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# Five-year plans, China finance and their consequences

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ABSTRACT

An important factor influencing corporate finance and economic growth in China lies in its government sponsored industrial policies. Examining China's five-year plans during 1991–2010, we find that state-owned firms in government supported industries enjoy faster growth in initial public offerings and higher offer prices. Further, they enjoy faster growth in loans granted by major national banks. However, this preferential access to capital by state-owned firms appears to be achieved at the expense of non-state-owned firms which are crowded out. Government support induces more investment but also brings more overinvestment, which mainly comes from the non-state sector. Finally, supported industries have higher stock market returns and cash flow growth that dampen when state ownership increases.


## 1. Introduction

While the first three decades after the establishment of the communist China in 1949 were marred by political turmoil, instabilities, ideological rigidness and natural and human-made disasters, China's economy has

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been growing rapidly since the start of its economic reform in 1978. Its GDP reached about USD8.34 trillion (RMB51.93 trillion) in 2012 (National Bureau of Statistics of China, 2013), exceeding Japan to become the second largest economy in world in 2010. It currently has the largest foreign currency reserve in the world, reaching USD2.85 trillion in 2011, representing 30% of the global reserve (State Administration of Foreign Exchange, 2011). China's securities market was established just two decades ago. However, by the end of 2010, its total market capitalization reached USD4.01 trillion (RMB26.54 trillion), representing 66.69% of China's GDP (China Securities Regulatory Commission, 2011). By the end of 2012, its total capitalization was RMB22.97 trillion.

On the other end of the spectrum, China's rapid economic growth appears to contradict and defy mainstream economic and finance theories. China is a highly politically centralized country. Its government has the power to nominate provincial and ministerial level officials and owns a significant portion of the national economy. China's leaders have the authority to directly interfere with almost all aspects of China's economic, civil, and political affairs. China lacks the rule of law that is considered essential for the development of the capital markets (La Porta, Lopez-de-Silanes, Shleifer and Vishny, 1997, 1998, 2002a).

Therefore, it is high time for us to re-recognize the important role played the government in economic development. After many countries failed in their attempt to become developed countries in the 1970s, many economists conclude that government interventions are detrimental. This view appears to be going to one extreme of the pendulum (Lin, 2012). With the success of China's economic reform, its government's model of economic development has been receiving more and more attention, especially its ability for strategic economic planning (Sachs, 2011; Stern, 2011). We start from such a background and depict how the Chinese government, playing the role of a central planner, influences resource allocations in China's capital markets and the consequences of such an influence.

We study official documents of China's five-year plans and identify industries that the Chinese government emphasizes. We consider two financial markets, the equity market (initial and seasoned equity markets) and the bank loan market. If the government is effective in channeling resources to strategically important industries, then these industries should enjoy higher equity finance and bank loan growth. Further, corporate investment should be affected by the government's national strategies. We also examine consequences of this government engineering to determine if five-year plans are at least partially responsible for China's economic growth. If there is a positive association between the two, we conclude that government engineering is effective in spurring economic growth.[1]

A good knowledge of the heavy influence that China's political system exerts on corporate finance is important for us to understand the myriads of economic and social activities of China and its business entities. We try to comprehend China's corporate finance from the angle of its political superstructure and the interaction between the market mechanism and government control. This research can be useful in helping us understand the following issues: (1) Why can China, a country with such a severe degree of government interference, grow its economy consistently at a rapid pace over the last three decades? (2) What is the association between government engineering and corporate finance? (3) What are the consequences of government engineering?

Focusing on four of China's strategic five-year national plans during 1991–2010, we find that government supported industries enjoy faster IPO growth. However, supported state-owned firms appear to crowd out non-state-owned firms. As the government controls the IPO approval and review mechanism, IPO resources are scarce and the government can exert a powerful influence on initial equity offerings. In the SEO market, the government's control power is subdued due to an increase in market orientation. In the bank loan market, the government's power is further subdued due to a further increase in market orientation. We find that the government's influence exists mainly in loans granted by major national banks to state-owned firms. This pattern helps us understand the interactive effect of the government force and the market force in influencing resource allocations.

On the investment dimension, we find that supported industries invest more. This pattern is present in both the state and non-state sectors. However, non-state-owned firms appear to overinvest more in response to government support. This evidence is consistent with the fact that the Chinese economy is investment-driven and the momentum of investment mainly comes from the non-state sector (Barnett and Brooks, 2006).

[1] Of course, even if we fail to find a positive association, we still cannot dismiss government engineering as ineffective as external benefits that cannot be internalized within certain supported industries are often the basis of government policies.

Finally, we examine the economic performance of the five-year plan national strategies. We find that government supported industries enjoy higher stock market returns and cash flow growth but these positive effects dampen when state ownership increases. However, government supported industries have a higher ratio of non-performing loans.

While results concerning industry stock returns, cash flow growth, and the ratio of non-performing loans are not entirely consistent with each other, they help us objectively evaluate the effect of government engineering on industry performance as five-year plans are complicated and multi-dimensional strategies. Industries consistent with government policies may generate external benefits that are difficult to internalize. A high level of non-performing loans in supported industries can be a price paid for these external benefits. However, the government can potentially internalize these external benefits. While to a certain industry, an increase in non-performing loans hurts its individual interest, to the government, losses due to non-performing loans can be offset by other ensuing benefits and therefore an industrial policy can still be rational. We show that supported industries have a higher level of non-performing loans but also higher stock returns and cash flow growth. This suggests that in formulating industrial policies, the government probably considers the balance between individual industries' interests and the society's aggregate interest. This perspective helps us comprehend the coexistence of the prevalence of low efficiency industries and the rapid economic growth in China.

An important innovation of our study is that we focus on government engineered five-year plans which play an important role in China's recent economic development and its people's everyday life. It is important to note that even based on economists most critical of China's economic development, its growth has so far been a sustained one. China's experience can be useful to other late developing countries.

Allen et al. (2005) challenge the "law, finance and growth" paradigm by providing evidence of China's economic growth under a backward system of law and finance. They examine the finance and growth of the state sector, the listed sector and the private sector and find that the more financially constrained private sector enjoys faster growth and support the possibility of informal financing or relationship-based financing. However, Ayyagari et al. (2010) compare China's formal and informal financing channels and show that firms with access to formal financing channels grow faster than those that can only access informal channels, not supporting Allen et al. (2005). Allen et al. (2011) propose a substitutive mechanism in explaining China's growth. They point out that at the early growth stage of a developing country, there could exist a dynamic and adaptive mechanism that is more effective than those in developed countries, such as a mature law and finance system. They do not provide evidence of this mechanism. Our logic is similar to Allen et al. (2005, 2011). National industrial policies can be the substitutive mechanism proposed in Allen et al. (2011). We establish links among government engineering, finance, investment and performance, and potentially reconcile Allen et al. (2011, 2005) and Ayyagari et al. (2010).

This paper proceeds as follows. Section 2 reviews the literature on the nexus among government, finance and economic growth. Section 3 describes China's institutional settings and its five-year plan program. Section 4 discusses research questions. Section 5 describes data, research design and presents empirical results. Section 6 concludes.

## 2. Literature

Studying corporate finance in emerging and transitional economies, one needs to start from fundamentals such as these economies' cultures, histories, political and legal systems (Williamson, 2000; Claessens et al., 2002). These systems are intertwined and influence each other in an ever-changing process of evolution. Issues such as corporate finance are born within these fundamental factors. Only through a good understanding of these fundamental factors can one gain a glimpse of how these factors combine to explain corporate finance and economic growth.

### *2.1. Political forces, the big push, catching up and the economy*

The structure of a nation's political system can affect how resources are allocated in the economy and the society (Olson, 1965; Shleifer and Vishny, 1994; Alesina and Rodrik, 1994; Fisman, 2001; La Porta et al., 2002b; Dinc, 2005; Faccio, 2006; Khwaja and Mian, 2005; Sapienza, 2004; Claessens et al., 2008; Perotti

and Vorage, 2008, 2009). An important criterion for assessing the power of a political system is the government's ability in playing a dominant role in resource allocations. During the early stage of the industrial revolution, governments of today's developed European and North American countries all played a crucial role in building the economic system, in protecting private properties and in promoting trade (Adelman and Morris, 1988). After the Second World War, with the resurrection of the post-war economy, the role governments play in nations' economic development was widely recognized. The economies of Japan, South Korea and the South-East Asian region took off. Behind the South-East Asia Miracle are governments (World Bank, 1993). However, during South-East Asia's financial crisis in the middle of 1990s, the role of the government was criticized (Stiglitz and Yusuf, 2001). Interestingly, when the 2008 global financial crisis hit, the debate was reignited on the limited role that the market mechanism could play in resource allocations. Governments stepped forward to save their financial markets and researchers start to reevaluate the role of the government.

Since the start of its economic reform in 1978, China has realized more than 30 years of rapid economic growth. Even though this growth is not gained without problems such as pollutions, corruptions and inefficiencies, it still represents a major achievement and helps enhance China's prestige and lift hundreds of millions of people out of abject poverty. Brandt and Rawski (2008) call this "China's Great Economic Transformation". Economic growth of developing nations often cannot be simplistically viewed from a free market perspective.

Murphy et al. (1989) propose a model of industrialization for under-developed countries. They point out that a premise for industrialization in South-East Asian economies such as South Korea is the government-initiated coordinated investment strategies in various industries. Trindade (2005) use the big push theory in open economies and explains how Taiwan and South Korea's industrialization is achieved under their governments' export oriented schemes. Governments can act as the engine of economic growth. China is probably doing this on a massive scale due to the size of its economy and the power of its government.

China's contemporary history of humiliation (since its defeat in the First Opium War against the British Empire, 1839–1842) and foreign domination has created a yearning for catching up among its people and leaders. A prosperous and powerful country can defend its people's properties, rights and dignities. To many Chinese people, the biggest threat to property rights may come from external forces and not from within. External threats are associated with a nation's backwardness. Economic development is an important premise for rights protection.

