how the expansion of the income gap affects the consumption demand. Based on Cointegration test and Vector Error Correction Model, we then empirically study the effects of the three kinds of income gap variables on the consumption demand of the residents using time-series data in China during the period from 1978 to 2014.

Employing the Johansen Cointegration test, we find that there indeed exists a long-term equilibrium relationship between the three types of the income gap variables and the consumption demand in China. Moreover, the Granger Causality test confirms that the three types of the income gap variables are the real reasons for the insufficiency of the consumption demand in the long run. Specifically, the residents' consumption rate decreases by 0.115 percentage points if the urban Gini Coefficient rises by 1 percentage points. The residents' consumption rate decreases by 0.057 percentage points if the rural Gini Coefficient rises by 1 percentage points. The residents' consumption rate decreases by 3.8 percentage points if the income ratio of urban residents to rural residents rises by 1. The paper also finds that the urban Gini Coefficient, the rural Gini Coefficient, and the income ratio can explain 30.9%, 11.3% and 44.6% of the extent of the decline in the residents' consumption rate respectively in China during the period from 1978 to 2014.

But the effects of the three types of the income gap variables on the consumption demand are different in the short run. Specifically, in the short run, the expansion of the urban income gap decreases the consumption demand of the residents while the expansion of the rural income gap has no significant effect on the consumption demand of the residents. Moreover, the expansion of the urban-rural income gap promotes the consumption demand but the positive effect is not quite obvious.

6.2 Suggestions

Based on the conclusions mentioned above, the expansion of the income gap indeed is one of the important reasons for the insufficiency of the consumption demand in China. Therefore, narrowing the income gap can effectively stimulate the domestic consumption demand and promote the economic development. In this context, we make several suggestions.

Firstly, the Chinese government should further improve the income tax system. In other words, the Chinese government should appropriately increase taxes imposed on the high-income group and cut down the taxes burden on the low-income group. The Chinese government should also improve social security system and increase the amount of the social transfer payments so as to guarantee the basic living standards of the low-income group. Moreover, the Chinese government should do its best to increase employment in order to alleviate poverty caused by unemployment and gradually increase the income proportion earned by the low-income group. Furthermore, the

Chinese government should improve legal system to fight against the illegal income which is regarded as one of the most important reasons for the expansion of the income gap of the residents.

Secondly, the Chinese government should narrow the income gap by readjusting the industrial structure. In order to ensure the quality of economic development, the Chinese government should encourage domestic enterprises to develop high-tech industries. However, China still abounds with labors at present. Therefore, the Chinese government should implement policies to promote the development of the labor-intensive industries because letting people have jobs is an effective measure to narrow the income gap.

Finally, the Chinese government should get rid of the institutional barriers of the urban-rural division and improve the medical insurance system in the vast rural areas. Specifically, the Chinese government should continue to expand the coverage of the new rural social pension insurance and gradually adopt the combination of family support, social endowment and commercial insurance. Moreover, the Chinese government also should eliminate the differences between the urban residents and rural residents.