The reason that the catching up strategy can be successful partially lies in the fact that developed countries' experience of success and failure reduces the information cost of national strategic decision-making and partially lies in the fact that governments can reduce transaction cost. To a certain extent, more advanced countries serve as an experimental ground for all sorts of technologies, systems, ideals and philosophies. If the catching up strategy is successful, the biggest beneficiaries are governments as they can enhance their legitimacy of ruling.

A less developed country may have to start from simple imitation if it strives to catch up with more advanced countries. China is no exception. China's catching up economic development strategy has gone through three stages: catching up based on a simple imitation of the completely planned economy of the former Soviet Union; catching up based on the comparative advantage strategies driven by both the government and the market; and catching up based on system innovation. Currently, China is transforming from the second stage to the third stage. This is the technological background of today's China.

Transforming is difficult. As a poor developing country, China formulated a catching up strategy by developing heavy industries after its establishment in 1949. As this strategy was inconsistent with China's natural endowment and technology at that time, economic growth was slow. After the start of the economic reform in 1978, the government changed the national strategy of developing heavy industries to the more advantageous labor intensive industries and realized rapid economic growth (Lin et al., 1994). The Chinese government runs the country like a giant corporation. To enhance economic efficiency and create a competitive environment, it supports key industries (the so-called lifeline or pillar industries), it creates state-owned firms aimed at realizing government's multiple goals, and it tilts financial resources towards preferred industries and state-owned firms. Stern (2011) calls this framework of economic development "China's Superior Economic Model".

Above said, we are not to deny that the market economy is potentially the most important and effective mechanism in resource allocations. For late developing countries, however, due to the lack of a mature market system, many industries that can contribute to the whole economy cannot be properly developed due to a high level of transaction cost. Governments can emerge to reduce the transaction cost and thus their role has economic rationale. This is especially true in China as more than two thousand years of ruling by the elite greatly reduces the mass's resistance to this model of development.

### *2.2. Formal versus informal financing*

Allen et al. (2005) show that the economic growth of China, especially the rapid growth of its private sector in an environment with weak property rights protection and a weak financial system, suggests the existence of some form of alternative financing channels and governance mechanism. Ayyagari et al. (2010), using opinion surveys of 2400 Chinese firms, investigate the effects of formal and informal financing channels on firm performance. They claim that their analysis does not support Allen et al.'s (2005) hypothesis of the importance of alternative financing channels. In fact, firms receiving formal financing significantly outperform firms using informal financing. Guariglia et al. (2011) investigate the effect of internal financing channels on firm growth. They find that among firms facing restrictions on external financing, those with ample free cash flows grow faster. They suggest that developing countries do not necessarily need a highly developed external financing market to warrant rapid economic growth. Note that Ayyagari et al. (2010) and Guariglia et al. (2011) are not necessarily in conflict with Allen et al. (2005). It is not difficult to imagine that even in the presence of informal and internal financing channels, formal financing can be more effective.

The above studies suggest that financing channels, for example, the presence of and the reliance on informal financing or internal financing, in developing countries such as China, are fundamentally different from those of developed countries. We argue for another dimension of financing in China, that is, government engineering. Government industrial policies, to a large extent, can exert a heavy influence on whether firms obtain finance to realize their growth opportunities. This perspective potentially enriches corporate finance theories for developing countries. From a certain perspective, our research extends Ayyagari et al. (2010) as we potentially explain why firms receiving formal financing significantly outperform firms using informal financing. When formal financing channels are heavily influenced by governments' industrial strategies, firms receiving government support can crowd out firms not receiving government support. This logic helps us understand conditions under which formal, informal and internal financing channels interact and impact firm performance. Formal finance is important to government supported industries. In non-supported industries, informal or internal finance potentially plays a bigger role. Therefore, our research helps us better assess Allen et al. (2005), Ayyagari et al. (2010) and Guariglia et al. (2011).

### *2.3. Political connections and corporate finance*

The corporate finance literature has accumulated a vast reservoir of evidence on how political connections influence governance, finance, investment and firm performance. Shleifer and Vishny (1994) propose a model of government control and show that political connections bring about excess employment, low efficiency and corruption (Stigler, 1971; Peltzman, 1976; Kornai, 1979; McChesney, 1987; De Soto, 1990). Researchers often find that non-state-owned firms are more efficient than state-owned firms which naturally have political connections and that the privatization of state-owned firms often brings efficiency gains (Kikeri et al., 1992; Megginson et al., 1994; Sun and Tong, 2003). Further, political connections increase the risk of government rent-seeking and property rights exploitation (Agrawal and Knoeber, 2001; Hadlock et al., 2002; Helland and Sykuta, 2004; Faccio, 2006). Due to this risk, firms with political connections under-perform non-connected firms (Fan et al., 2007).

On the other hand, political connections can bring benefits to connected firms. Backman (1999) and Dinc (2005) show that the government brings benefits to firms with political connections through its control of banks. De Soto (1990) finds that political connections bring about tax benefits. Fisman (2001) provides evidence that the health condition of Indonesia's former president Suharto affects the value of firms connected to him. Faccio's (2006) international study shows that high level executives who enter politics bring benefits

to their firms. However, these benefits are often obtained through wealth redistribution and rather than through wealth creation. That is, politically connected firms establish unfair competition and exploit other firms to create gains for themselves. In sum, most of the studies on political connections suggest that political connections negatively impact overall resource allocations.

Political connections are not necessarily the original purposes of policy-makers. If the effect of political connections is universally negative, then where does the economic growth of many developing countries, including China, come from? If, among some developing countries, governments' economic planning is effective to a certain extent, will this offer an explanation for the widespread government interference of economic affairs? It is possible that political connections are merely a by-product of government-led economic development. Foregoing economic development to avoid these by-products may not be a desired solution.

Further, allow us to raise the research stake a little higher by thinking about the causality of the above issues. Will this help us explain why small government-large market countries are mostly developed countries while large government-small market countries are often developing countries? What is the causal relation between these? It is possible that a shrinking government is a result of economic development rather than that economic development is a result of a small government, and that the nexus between law and finance is more important in developed countries (King and Levine, 1993; Levine and Zervos, 1998; Rajan and Zingales, 1998; La Porta et al., 1997, 1998, 2002a; Demirgüç-Kunt and Maksimovic, 1998; Levine, 1999; Beck and Levine, 2002) while the link between the government and finance fits developing countries better.

## 3. China and its five-year national plan program

### *3.1. Political control system*

China is a highly politically centralized country. It has thirty-four provinces, direct administrative cities, or minority autonomous regions. It has twenty-nine ministries, 333 prefecture-level governments, 2858 county-level governments and over 40,000 township-level governments (China Statistical Yearbook, 2010). This system employs about 10 million people. However, the control power of such a large organization resides with the Politburo of the Central Committee of the Communist Party of China (CCCPC). The Politburo is the supreme decision-making organization. The State Council and ministries below it convert national policies into executable government policies. This political control system functions through appointments, promotions, rotations and cross-postings of government officials (Huang, 2002).

### *3.2. Banking and finance*

After its establishment in 1949, communist China adopted a policy of financial repression (McKinnon, 1973). Four major state-owned banks (Industrial and Commercial Bank of China, Bank of China, China Construction Bank and Agricultural Bank of China) dominate the banking system (Allen et al., 2005). During 1949–1990, the securities markets were non-existent.

China's stock market was established in 1990 (Shenzhen and Shanghai Exchanges), originating from the ideal of "crossing the river by feeling the rocks".[2] However, the government tightly controls the stock market. To facilitate market development, in October 1992, the State Council established the Securities Commission of the State Council as a regulatory authority of all securities businesses and the Securities Regulatory Commission as the monitoring authority of the Securities Commission of the State Council. In 1998, State Council reform merged these two organizations into the China Securities Regulatory Commission (CSRC) directly under the State Council. It is the counterpart to the SEC of the U.S. All chairmen of the CSRC came from high level government officials. Before becoming CSRC chairmen, they were State Council secretariats or general managers of the People's Bank of China (China's central bank), or even Politburo members of the highest

[2] "If it turns out to be good, we will do it. If it turns out to be bad, we will shut it down. We can try this." (Deng Xiaoping's (former Chinese President) talk during excursions to China's southern cities).

decision-making organization. This way, China's central government effectively controls the securities regulatory authority and therefore realizes its goal of policy promotions.

Since 1992, the IPO and SEO offering processes have experienced several reforms.[3] A major trend is the transition from an approval system to a review system. Of course, the monitoring mechanism for IPOs and SEOs has not been fundamentally changed. Though CSRC adopted a review system for IPOs and SEOs in 2004, in practice, both stock exchanges still use an approval system.[4] From CSRC's official documents governing IPOs and SEOs, a common criterion for equity offerings is that "they are consistent with the national industrial policies".

Based on the above discussion of China's political control system, we have reasons to believe that China's central government can fulfill its policy goals through its effective political control system and tilts financial resources towards supported industries.

### 3.3. Origin of five-year plans

Five-year plans originated from the former Soviet Union. On November 22, 1926, at the seventh expansionary conference of the Executive Committee of the Communist International, Joseph Stalin stated the doctrine that "The socialist economy is the most centralized economy. The socialist economy should progress based on plans." (Complete Works of Stalin, People's Publishing House, China, 1954). Based on his socialist economic philosophy, in December 1927, at the Fifteenth Congress of the All-Union Communist Party (Bolsheviks) of the former Soviet Union, Stalin further developed his doctrine of centralized and planned socialist economy. Under his guidance, the former Soviet Union adopted highly concentrated and all-encompassing economic plans. The Sixteenth Congress of the All-Union Communist Party approved the 1928–1932 national economic plan. This signaled the birth of five-plans in the former Soviet Union. By the time it completed the second five-year plan, the former Soviet Union had become the largest economy in Europe and the second largest economy in the world.

### 3.4. China's five-year plans

As early as 1928, the government of the Republic of China started drawing plans for economic growth, for example, the fundamental industry-building plan in 1928 and the five-year plan for heavy industries (1935) (Wu, 2013, p. 164). These plans were interrupted by the Japanese invasion of China during 1937–1945. However, the 1928–1937 is considered a golden ten-year period in contemporary Chinese economic history with an average annual industry growth of 8.7% (Fairbank, 1994).

After the communist government took over the country in 1949, China went through three years of economic recovery. In 1953, China started its first five-year plan covering 1953–1957. The focus of the First Five-Year Plan was "developing heavy industries" (People's Daily, 1953). Since 1953, China has implemented eleven five-year plans. Year 2011 marked the first year of the Twelfth Five-Year Plan.[5]

Before the start of the economic reform in 1978, due to a lack of statistical data and technical expertise, Chinese government's capabilities of formulating five-year plans were limited. This was especially true during the Great Leap Forward and the Cultural Revolution periods. Plans were often interrupted or the goals were set unrealistically high, causing a spate of problems or even disasters during implementation. In fact, during 1949–1978, China focused on socialist ideologies, politics, power struggle, "the revolution", and not on economic development.

Since the start of the economic reform in 1978, China's economy has gradually moved to an increasingly market-oriented system. The government's abilities in managing economic and social affairs also improve.

[3] For China's regulations on IPOs, please refer to Kao et al. (2009). For China's regulations on rights offerings, please refer to Chen and Yuan (2004).

[4] Based on CSRC's official interpretation (Chi Bin, 2011) (Source: http://www.qgcy.org/show.asp?id = 3519).

[5] The twelve five-year plans are: First Five-Year Plan (1953–1957), Second Five-Year Plan (1958–1962), Third Five-Year Plan (1966–1970), Fourth Five-Year Plan (1971–1975), Fifth Five-Year Plan (1976–1980), Sixth Five-Year Plan (1981–1985), Seventh Five-Year Plan (1986–1990), Eighth Five-Year Plan (1991–1995), Ninth Five-Year Plan (1996–2000), Tenth Five-Year Plan (2001–2005) and Eleventh Five-Year Plan (2006–2010) and Twelfth Five-Year Plan (2011–2015). Note that due to the three-year famine in 1959–1961, the Third Five-Year Plan was delayed by three years and the economy went through a period of adjustment.

Starting from the Sixth Five-Year Plan formulated during 1981–1982, the procedure has become more and more formalized. By the end of the last year of the current five-year plan period, the Politburo will convene a session to discuss and propose recommendations for the next five-year plan. Based on these recommendations, the State Council will formulate outlines for making the plan. After its approval in the next year's National People's Congress, the new five-year plan is finalized.

China's Eighth Five-Year Plan (1991–1995) reflected reform philosophies of Deng Xiaoping's "Talks during Excursions to China's Southern Cities". It is a relatively special five-year plan.[6] Based on Deng's "three-step" strategy, the government formulated the Eighth Five-Year Plan and the long-term ten-year (1991–2000) scheme (Deng, 1993; Chinese Communist Party Central Committee, 1987).[7] The government also sought advices from various strata of the society.

The formulation of the Ninth Five-Year Plan (1996–2000) started in September 1995. Based on achievements and experience of the Eighth Five-Year Plan, the Chinese government also proposed long-term goals for the year 2010. At the same time, China's economy weathered through the 1997 Asian financial crisis and progressed towards its goals. The average annual GDP growth was 8.3% during the Ninth Five-Year Plan period. In 2000, GDP reached RMB8.94 trillion (exceeding USD1 trillion). Average per capita GDP reached USD856 (National Bureau of Statistics of China, 2001).

The Tenth Five-Year Plan (2001–2005) was formulated during a period when China's overall economic situation was relatively good. By that time, GDP has exceeded USD1 trillion. The situation of consumer goods shortage was largely eliminated and a consumer market began to take shape. The formulation of the Tenth Five-Year Plan was different from that of previous ones. First, the planning committee listened to suggestions from international organizations such as the World Bank.[8] Second, based on the national plan, specialized plans and regional plans were also made.

As the importance of five-year plans on people's standard of living and national development became more apparent, the formulation process also became more democratic and transparent. Many people from different social strata participated in the formulation of the Eleventh Five-Year Plan (Jiang, 2006). For example, the National Development and Reform Committee was made up of experts from various different government departments and organizations. Further, comments and suggestions were taken from members of the National People's Congress, National Political Consultative Congress, the Eleventh Five-Year Plan Expert Committee, political and military organizations, the so-called democratic parties, representatives from provinces, direct administrative cities and minority autonomous regions. The State Council also held four conferences to listen to comments and advices.

The Twelfth Five-Year Plan, which started in 2011 and which is not covered in this study, is markedly different from previous ones. It contains more intangible themes such as sustainable growth, moving up the value chain, reducing income disparities, improving citizens' lives, enhancing scientific development, education, urbanization, environmental protection, energy efficiency and domestic consumption (Chinese Communist Party Central Committee, 2010; KPMG, 2011). It signals a crucial stage in China's reform and transition.

Five-year plans have exerted a profound influence on China's national economy and social life. They provide guidance for major projects and help fulfill government's goals. An important objective of five-year plans

[6] Early 1992, Deng Xiaoping gave talks in Wuchang, Shenzhen, Zhuhai, Shanghai and other cities. These talks are historically summarized as "Deng Xiaoping's Talks during Excursions to China's Southern Cities". During this period, Deng proposed many bold ideas and smashed conservative thinking in economic development at that time. These ideas include: "More audacious reform", "The difference between socialism and capitalism does not lie in more planned economy or more market economy.", "Planned economy does not equal socialism as capitalism also has plans. Market economy does not equal capitalism as socialism also has markets." After Deng talks, the central committee adjusted the Eighth Five-Year Plan on dimensions such as the pace of economic reform, industrial structure, the use of foreign investment, import and export, scale of investments, etc.

[7] Deng Xiaoping proposes a three-step formula for China's modernization development, reflecting long-term strategies for China's economic reform. First step, GDP in 1990 should double that in 1981 to cover people's basic needs. Second step, from 1991 to the end of the twentieth century, GDP should double again. Third step, by the middle of the twenty-first century, GDP per capita should reach that of medium developed countries.

[8] Early 1999, World Bank was entrusted by the National Development and Planning Committee to provide recommendations on China's Tenth Five-Year Plan and the 2015 long-term scheme. World Bank produced "China's Intermediate Economic Transition: Several Issues Related to Economic Development in the Tenth Five-Year Plan". This document contained 21 reports and provided valuable views on China's economic development and reform (World Bank, 2000)

is guidance for various industries, that is, industrial policies. Compared with the completely free market economy and the completely planned economy, five-year plans reflect a mixture of the two and are a manifestation of China's pragmatism.

## 4. Research questions

### *4.1. Five-year plans and corporate finance*

An important method for realizing government industrial strategies is the creation of preferential financing opportunities. This method can also encourage more firms to enter supported industries until the marginal benefit equals the marginal cost. In China, both the equity market and the loan market are, to a varying degree, controlled by the central government. The government has the review and approval rights of initial and seasoned equity offering applications. The government can further control the equity market through its personnel control system. For example, the chairman of the CSRC is named by the State Council. Finally, major banks are state-owned. Therefore, the capital markets are capable of carrying out government's industrial policies. We predict that firms in government supported industries have a larger chance of obtaining equity finance and bank loans.

State-owned firms play an important role in carrying out government strategies. The government's control over state-owned firms is obviously stronger than its control over non-state-owned firms. Further, supporting state-owned firms can also enlarge the base of state ownership and build a foundation for carrying out the next strategy. In a way, preserving state-ownership potentially helps the government carry out national strategies. Therefore, out of strategic considerations as well as profit motives, government strategies are more tilted towards industries with a high concentration of state ownership. Of course, state-owned firms are also likely more willing to carry out national strategies. We predict that state ownership enhances supported industries' ability to obtain financing opportunities.

### *4.2. Five-year plans and corporate investment*

China's economic growth is largely investment driven. The proportion of investment in GDP growth exceeds 30% (Barnett and Brooks, 2006). Therefore, how government policies affect corporate investment is an important empirical question. Since the 2008 financial crisis, China's economy has received a lot of attention, especially its level of investment. In an investment-driven economy, supported industries will need to use investment to realize their growth. We predict that government supported industries invest more than non-supported industries.

### *4.3. Five-year plans and industry performance*

We cannot avoid a discussion and an examination of the association between government engineering and industry performance. However, this is a tricky issue. The literature appears to believe that government interference brings about resource allocation distortion and inefficiency (Fan et al., 2007; Morck, Yavuz and Yeung, 2011). This certainly is a viable proposition. However, distortion and inefficiency cannot be entirely measured in short-run economic or financial terms. For example, a government may be willing to enter industries that have low short-term profit prospects or even no profit prospects at all but are deemed strategic or vital to the national interest or have long-term prospects. Therefore, relatively short-run inferior economic or financial outcome associated with government engineering should not necessarily be viewed as distortional or inefficient. Further, even in economic or financial terms, government engineering may not necessarily be associated with inefficiency. The Chinese economy has been growing rapidly in the last three decades. It would be hard to imagine that the government has been doing this all wrong and economic growth is primarily driven by firms in non-supported industries.

Based on the above, there are two potentially opposing explanations of this tricky issue. We treat it as an empirical question and examine whether government engineering, as manifested in five-year plans, is associated with superior or inferior industry performance. We consider three measures of performance, stock

performance (a market measure), growth in cash flow (an accounting measure) and the ratio of non-performing loans. Of course, we hasten to admit, and to avoid contradicting our discussion earlier, that relying on the capital markets for evaluating five-year plans is narrowly focused. Five-year plans affect many aspects of the economy and we capture just a part of the picture by focusing on the capital markets.