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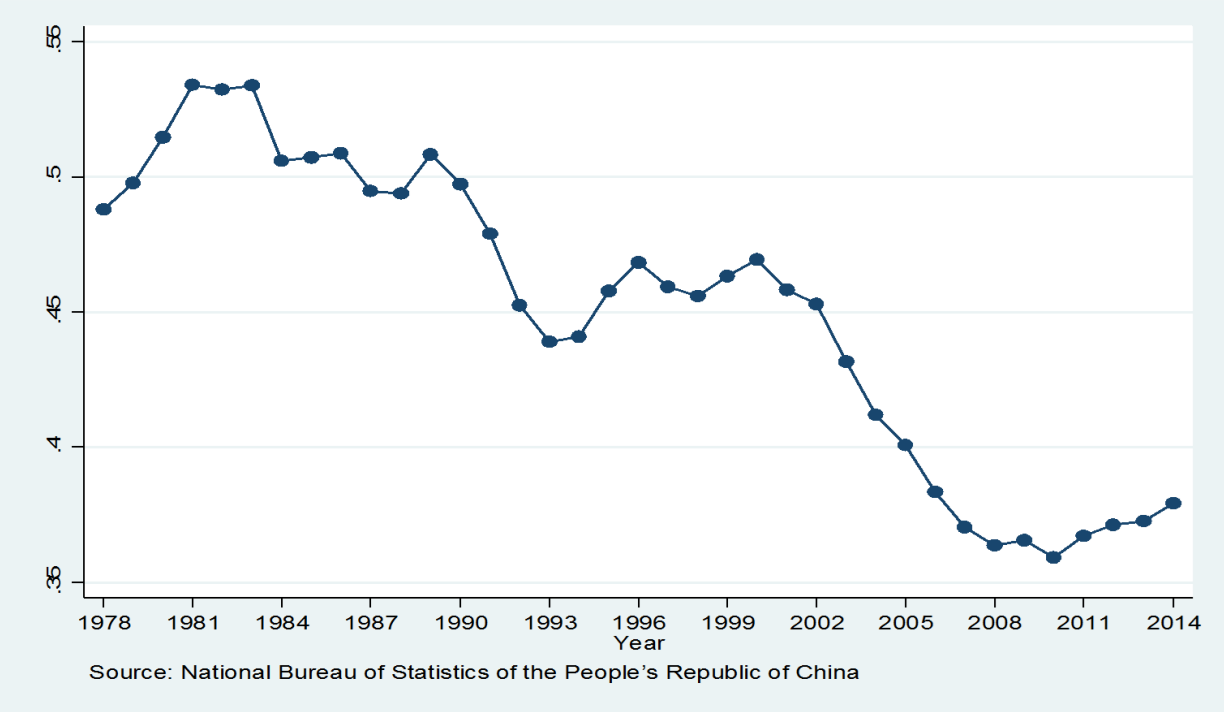