## 5. Data and empirical analyses

### *5.1. Data*

We hand-collect actual reports of four five-year plans by the Chinese central government during 1991–2010, covering the Eighth (1991–1995), Ninth (1996–2000), Tenth (2001–2005) and Eleventh (2006–2010) Five-Year Plans. We analyze the content of their "industry schemes" to determine government supported industries. Listed firms' industry classifications are based on the "Index for Listed Firms' Industry Classifications" published by the China Securities Regulatory Commission (CSRC) in 2001 and "Guideline # 6 of Listed Firms' Conduct of Businesses – Modified Industry Classifications" published in 2007. Classifications for industrial firms are based on "Classifications and Code Standards of National Economic Industries" – National Standards (Guo Biao) GB/T4754 published by the National Bureau of Statistics of China in 1983 and the more recently revised "National Industry Classifications" GB/T4754-2002 published in 2003.

Data for Chinese listed firms come from (Research Set) RESSET for IPO and SEO data covering 1991–2010 and (China Stock Market Trading Database) CSMAR for bank loan data covering 1996–2010. Annual reports of China's banking industry are hand-collected. We examine the industry distribution of non-performing loans. We hand-collect China Statistical Yearbooks to obtain industry economic growth data.

### *5.2. Capturing government engineering*

In order to evaluate the government's influence on the national economy and the capital markets, we collect five-year plan government documents (see Appendix A). These reports include: "Guidelines for the national economy and social development ten-year scheme and the Eighth Five-Year Plan of the People's Republic of China" (Fourth Plenum of the Seventh Conference of the National People's Congress, April 9, 1991), "Guidelines for the national economy and social development Ninth Five-Year Plan and goals beyond year 2010 of the People's Republic of China" (Fourth Plenum of the Eighth Conference of the National People's Congress, March 17, 1996), "Guideline for the national economy and social development Tenth Five-Year Plan of the People's Republic of China" (Fourth Plenum of the Ninth Conference of the National People's Congress, March 15, 2001) and "Guideline for the national economy and social development Eleventh Five-Year Plan of the People's Republic of China" (Fourth Plenum of the Tenth Conference of the National People's Congress, March 14, 2006).

These documents detail plans for China's industrial deployment during the next five years. For example, the third chapter of the Eighth Five-Year Plan contains "goals and policies for the development of major economic sectors during the Eighth Five-Year Plan". It covers several industries, such as agriculture and the agricultural economy, hydroelectric industry, energy industry, transportation and postal communication industry, raw materials industry, geological survey and atmospheric industry, electronic industry, machinery manufacturing industry, national defense industry and national defense research and development, and textile industry, etc. For each industry, these reports explicitly point out the goals and directions of that industry during the next five years as well as measures to achieve these goals. From these documents, we identify keywords that determine government supported industries. We define an industrial policy variable *IP* that equals 1 if an industry is supported by the government in the current five-year plan period, and 0 otherwise.

### *5.3. Growth in finance*

#### *5.3.1. IPO/SEO*

Since the establishment of two stock exchanges in 1990, China now has 1718 listed firms and a total amount of raised capital of RMB3662 billion (China Statistics Yearbook, 2010). We are interested in how the govern-

Table 1
Sample Selections for Equity Finance (IPOs/SEOs) and Bank Loan Finance.

| | | | | | | Firm Number |
|---|---|---|---|---|---|---|
| *Panel A: IPOs* | | | | | | |
| *A1: IPO Sample Selection* | | | | | | |
| A-share firms listed in 1991–2010 | | | | | | 2060 |
| minus: Financial firms | | | | | | 30 |
| minus: Firms missing information on IPO amount | | | | | | 7 |
| Final sample | | | | | | 2023 |
| | | Eighth Five-Year Plan (1991–1995) | | Ninth Five-Year Plan (1996–2000) | Tenth Five-Year Plan (2001–2005) | Eleventh Five-Year Plan (2006–2010) |
| *A2: IPO Sample Distribution* | | | | | | |
| Final sample | 2023 | 282 | | 722 | 328 | 791 |
| Supported firms | 1469 | 175 | | 549 | 297 | 448 |
| % of supported firms | (72.61) | (62.06) | | (76.04) | (90.55) | (56.64) |
| *A3: IPO Industry Distribution* | | | | | | |
| Industries | 41 | 36 | | 41 | 37 | 41 |
| Supported Industries | | 24 | | 24 | 26 | 17 |
| % of supported industries | | (66.67) | | (58.54) | (70.27) | (41.46) |
| | Firms | =1 | | =2 | =3 | >3 | Total |
| *Panel B: SEOs* | | | | | | | |
| *B1: SEO Total Sample* | | | | | | | |
| Rights Issue | 650 | 393 | | 178 | 61 | 18 | 1010 |
| Additional Offering | 722 | 547 | | 157 | 16 | 2 | 917 |
| Total | | | | | | | 1927 |
| Five-Year Plans | | | Rights Issues | | | | Additional Offerings |
| *B2: SEO Distribution Over Five-Year Plans* | | | | | | | |
| Eighth Five-Year Plan | | | 219 | | | | 3 |
| Ninth Five-Year Plan | | | 635 | | | | 52 |
| Tenth Five-Year Plan | | | 101 | | | | 67 |
| Eleventh Five-Year Plan | | | 55 | | | | 795 |
| Total | | | 1010 | | | | 917 |
| Loan types | | Big4 | | | | Non-Big4 | |
| | | N | Loan sum | | | N | Loan sum |
| *Panel C: Bank Loans* | | | | | | | |
| *C1: Types of Loans* | | | | | | | |
| Non-Collateralized Loans | | 330 | 94.6628 | | | 291 | 215.1753 |
| Collateralized Loans | | 682 | 60.3518 | | | 844 | 144.9589 |
| Project finance, trade finance and bill discount | | 9 | 3.0171 | | | 21 | 46.1803 |
| Letter of credit and bill purchase | | 9 | 0.4620 | | | 14 | 6.4781 |
| Others | | 111 | 62.4998 | | | 156 | 63.1229 |
| *C2: Loan distribution over time* | | | | | | | |
| Five-Year Plans | | Big4 | | | | Non-Big4 | |
| | | N | Loan Sum | | | N | Loan Sum |
| Ninth Five-Year Plan (1996–2000) | | 42 | 24.7746 | | | 32 | 10.0013 |
| Tenth Five-Year Plan (2001–2005) | | 583 | 80.0171 | | | 539 | 154.0553 |
| Eleventh Five-Year Plan (2006–2010) | | 516 | 116.2018 | | | 755 | 311.8589 |

Table 2
Descriptive statistics for equity finance (IPOs/SEOs) and bank loan finance.

| Industry | Industry Abbr. | Equity Issues (billion RMB) | | Bank Loans (billion RMB) | |
|---|---|---|---|---|---|
| | | IPO | SEO | Big4 | Non-Big4 |
| Agriculture | *AGRIC* | 20.63 | 35.10 | 1.50 | 1.02 |
| Extractive | *MINES* | 230.85 | 54.50 | 1.36 | 3.83 |
| Food Processing | *FDPROC* | 13.80 | 18.76 | 1.57 | 1.39 |
| Food Production | *FDPROD* | 8.68 | 18.31 | 0.05 | 0.30 |
| Beverage Production | *BEVRG* | 15.81 | 14.46 | 2.33 | 0.15 |
| Textile Industry | *TXTLS* | 20.54 | 23.95 | 3.48 | 3.71 |
| Garments and Other Fiber Products | *GARMTS* | 18.37 | 5.31 | 1.14 | 0.22 |
| Leather, Furs, Down and Related Products | *LETHR* | 1.30 | 1.64 | | |
| Timber Processing, Bamboo, Cane, Palm Fiber and Straw Products | *WOOD* | 2.41 | 2.33 | 0.04 | |
| Furniture Manufacturing | *FURN* | 3.28 | 2.25 | | |
| Papermaking and Paper Products | *PAPER* | 16.11 | 16.70 | 3.50 | 4.99 |
| Printing Industry | *PRINT* | 2.81 | 0.86 | 0.01 | 0.05 |
| Stationery, Educational and Sports Goods | *STAT* | 4.06 | 0.38 | | |
| Petroleum Processing and Coking Products | *PTRLM* | 5.05 | 6.74 | 2.57 | 0.30 |
| Raw Chemical Materials and Chemical Products | *CHEMS* | 69.25 | 70.24 | 5.07 | 20.70 |
| Chemical Fibers | *CHMSFIBR* | 14.03 | 11.32 | 0.97 | 0.38 |
| Rubber Products | *RUBBR* | 2.86 | 3.06 | 0.85 | 2.06 |
| Plastic Products | *PLASTICS* | 12.22 | 9.27 | 0.75 | 4.54 |
| Electronic Components Manufacturing | *ELCTRCOMP* | 40.27 | 54.36 | 4.30 | 5.64 |
| Household Electronic Appliances Manufacturing | *HHELCTR* | 13.37 | 19.31 | 9.61 | 11.30 |
| Nonmetal Mineral Products | *GLASS* | 23.22 | 57.53 | 6.39 | 4.71 |
| Smelting and Pressing of Ferrous Metals | *FERMTAL* | 38.75 | 165.45 | 0.48 | 19.43 |
| Smelting and Pressing of Nonferrous Metals | *NFERMTAL* | 22.82 | 63.23 | 1.55 | 2.30 |
| Metal Products | *MTLPR* | 22.62 | 18.27 | 0.50 | 10.89 |
| Ordinary Machinery Manufacturing | *GENMACHN* | 32.30 | 39.32 | 0.54 | 1.19 |
| Special Purposes Equipment Manufacturing | *SPLMACHN* | 50.65 | 45.87 | 1.30 | 12.49 |
| Transportation Equipment Manufacturing | *CARS* | 62.65 | 135.35 | 6.55 | 32.93 |
| Electric Equipment and Machinery | *ELCTRMCHN* | 69.67 | 86.85 | 35.48 | 8.07 |
| Instruments, Meters, Cultural and Official Machinery | *INSTR* | 11.46 | 5.69 | 0.29 | 0.69 |
| Medical and Pharmaceutical Products | *MEDICAL* | 54.86 | 44.24 | 3.43 | 3.32 |
| Biological Products | *BIOLG* | 8.61 | 4.80 | 1.36 | 0.70 |
| Other Manufacturing | *OTHMANU* | 5.52 | 2.45 | 1.05 | 1.10 |
| Electric Power, Steam and Hot Water Production and supply | *POWER* | 35.59 | 128.81 | 65.30 | 36.14 |
| Gas Production and Supply | *GAS* | 7.68 | 11.32 | | |
| Construction | *CONSTR* | 133.05 | 24.58 | 0.69 | 11.29 |
| Transportation and warehousing | *TRANS* | 140.25 | 141.69 | 9.24 | 59.18 |
| Information Technology | *IT* | 81.23 | 63.45 | 4.69 | 53.12 |
| Wholesale and Retail | *WHLSL* | 35.44 | 90.01 | 7.44 | 6.73 |
| Real Estate | *RLEST* | 18.24 | 183.64 | 34.05 | 18.13 |
| Social Services | *SRVC* | 28.53 | 37.32 | 5.86 | 2.85 |
| Broadcasting and Media | *MEDIA* | 12.57 | 4.45 | 2.04 | 3.13 |
| Others | *OTHR* | 9.61 | 56.48 | 10.42 | 10.15 |
| Total | | 1421.04 | 1779.66 | 238.24 | 360.28 |