Figure 1 Aggregate Consumption as a Percentage of GDP in China during 1978—2014

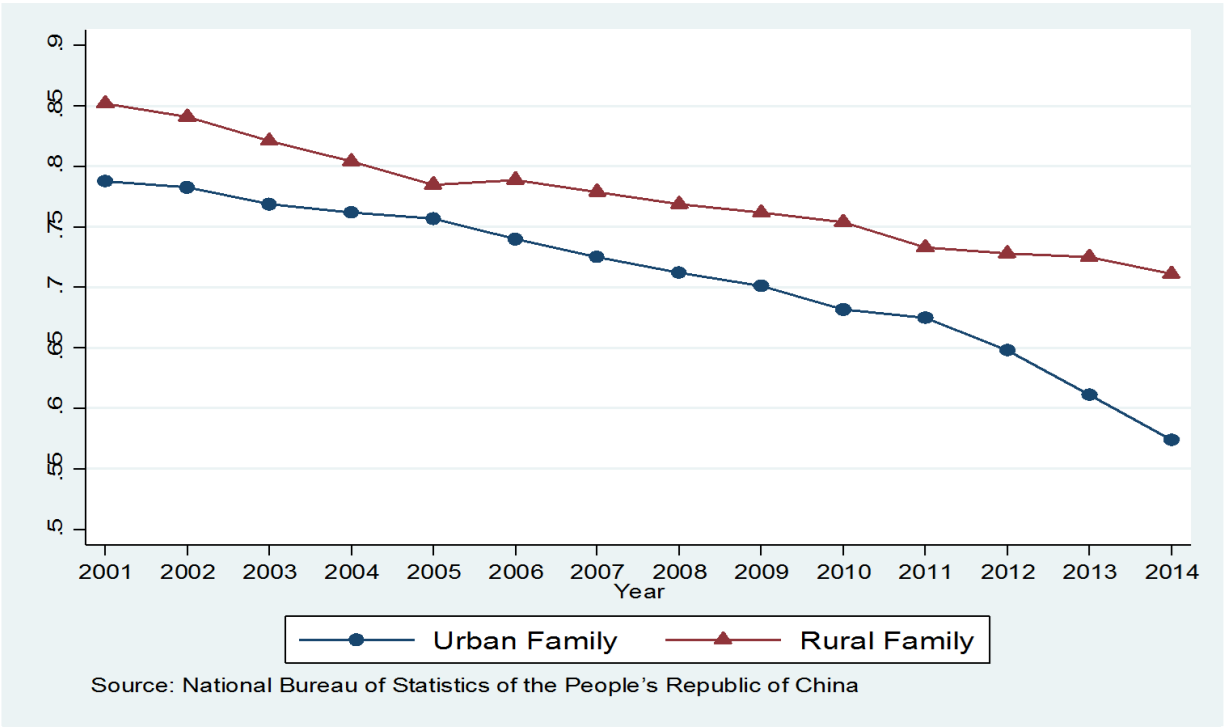
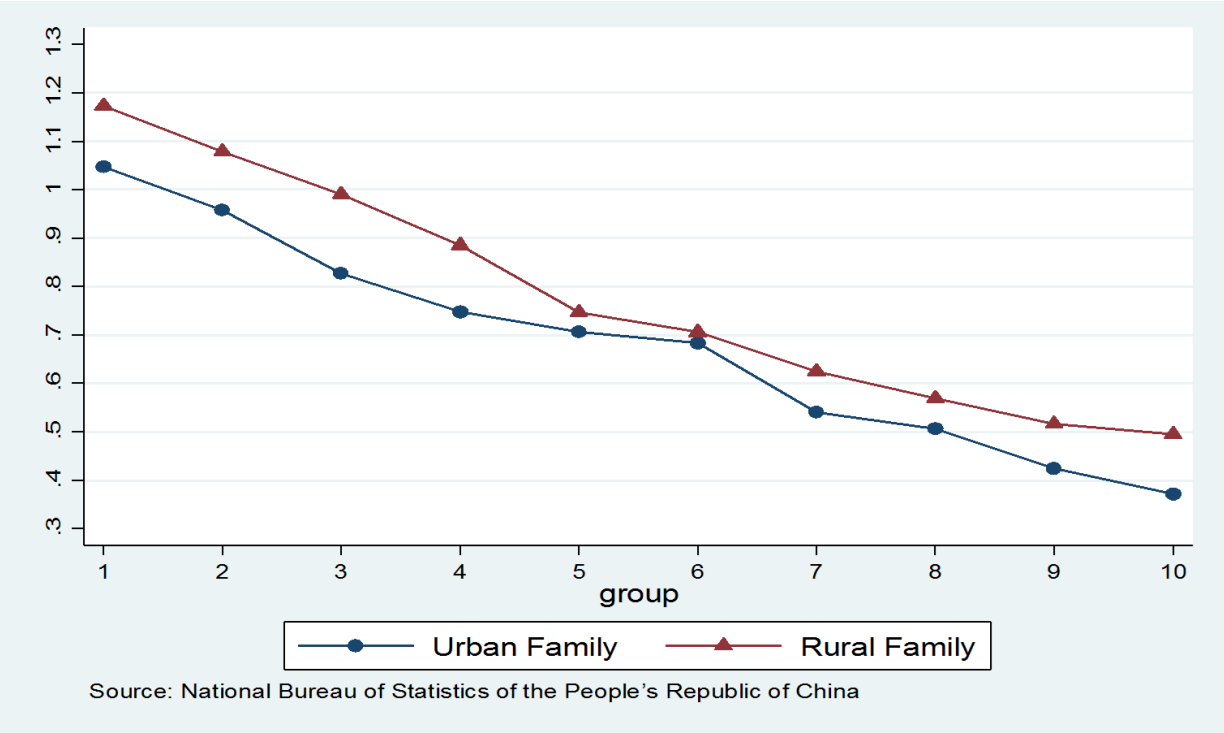


Figure 2 Average Propensity to Consume (*APC*) of Urban Family and Rural Family during 1978—2014



Note: The first group is the lowest income group and the tenth group is the highest income group.

Figure 3 Average Propensity to Consume (*APC*) of Different Groups within Urban Family and Rural Family

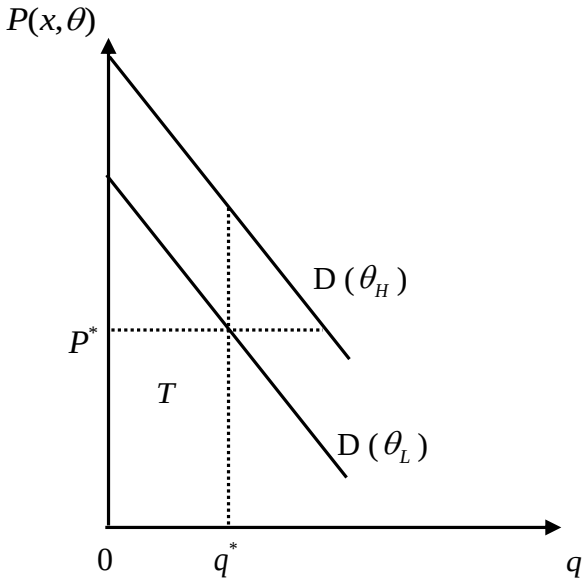


Figure 4 Consumer's Inverse Demand Curves

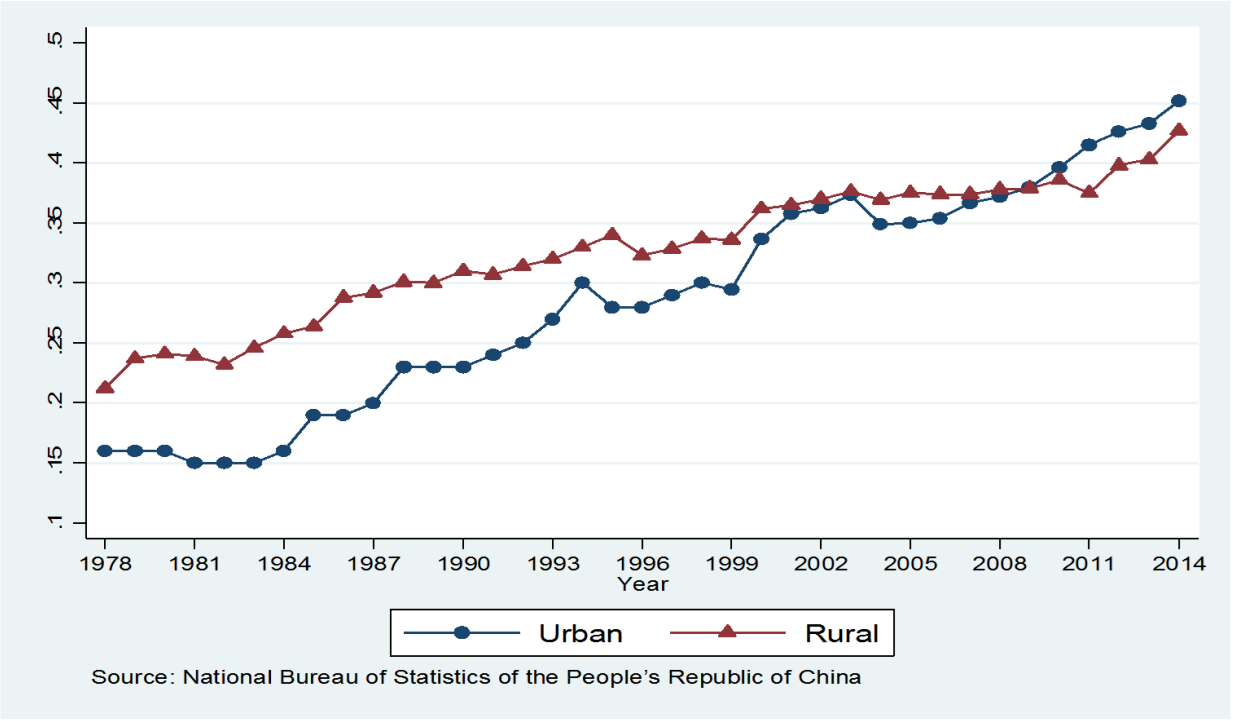


Figure 5 Urban and Rural