ment engineered industrial policies affect corporate finance. We follow Rajan and Zingales (1998) but use industry and five-year plan combinations as units. Specifically, we aggregate amounts raised in (the frequency of) IPOs/SEOs for a specific industry during a five-year plan period.

Table 3
Equity Finance Activities and Five-Year Plans. The growth rate of IPO/SEO total amount (number) during Five-Year Plan $t$ (compared with the previous five-year plan) for Industry $j$: Growth in IPO amount, $(SumIPO_{jt} - SumIPO_{jt-1})/SumIPO_{jt-1}$; Growth in IPO frequency, $(NumIPO_{jt} - NumIPO_{jt-1})/NumIPO_{jt-1}$; Growth in SEO amount, $(SumSEO_{jt} - SumSEO_{jt-1})/SumSEO_{jt-1}$; Growth in SEO frequency, $(NumSEO_{jt} - NumSEO_{jt-1})/NumSEO_{jt-1}$, where *Sum* indicates IPO/SEO amount and *Num* indicates IPO/SEO number. SOE is the value-weighted ratio of state ownership enterprises over the public firms. $Growth_{jt}$ is the growth rate for industry $j$ in during the $t$th five-year plan based on China Statistical Yearbook, $\log(Assets)_{jt}$ is the logarithm transformation of Industry $j$'s median total assets, $P10\_5_{jt}$ and $P11\_5_{jt}$ are indicators that equal 1 for the Tenth and Eleventh Five-Year Plans and 0 otherwise, respectively.

| Industry | IPO growth | | SEO growth | | SOE | Log assets | Industrial growth |
|---|---|---|---|---|---|---|---|
| | Amount | Freq. | Amount | Freq. | | | |
| Panel A: Means | | | | | | | |
| *AGRIC* | 36.630 | 5.692 | 28.640 | 3.433 | 0.748 | 24.020 | 0.645 |
| *MINES* | 6.127 | 0.264 | 30.300 | 3.950 | 0.978 | 26.660 | 1.422 |
| *FDPROC* | 4.912 | 1.067 | 9.606 | 1.944 | 0.557 | 23.980 | 1.527 |
| *FDPROD* | 10.340 | 1.644 | 24.400 | 5.048 | 0.779 | 24.070 | 1.147 |
| *BEVRG* | 1.555 | 0.701 | 21.770 | 2.506 | 0.825 | 24.770 | 1.073 |
| *TXTLS* | 2.043 | 0.377 | 5.122 | 1.150 | 0.598 | 24.340 | 0.869 |
| *GARMTS* | 1.585 | 0.033 | 0.437 | −0.197 | 0.367 | 24.230 | 1.107 |
| *LETHR* | 2.197 | −0.250 | 4.224 | 1.000 | 0.047 | 21.810 | 1.165 |
| *WOOD* | 3.400 | 1.000 | −1.000 | −1.000 | 0.591 | 23.450 | 1.791 |
| *FURN* | 1.951 | −0.250 | −1.000 | −1.000 | 0.004 | 22.900 | 1.782 |
| *PAPER* | 0.639 | −0.202 | 10.070 | 3.893 | 0.824 | 24.570 | 1.284 |
| *PRINT* | 0.578 | −0.500 | −1.000 | −1.000 | 0.163 | 22.600 | 1.028 |
| *STAT* | −1.000 | −1.000 | 4.121 | 0.500 | 0.667 | 22.730 | 0.972 |
| *PTRLM* | 9.760 | 5.000 | 11.640 | 4.000 | 0.744 | 24.050 | 1.491 |
| *CHEMS* | 4.099 | 1.845 | 5.765 | 2.175 | 0.826 | 25.340 | 1.411 |
| *CHMSFIBR* | 13.350 | 2.280 | 12.640 | 4.211 | 0.743 | 24.490 | 1.004 |
| *RUBBR* | 1.532 | 0.167 | 9.906 | 1.750 | 0.779 | 23.860 | 1.163 |
| *PLASTICS* | 2.205 | 0.527 | 0.272 | −0.163 | 0.504 | 24.080 | 1.390 |
| *ELCTRCOMP* | 24.270 | 2.838 | 33.380 | 5.285 | 0.790 | 24.790 | 2.086 |
| *HHELCTR* | 36.940 | 4.056 | 5.753 | 0.000 | 0.918 | 24.910 | 0.855 |
| *GLASS* | 1.187 | 0.273 | 10.710 | 1.839 | 0.708 | 24.890 | 1.271 |
| *FERMTAL* | 2.395 | 0.569 | 12.750 | 0.756 | 0.957 | 26.510 | 1.527 |
| *NFERMTAL* | 36.670 | 5.754 | 14.670 | 5.100 | 0.785 | 25.140 | 1.978 |
| *MTLPR* | 6.673 | 1.652 | 10.570 | 1.989 | 0.682 | 24.470 | 1.358 |
| *GENMACHN* | 2.872 | 0.937 | 12.880 | 2.361 | 0.835 | 24.930 | 1.462 |
| *SPLMACHN* | 3.440 | 0.877 | 11.800 | 2.292 | 0.794 | 24.850 | 1.425 |
| *CARS* | 3.577 | 0.552 | 18.740 | 3.417 | 0.895 | 25.670 | 1.543 |
| *ELCTRMCHN* | 2.363 | 0.609 | 23.360 | 3.542 | 0.620 | 25.430 | 1.620 |
| *INSTR* | 3.864 | 3.040 | 4.011 | 1.944 | 0.602 | 23.160 | 1.525 |
| *MEDICAL* | 2.647 | 0.423 | 6.814 | 2.147 | 0.627 | 24.760 | 1.278 |
| *BIOLG* | 3.689 | 1.533 | 20.000 | 1.556 | 0.477 | 23.510 | 1.823 |
| *POWER* | 1.094 | −0.017 | 14.080 | 3.463 | 0.980 | 26.350 | 1.713 |
| *GAS* | 10.990 | 0.944 | 0.414 | −0.250 | 0.799 | 24.210 | 1.526 |
| *CONSTR* | 28.180 | 3.880 | 18.800 | 4.544 | 0.923 | 25.590 | 1.666 |
| *TRANS* | 21.430 | 1.001 | 16.870 | 2.450 | 0.888 | 26.280 | 0.340 |
| *IT* | 6.667 | 1.991 | 7.801 | 1.850 | 0.822 | 25.850 | 3.368 |
| *WHLSL* | 2.489 | 0.266 | 6.951 | 1.492 | 0.780 | 25.210 | 0.967 |
| *RLEST* | 0.969 | −0.154 | 11.370 | 2.441 | 0.731 | 25.640 | 2.091 |
| *SRVC* | 31.230 | 6.261 | 11.140 | 1.788 | 0.796 | 24.640 | 0.991 |
| *MEDIA* | 5.974 | −0.500 | 3.131 | 0.000 | 0.833 | 23.460 | 0.232 |
| *OTHR* | 2.471 | −0.233 | 6.037 | 0.525 | 0.519 | 25.240 | 1.221 |
| Sample avg. | 9.005 | 1.457 | 12.260 | 2.261 | 0.695 | 24.590 | 1.369 |

(*continued on next page*)

Table 3 (*continued*)

| Industry | IPO growth | | SEO growth | |
|---|---|---|---|---|
| | Amount | Freq. | Amount | Freq. |
| Panel B: Supported industries versus non-supported industries | | | | |
| *Supported* | | | | |
| Mean | 10.480 | 1.802 | 13.470 | 2.538 |
| Median | 1.870 | 0.538 | 5.891 | 1.710 |
| N | 65 | 65 | 63 | 63 |
| *Non-supported* | | | | |
| Mean | 6.918 | 0.968 | 10.490 | 1.856 |
| Median | 1.914 | 0.000 | 4.864 | 1.000 |
| N | 46 | 46 | 43 | 43 |
| *Supported vs. non-supported* | | | | |
| Mean | 3.562 | 0.834 | 2.980 | 0.682 |
| Median | −0.044 | 0.538 | 1.027 | 0.710 |
| *T-test (Z-test)* | | | | |
| *t*-statistics | 0.90 | 1.30 | 0.89 | 1.03 |
| *z*-statistics | 0.80 | 1.47 | 1.19 | 1.19 |