Gini Coefficients in China during 1978—2014

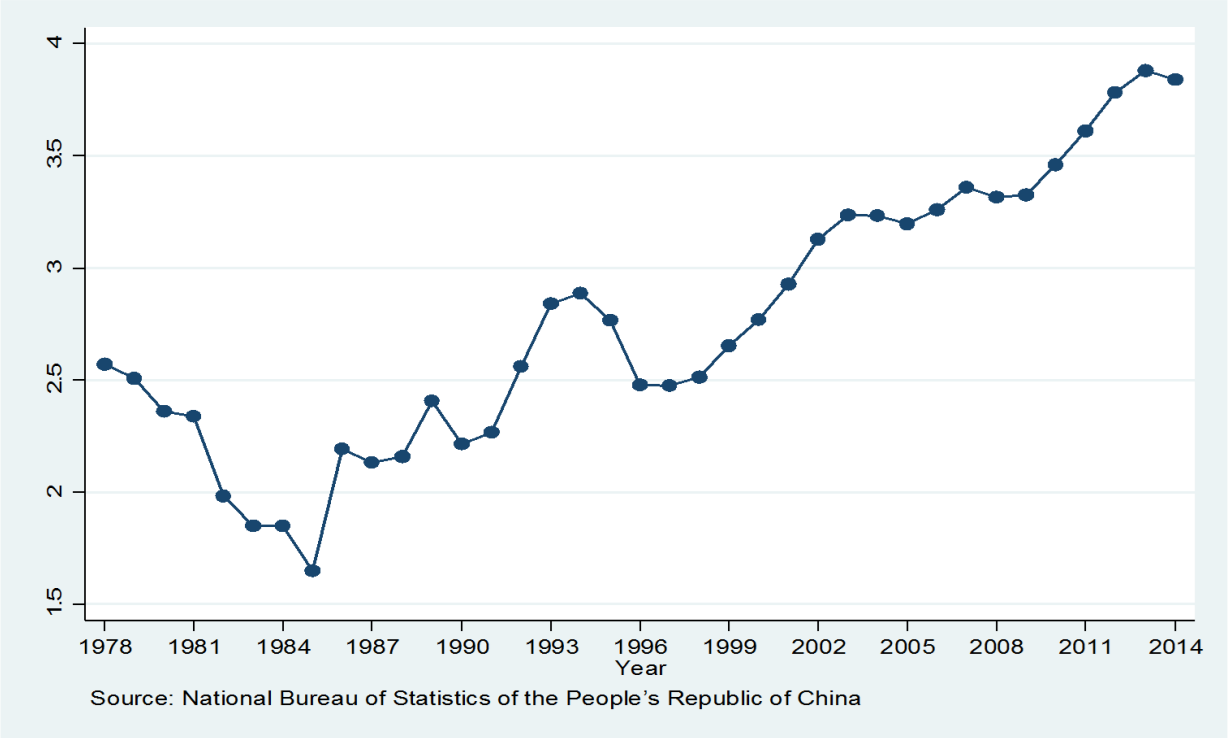
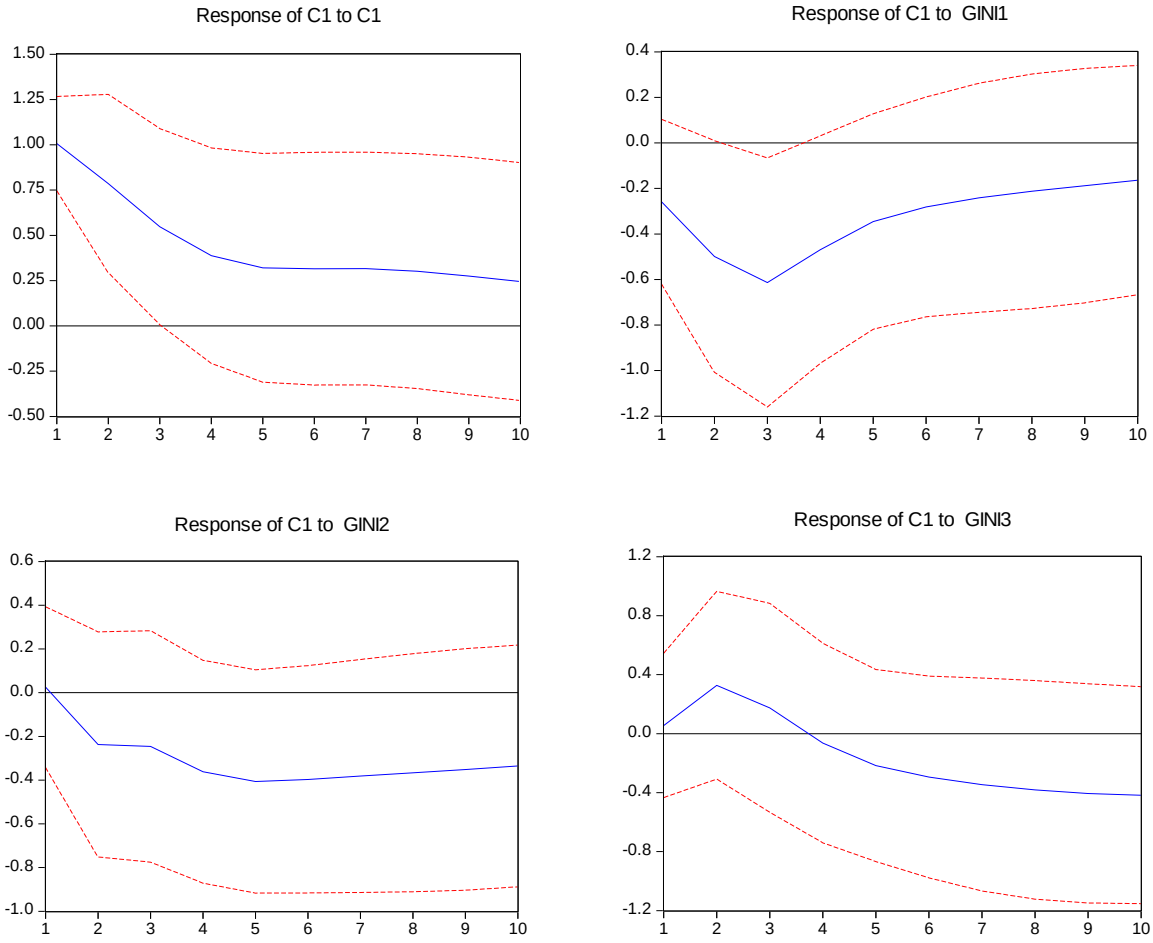