***Represents significance level at 1%.
**Represents significance level at 5%.
*Represents significance level at 10%.

Table 4
Regressions of Equity Finance Activities and Five-Year Plans. Industrial policy $IP_{jt}$ equals 1 if Industry *j*is supported by the government in Five-Year Plan*t*, and 0 otherwise. The growth rate of IPO/SEO total amount (number) during Five-Year Plan *t* (compared with the previous five-year plan) for Industry *j*: Growth in IPO amount, $(SumIPO_{jt} - SumIPO_{jt-1})/SumIPO_{jt-1}$; Growth in IPO frequency, $(NumIPO_{jt} - NumIPO_{jt-1})/NumIPO_{jt-1}$; Growth in SEO amount, $(SumSEO_{jt} - SumSEO_{jt-1})/SumSEO_{jt-1}$; Growth in SEO frequency, $(NumSEO_{jt} - NumSEO_{jt-1})/NumSEO_{jt-1}$, where *Sum* indicates IPO/SEO amount and *Num* indicates IPO/SEO number. SOE is the value-weighted ratio of state ownership enterprises over the public firms. $Growth_{jt}$ is the growth rate for industry *j* in during the *t*th five-year plan based on China Statistical Yearbook, $\log(Assets)_{jt}$ is the logarithm transformation of Industry *j*'s median total assets, $P10\_5_{jt}$ and $P11\_5_{jt}$ are indicators that equal 1 for the Tenth and Eleventh Five-Year Plans and 0 otherwise, respectively.

| Variables | IPO growth | | | | SEO growth | | | |
|---|---|---|---|---|---|---|---|---|
| | Amount | Freq. | Amount | Freq. | Amount | Freq. | Amount | Freq. |
| *IP* | 7.187 | 1.554 | −17.87 | −3.317 | 4.827 | 1.181 | −3.329 | −1.431 |
| | (2.06)** | (2.54)** | (−2.11)** | (−2.21)** | (1.45) | (2.22)** | (−0.35) | (−0.80) |
| *SOE* | – | – | 26.09 | 3.052 | – | – | 9.827 | 1.480 |
| | | | (2.50)** | (2.09)** | | | (1.47) | (1.40) |
| *IP·SOE* | – | – | 29.85 | 6.068 | – | – | 9.841 | 3.317 |
| | | | (2.21)** | (2.61)** | | | (0.82) | (1.59) |
| *Growth* | −3.391 | −0.444 | −2.554 | −0.331 | 1.337 | 0.237 | 1.582 | 0.292 |
| | (−1.09) | (−1.07) | (−1.02) | (−0.96) | (0.99) | (1.07) | (1.10) | (1.13) |
| log(*Assets*) | −6.116 | −1.133 | −11.54 | −1.898 | −0.856 | −0.112 | −2.683 | −0.498 |
| | (−2.43)** | (−3.02)*** | (−3.32)*** | (−3.72)*** | (−0.37) | (−0.35) | (−1.15) | (−1.57) |
| *P*10_5 | −12.21 | −2.517 | −1.120 | −0.897 | −20.49 | −4.421 | −16.96 | −3.651 |
| | (−3.24)*** | (−4.10)*** | (−0.25) | (−1.29) | (−5.88)*** | (−7.30)*** | (−4.92)*** | (−6.52)*** |
| *P*11_5 | 8.144 | 1.646 | 27.46 | 4.482 | −0.536 | 0.839 | 6.297 | 2.318 |
| | (1.07) | (1.28) | (2.51)** | (2.58)** | (−0.08) | (0.78) | (0.97) | (2.32)** |
| *Constant* | 157.0 | 28.53 | 257.1 | 42.99 | 35.87 | 5.310 | 68.77 | 12.63 |
| | (2.65)** | (3.24)*** | (3.40)*** | (3.85)*** | (0.66) | (0.74) | (1.31) | (1.82)* |
| Observations | 111 | 111 | 111 | 111 | 106 | 106 | 106 | 106 |
| Adjusted R-squared | 0.15 | 0.24 | 0.24 | 0.32 | 0.34 | 0.51 | 0.35 | 0.53 |

*** Represents significance level at 1%.
** Represents significance level at 5%.
* Represents significance level at 10%.

We compute the growth rate of IPO/SEO in total amount (number) during Five-Year Plan $t$ (compared with the previous five-year plan) for Industry $j$. We define four variables: Growth in IPO amount, $(SumIPO_{jt} - SumIPO_{jt-1})/SumIPO_{jt-1}$; Growth in IPO frequency, $(NumIPO_{jt} - NumIPO_{jt-1})/NumIPO_{jt-1}$; Growth in SEO amount, $(SumSEO_{jt} - SumSEO_{jt-1})/SumSEO_{jt-1}$; Growth in SEO frequency, $(NumSEO_{jt} - NumSEO_{jt-1})/NumSEO_{jt-1}$, where *Sum* indicates IPO/SEO amount and *Num* indicates IPO/SEO number. We estimate the following regression to determine if government industrial policies affect corporate finance:

$$IPO\ Growth \text{ or } SEO\ Growth = \beta_0 + \beta_1 IP_{jt} + \beta_2 Growth_{jt} + \beta_3 \log(Assets)_{jt-1} + \beta_4 P10\_5_{jt} + \beta_5 P11\_5_{jt} + e1_{jt}, \quad (1)$$

where $Growth_{jt}$ is the growth rate for Industry $j$ in during the $t$th Five-Year Plan based on China Statistical Yearbook, $\log(Assets)_{jt-1}$ is the logarithm transformation of Industry $j$'s median total assets, $P10\_5_{jt}$ or $P11\_5_{jt}$ is an indicator that equals 1 for the Tenth or the Eleventh Five-Year Plan, and 0 otherwise. If the coefficient on $IP_{jt}$ is positive, then we have evidence that government industrial policies, as reflected in five-year plans, influence the equity finance market.

Panels A and B, Table 1 report sample selections for IPOs and SEOs, respectively. Table 2 shows that the total IPO amount is RMB1421.04 billion and the total SEO amount is RMB1779.66 billion during 1991–2010. The Extractive industry (*MINES*) and the Transportation and Warehousing industry (*TRANS*) are the two biggest recipients of equity finance opportunities.

Panel A, Table 3 shows the industry distribution of IPO/SEO growth. Overall, the average IPO growth in amount (growth in frequency) is 9.005 (1.457). The average SEO growth in amount (growth in frequency) is 12.260 (2.261). In terms of IPO growth in amount, the Household Electronic Appliances industry (*HHELCTR*) has the highest growth of 36.940, followed by the Smelting and Pressing of Nonferrous Metals industry (*NFERMTAL*) of 36.760 and the Agriculture industry (*AGRIC*) of 36.630. The industry with the highest growth in IPO frequency is the Social Services industry (*SRVC*) of 6.261, followed by the Smelting and Pressing of Nonferrous Metals industry (*NFERMTAL*) and the Agriculture industry (*AGRIC*).

Overall SEO growth in amount (growth in frequency) is 12.260 (2.261). The industry with the highest SEO growth in amount (growth in frequency) is the Electronic Components Manufacturing industry (*ELCTRCOMP*), 33.380 (5.285). Using total assets as weights, the proportion of state-ownership is 69.5%, suggesting that the state occupies a dominant place in the capital markets. The Electric Power, Steam and Hot Water industry (*POWER*) has the highest level of state-ownership, 98.0%, followed by the Extractive industry (*MINES*), 97.8%. Therefore, state ownership is dominant in traditional industries and utilities.

Panel B, Table 3 compares IPO and SEO growth for supported and non-supported industries. All differences are insignificant. Regression results for IPOs and SEOs are reported in Table 4. Each observation is an industry-five-year-plan combination. Consistent with our expectation, in government supported industries, the growth of IPOs (in terms of amount and frequency) is higher than that in other industries. The coefficient on *IP* is positive and significant (7.187, $t = 2.06$ for growth in IPO amount; 1.554, $t = 2.54$ for growth in IPO frequency). The coefficient on industrial policy *IP* is higher for IPO amount than that for IPO frequency, suggesting that the IPO amount grows even faster, consistent with the government's intention of supporting these industries. The growth in SEO frequency is also higher in government supported industries than that in other industries. The coefficient on *IP* is 1.181 ($t = 2.22$).

When comparing the results for IPOs and SEOs, we find that the effect of industrial policies is stronger for IPOs than for SEOs, suggesting that government's ability in implementing industrial policies is likely stronger in the initial offering market than in the secondary market. This is consistent with the fact that the role played by the government in reviewing and approving of IPOs is larger than that of SEOs. SEO firms already have obtained the listing status and the market force plays a larger role in them. Further, regulatory authorities are more careful dealing with initial offerings than with secondary offerings. As for an already listed firm, its SEO application time and cost are usually shorter or lower than those of an IPO firm. In addition, SEO firms often need to attract new investors through good performance. This is a more market-oriented mechanism. The role of the government in influencing SEOs is reduced (as compared with IPOs) as the market force becomes stronger.

State ownership is very important in China's economy. Using shareholder data from CCER, we compute the proportion of state ownership for each industry, *SOE*, to determine whether a high level of state ownership enables supported industries to obtain equity finance more easily. We estimate the following regression:

$$IPO\ Growth \text{ or } SEO\ Growth = \beta_0 + \beta_1 IP_{jt} + \beta_2 SOE_{jt} + \beta_3 IP_{jt} \cdot SOE_{jt} + \beta_4 Growth_{jt} + \beta_5 \times \log(Assets)_{jt-1} + \beta_6 P10\_5_{jt} + \beta_7 P11\_5_{jt} + e2_{jt}. \quad (2)$$

If the coefficient on $IP_{jt} \cdot SOE_{jt}$ is positive, we have evidence that national strategies are more tilted towards the state-owned sector or the state-owned sector is more responsive to national strategies.