Figure 6 Income Ratio of Urban Residents to Rural Residents during 1978—2014



Notes: C1 represents consumption rate of the residents; GINI1 represents urban Gini Coefficient; GINI2 represents rural Gini Coefficient; GINI3 represents income ratio of urban residents to rural residents.

Figure 7 Impulse Response Function

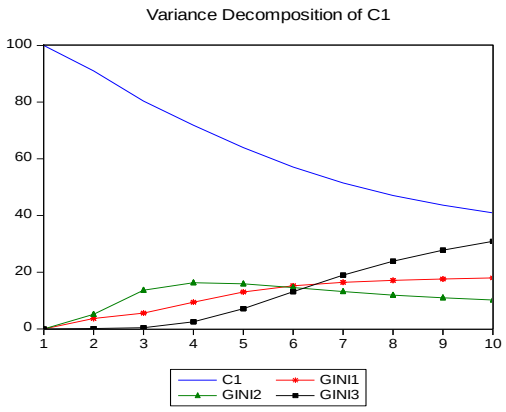


Figure 8 Variance Decomposition

Table 1 Statistical description of all variables (N = 37)

Variables	Definition	Mean	Std. Dev.	Min	Max
C	Percentage of residents' aggregate consumption in GDP	0.451	0.056	0.359	0.534
G_1	Urban Gini Coefficient	0.286	0.093	0.150	0.452
G_2	Rural Gini Coefficient	0.326	0.056	0.212	0.427
G_3	Income ratio of urban residents to rural residents	2.756	0.594	1.649	3.880

Table 2 Augmented Dickey-Fuller Tests for Variables

Variables	$I(0)$				$I(1)$			
	Spec.	ADF	Crit. Value	Conclusion	Spec.	ADF	Crit. Value	Conclusion
C	(C, T, 1)	–1.88	–3.22*	non-stationary	(C, 0, 1)	–3.18	–2.97**	stationary
G_1	(C, T, 0)	–2.81	–3.22*	non-stationary	(C, 0, 0)	–5.23	–3.67***	stationary
G_2	(C, 0, 0)	–1.11	–2.62*	non-stationary	(C, 0, 1)	–3.50	–3.27*	stationary
G_3	(C, 0, 4)	–0.17	–2.62*	non-stationary	(C, 0, 2)	–4.14	–3.70***	stationary

Notes: In the specification (C, T, K), C represents that the test equation includes Intercept and T represents that the test equation includes Trend and K represents the lag length. ***, ** and * represent statistical significance in the significance level of 1%, 5% and 10% respectively.

Table 3 Johansen Cointegration Test

Null Hypothesis	Eigenvalue	Trace Statistic	0.05 Critical Value	P-value
None**	0.55	59.24	54.08	0.0161
At most 1**	0.47	35.37	35.19	0.0478
At most 2	0.28	16.39	20.26	0.1571
At most 3	0.20	6.55	9.16	0.1526

Notes: Sample (adjusted): 1980-2009; Lags interval (in first differences): 1 to 1; ** represents statistical significance in the significance level of 5%.

Table 4 Granger Causality Test

VAR model (C, G_1, G_2, G_3)′			
Null Hypothesis (H_0)	χ^2 Statistic	P-value	Conclusion
G_1 is not the Granger reason for C	7.31**	0.0258	Reject H_0
G_2 is not the Granger reason for C	4.89*	0.0867	Reject H_0
G_3 is not the Granger reason for C	19.08***	0.0040	Reject H_0
C is not the Granger reason for G_1	2.90	0.2341	Accept H_0
C is not the Granger reason for G_2	0.12	0.9415	Accept H_0
C is not the Granger reason for G_3	7.05**	0.0294	Reject H_0

Note: ***, ** and * represent statistical significance in the significance level of 1%, 5% and 10% respectively.

Table 5 Vector Error Correction Model

Variables	(1)	(2)	(3)	(4)
	ΔC	ΔG_1	ΔG_2	ΔG_3
ECM_{t-1}	–0.07(–2.44)**	–0.11(–2.79)***	–0.05(–2.21)**	–0.13(–2.54)**
ΔC_{t-1}	–0.03(–0.14)	0.21(0.80)	–0.05(–0.19)	0.04(1.63)*
ΔG_{1t-1}	–0.13(–2.79)***	0.22(1.25)	0.49(2.53)**	0.07(3.47)***
ΔG_{2t-1}	–0.08(–0.50)	–0.22(–0.98)	–0.09(–0.38)	–0.08(–2.14)**
ΔG_{3t-1}	0.18(2.08)**	0.91(0.46)	–0.13(–0.06)	0.28(1.31)

Notes: t-statistics are in parentheses; Asterisks indicate statistical significance at 1% ***, 5% **, and 10% * levels.