Results are reported in Table 4. In the IPO regressions, when *SOE* and *IP·SOE* are added, the coefficients on *IP·SOE* are positive and significant (29.85, $t = 2.21$ using amount; 6.068, $t = 2.61$ using frequency), suggesting that state-owned firms in supported industries enjoy more IPO opportunities. However, the coefficients on *IP* become negative and significant (−17.87, $t =$ -2.11 using amount; −3.317, $t = -2.21$ using frequency). This result suggests that state-owned firms may have crowded out non-state-owned firms in terms of IPO financing in supported industries. The coefficients on *SOE* are positive and significant (26.09, $t = 2.50$ using amount; 3.052, $t = 2.09$ using frequency), suggesting that state-owned firms always enjoy better IPO opportunities. In the SEO regressions, with the addition of *SOE* and *IP·SOE*, *IP*, *SOE* and *IP·SOE* are all insignificant. Again, it appears that the results for SEOs are weaker than those for IPOs.

Apart from IPO growth, we also examine a measure of the cost of equity financing, IPO underpricing. The higher is the level of underpricing, the higher is the cost of equity financing as initial shares are sold at a lower price. Although IPO underpricing captures only one aspect of the cost of equity capital, it is a reasonable and easy indicator for the ease or the difficulty of obtaining equity capital.

We construct two measures of underpricing. *IR* is the average initial return during Five-Year Plan *t* for Industry *j* and *IR_W* is the size-weighted initial return during Five-Year Plan *t* for Industry *j*, where initial return is computed as (IPO first day closing price − IPO offer price/IPO offer price). We replace *IPO Growth* and *SEO Growth* with *IR* or *IR_W* in Models (1) and (2). Results are presented in Table 5. When we do not consider state-ownership, the coefficients on *IP* are both insignificant. When we add *SOE* and *IP·SOE*, the coefficients on *IP·SOE* are both negative and significant (−1.096, $t = -1.83$ using *IR*; −1.319, $t = -2.26$ using *IR_W*). Further, when *IR_W* is used, the coefficient on *IP* becomes positive and significant (0.739, $t = 1.81$). Therefore, state-owned firms in government supported industries are able to sell their initial shares at higher

Table 5
Regressions of IPO Underpricing and Five-Year Plans. Industrial policy $IP_{jt}$ equals 1 if Industry *j* is supported by the government in Five-Year Plan *t*, and 0 otherwise. IR (IR_W) is the average (weighted) initial return during Five-Year Plan *t* for Industry *j*, computed as (close price at IPO - offering price/offering price). $Growth_{jt}$ is the growth rate for industry *j* in during the *t*th five-year plan based on China Statistical Yearbook, $\log(Assets)_{jt}$ is the logarithm transformation of the industry median of assets, $P11\_5_{jt}$ is an indicator that equals 1 for the Eleventh Five-Year Plan and 0 otherwise, respectively.

| Variables | *IR* | *IR_W* | *IR* | *IR_W* |
|---|---|---|---|---|
| *IP* | −0.134 | −0.172 | 0.617 | 0.739 |
| | (−0.70) | (−0.93) | (1.43) | (1.81)* |
| *SOE* | – | – | 0.804 | 0.898 |
| | | | (1.31) | (1.48) |
| *IP·SOE* | – | – | −1.096 | −1.319 |
| | | | (−1.83)* | (−2.26)** |
| *Growth* | 0.067 | 0.050 | 0.075 | 0.058 |
| | (0.72) | (0.56) | (0.92) | (0.74) |
| log(*Assets*) | −0.046 | −0.086 | −0.102 | −0.144 |
| | (−0.49) | (−0.95) | (−1.00) | (−1.44) |
| *P10_5* | −0.303 | −0.241 | −0.243 | −0.185 |
| | (−1.58) | (−1.47) | (−1.02) | (−0.85) |
| *P11_5* | −0.038 | 0.090 | 0.080 | 0.202 |
| | (−0.14) | (0.36) | (0.23) | (0.59) |
| *Constant* | 2.523 | 3.284 | 3.264 | 4.022 |
| | (1.21) | (1.65) | (1.51) | (1.92)* |
| Observations | 106 | 106 | 106 | 106 |
| Adjusted R-squared | 0.03 | 0.06 | 0.06 | 0.10 |

***Represents significance level at 1%.
** Represents significance level at 5%.
* Represents significance level at 10%.

prices, again indicating the relative ease that state-owned firms in supported industries have in obtaining equity capital.

*5.3.2. Bank loans*

Allen et al. (2005) investigate four important financing channels when Chinese firms invest in fixed assets: domestic bank loans, self-financing, state budget and foreign direct investment. They point out that domestic bank loans are the most important channel. We therefore investigate the effect of industrial policies on bank loans. We follow Foos et al. (2010) to compute growth in bank loans for an industry. We also hand-collect information on the lead banks of these loans. According to Allen et al. (2005), China's banking industry is mainly occupied by four major state-owned banks. We therefore divide banks into two categories: Big4 state-owned banks (Industrial and Commercial Bank of China, Bank of China, Agricultural Bank of China and Bank of Construction) and non-Big4 banks.[9] We further divide the sample into loans with collaterals and loans without collaterals. We estimate the following regression separately for big-four banks and non-big-four banks with and without collaterals.

$$Loan\ Growth = \beta_0 + \beta_1 IP_{jt} + \beta_2 Growth_{jt} + \beta_3 \log(Assets)_{jt-1} + \beta_4 P11\_5_{jt} + e3_{jt}. \quad (3)$$

If the coefficient on $IP_{jt}$ is positive, we have evidence that government industrial policies, as reflected in five-year plans, influence the bank loan market. Panel C, Table 1 shows the sample selection process for bank loans.

Based on an earlier discussion of China's political control system, China's control of its financial system is an integral part of its political control system. For example, the chairmen of the Industrial and Commercial Bank of China and the Bank of China were members of the Sixteenth and Seventeenth Chinese Communist Party Central Committees. They, being a part of the political control system, certainly behave differently from other bank executives. Among many differences, an important one is the ability and the intent to carry out national policies. Therefore, we expect to observe differences between the Big4 national banks and non-Big4 banks. The Big4 national banks are more likely to carry out national policies.

From descriptive statistics in Table 2, we observe evidence that China's bank loan market is mainly headed by national banks (Allen et al., 2005). Among the 2467 bank loans (RMB598.52 billion), RMB238.24 billion are attributable to the Big4 national banks and RMB360.28 billion are attributable to other banks (including national banks such as China Development Bank and Bank of Communication). The Big4 national banks account for 39.80% of the loan market, suggesting that they have a scale advantage over other banks. We also see that the Big4 national banks and non-Big4 banks differ in clienteles. Among the Big4 banks, the industry receiving the most loans is the electric power, steam and hot water production and supply industry (*POWER*), a total of RMB65.30 billion. This industry is mainly represented by national monopolies. The second clientele group is the real estate industry (*RLEST*), representing RMB34.05 billion. Non-Big4 banks have only about a half of that amount in these industries. The Big4 national banks' monopolistic power is high in traditional industries and high-profit industries.

Panel A, Table 6 presents basic information on bank loan growth. Panel B, Table 6 compares bank loan growth between supported and non-supported industries. It appears that supported industries have a significantly higher level of loan growth than non-supported industries and this pattern mainly occurs in loans initiated by Big4 banks.

Table 7 reports regression results on bank loan growth. Again, each observation is an industry-five-year-plan combination. In Panel A based on the full sample, we find that loan growth is affected by industrial polices. The coefficient on *IP* is positive and significant (6.168, $t = 2.07$ using loan amount).

Next, we consider the role of state-ownership by estimating the following regression:

$$Loan\ Growth = \beta_0 + \beta_1 IP_{jt} + \beta_2 SOE_{jt} + \beta_3 IP_{jt} \cdot SOE_{jt} + \beta_4 Growth_{jt} + \beta_5 \log(Assets)_{jt-1} + \beta_6 P11\_5_{jt} + e4_{jt}. \quad (4)$$

However, with the addition of *SOE* and *IP·SOE*, the coefficients on *IP*, *SOE* and *IP·SOE* are all insignificant.

In Panel B, Table 7, we perform our analysis based on combinations of Big4, non-Big4 banks and loans with and without collaterals. For loans issued by Big4 banks, before we introduce *SOE* and *IP·SOE*, only

[9] Interestingly, the names of these Big4 state-owned banks all reflect flavors of industrial policies.

Table 6
Bank loan growth and five-year plans. Industrial policy $IP_{jt}$ equals 1 if Industry $j$ is supported by the government in Five-Year Plan $t$, and 0 otherwise. The growth rate of Loan total amount (number) during Five-Year Plan $t$ (compared with the previous five-year plan) for Industry $j$: Growth in Loan amount, $(SumLoan_{jt} - SumLoan_{jt-1})/SumLoan_{jt-1}$; Growth in Loan frequency, $(NumLoan_{jt} - NumLoan_{jt-1})/NumLoan_{jt-1}$. Growth in Loan (ALL) is from both Big4 national banks and Non-big4 national banks. Growth in Loan (Big4) is from collateral and non-collateral loans issued by Big4 national banks. Growth in Loan (NonBig4) is from collateral and non-collateral loans issued by Non-Big4 national banks. Growth in Loan (Big4/Collateral) is from collateral loans issued Big4 national banks. Growth in Loan (Big4/Non-Collateral) is from non-collateral loans issued Big4 national banks. Growth in Loan (NonBig4/Collateral) is from collateral loans issued by NonBig4 national banks. Growth in Loan (NonBig4/Non-Collateral) is from non-collateral loans issued by NonBig4 national banks.

| Industry | ALL | | Big4 | | NonBig4 | |
|---|---|---|---|---|---|---|
| | Amount | Freq. | Amount | Freq. | Amount | Freq. |
| Panel A: Means | | | | | | |
| *AGRIC* | 33.980 | 7.219 | −0.429 | −0.833 | 17.750 | 4.300 |
| *MINES* | 48.990 | 14.000 | 1.157 | 1.333 | . | . |
| *FDPROC* | 3.311 | 6.633 | 2.089 | 4.298 | 1.656 | −0.222 |
| *FDPROD* | −1.000 | −1.000 | −1.000 | −1.000 | −1.000 | −1.000 |
| *BEVRG* | 3.118 | 1.000 | −0.861 | 0.333 | 1.198 | 1.000 |
| *TXTLS* | 19.100 | 11.110 | 1.008 | 4.500 | 3.088 | 7.167 |
| *GARMTS* | 0.215 | 1.250 | 0.070 | 1.125 | 1.376 | 4.000 |
| *LETHR* | . | . | . | . | . | . |
| *WOOD* | . | . | . | . | . | . |
| *FURN* | . | . | . | . | . | . |
| *PAPER* | 1.337 | −0.533 | −0.828 | −0.577 | 13.920 | 0.333 |
| *PRINT* | −1.000 | −1.000 | . | . | −1.000 | −1.000 |
| *STAT* | . | . | . | . | . | . |
| *PTRLM* | 2.310 | 11.080 | 4.821 | 10.020 | . | . |
| *CHEMS* | 34.390 | 25.690 | 0.804 | 0.351 | 52.180 | 9.526 |
| *CHMSFIBR* | 3.673 | 3.000 | 0.970 | 1.500 | −0.420 | 1.250 |
| *RUBBR* | 0.409 | −0.200 | 1.130 | 0.000 | −0.534 | −0.500 |
| *PLASTICS* | . | . | −0.707 | 2.000 | −1.000 | −1.000 |
| *ELCTRCOMP* | 2.420 | 8.694 | 0.312 | 7.313 | 0.461 | 0.667 |
| *HHELCTR* | 7.961 | 0.833 | 9.235 | 0.750 | 7.939 | 0.667 |
| *GLASS* | 3.238 | 2.815 | 0.343 | 1.469 | 5.828 | 5.500 |
| *FERMTAL* | 1.454 | 4.250 | −1.000 | −1.000 | 27.510 | 2.000 |
| *NFERMTAL* | 0.997 | 9.575 | −0.073 | 3.375 | 0.220 | 0.267 |
| *MTLPR* | 6.610 | 16.500 | . | . | 31.890 | 3.500 |
| *GENMACHN* | 0.240 | 0.667 | 0.475 | 0.833 | 0.251 | 1.333 |
| *SPLMACHN* | 15.590 | −0.059 | 0.324 | 0.556 | 17.990 | −0.120 |
| *CARS* | 13.150 | 3.238 | 3.608 | −0.556 | 14.340 | 2.095 |
| *ELCTRMCHN* | 11.290 | 3.301 | 9.541 | 1.975 | 3.673 | 3.712 |
| *INSTR* | 0.555 | 0.300 | −0.777 | −0.889 | 1.097 | 0.500 |
| *MEDICAL* | 2.885 | 11.090 | 5.996 | 9.714 | −0.392 | 0.571 |
| *BIOLG* | 1.640 | 13.140 | 1.145 | 6.286 | −0.544 | −0.813 |
| *POWER* | 15.980 | 18.610 | 1.385 | 0.706 | 21.930 | 16.850 |
| *GAS* | 11.210 | 3.000 | . | . | 11.210 | 3.000 |
| *CONSTR* | 8.454 | 0.000 | −0.588 | 2.083 | 3.889 | 0.385 |
| *TRANS* | 3.884 | 5.426 | 2.294 | 4.850 | 4.455 | 4.024 |
| *IT* | 9.475 | 2.746 | −0.365 | 1.978 | 3.803 | 3.076 |
| *WHLSL* | 1.631 | 0.289 | 0.223 | 0.286 | 0.743 | 0.065 |
| *RLEST* | 12.320 | 25.440 | 7.237 | 10.340 | 2.207 | 16.530 |
| *SRVC* | 1.964 | 8.719 | 0.591 | 6.821 | −0.103 | 1.462 |
| *MEDIA* | 0.786 | −0.688 | 14.260 | −0.200 | −0.207 | −0.909 |
| *OTHR* | 11.020 | 10.310 | 0.167 | 2.894 | 52.020 | 12.690 |
| Sample avg. | 8.503 | 7.485 | 2.064 | 3.152 | 10.880 | 3.812 |

(*continued on next page*)

Table 6 (*continued*)

| Industry | ALL | | Big4/Collateral | | Big4/Non-Collateral | | NonBig4/Collateral | | NonBig4/Non-Collateral | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Amount | Freq. | Amount | Freq. | Amount | Freq. | Amount | Freq. | Amount | Freq. |
| Panel B: Supported industries versus non-supported industries | | | | | | | | | | |
| *Supported* | | | | | | | | | | |
| Mean | 12.420 | 9.826 | 4.193 | 2.832 | 1.164 | 1.682 | 13.310 | 3.870 | 6.871 | 0.901 |
| Median | 4.287 | 3.000 | 2.539 | 0.900 | −0.622 | −0.619 | 4.054 | 2.500 | 0.964 | −0.608 |
| N | 33 | 33 | 22 | 22 | 24 | 24 | 20 | 20 | 22 | 22 |
| *Non-support* | | | | | | | | | | |
| Mean | 3.331 | 4.395 | 1.454 | 0.910 | −0.272 | −0.506 | 20.720 | 2.393 | 5.013 | 0.942 |
| Median | 1.090 | 0.667 | 0.241 | 0.000 | −1.000 | −1.000 | 2.921 | 0.967 | −0.471 | −0.250 |
| N | 25 | 25 | 17 | 17 | 13 | 13 | 16 | 16 | 12 | 12 |
| *Supported vs. non-supported* | | | | | | | | | | |
| Mean | 9.089 | 5.431 | 2.739 | 1.922 | 1.436 | 2.188 | −7.41 | 1.477 | 1.858 | −0.041 |
| Median | 3.197 | 2.333 | 2.298 | 0.900 | 0.378 | 0.381 | 1.133 | 1.533 | 1.435 | −0.358 |
| *T-test* (*Z-test*) | | | | | | | | | | |
| *t*-statistics | 2.62** | 1.79* | 2.04** | 1.82* | 1.63 | 2.32** | −0.56 | 1.04 | 0.40 | −0.03 |
| *z*-statistics | 2.07** | 1.71* | 2.05** | 1.74* | 2.14** | 2.11** | 1.00 | 1.56 | 0.73 | −0.18 |

***Represents significance level at 1%.
** Represents significance level at 5%.
* Represents significance level at 10%.

the coefficient on *IP* for loans with collaterals in amount is significant (2.303, $t = 2.07$). After we introduce *SOE* and *IP·SOE*, the coefficients on *IP* are negative and significant (−6.600, $t = -2.25$ in amount with collaterals; −2.999, $t = -1.72$ in frequency without collaterals; −4.863, $t = -1.71$ in amount without collaterals). The coefficients on *IP·SOE* are positive and significant (14.113, $t = 2.75$ in amount with collaterals; 8.351, $t = 2.16$ in frequency without collaterals; 9.525, $t = 1.94$ in amount without collaterals). Therefore, for loans initiated by Big4 banks, government engineering benefits state-owned firms while crowding out non-state-owned firms. However, this pattern does not exist in loans initiated by non-Big4 banks. Overall, it appears that Big4 banks are more likely to grant policy-oriented loans.

### 5.4. Investment

Based on the above analyses of the IPO, SEO and the bank loan markets, it is natural to consider and determine whether financing opportunities spur investment. This is especially important as China's economy is investment-driven. We define new investment $I_{NEWjt}$ as $I_{TOTALjt} - I_{MAINTENANCEjt}$ (Richardson, 2006), where $I_{TOTAL}$ is measured as cash payments for fixed assets, intangible assets, and other long-term assets from the cash flow statement, scaled by beginning total assets. This definition of $I_{TOTAL}$ is equivalent to capital expenditure used in US-based studies. $I_{MAINTENANCE}$ is measured as depreciation and amortization, scaled by beginning total assets. All observations are industry-five-pear plan combinations. We estimate the following regression:

$$I_{NEWjt} = \beta_0 + \beta_1 IP_{jt} + \beta_2 Growth_{jt} + \beta_3 \log(Assets)_{jt-1} + \beta_4 P10\_5_{jt} + \beta_5 P11\_5_{jt} + e5_{jt}. \quad (5)$$

We use the average value of investment for all firms in the industry. All other variables are as defined earlier. If the coefficient on $IP_{jt}$ is positive, we have evidence that supported industries invest more than non-supported industries.

To determine investment efficiency, we also measure overinvestment following Richardson (2006) and estimate the following regression:

$$I_{NEWit} = \gamma_0 + \gamma_1 VP_{it-1} + \gamma_2 Leverage_{it-1} + \gamma_3 Cash_{it-1} + \gamma_4 Age_{it-1} + \gamma_5 Size_{it-1} + \gamma_6 Stock\ Return_{it-1} + \gamma_7 I_{NEWit-1} + Year + Industry + \varepsilon 6_{it}, \quad (6)$$

Table 7
Regressions of bank loan growth and five-year plans. Industrial policy $IP_{jt}$ equals 1 if Industry $j$ is supported by the government in Five-Year Plan $t$, and 0 otherwise. $SOE_{jt}$ is the proportion of state ownership for Industry $j$ during the $t$th five-year plan. The growth rate of Loan total amount (number) during Five-Year Plan $t$ (compared with the previous five-year plan) for Industry $j$: Growth in Loan amount, $(SumLoan_{jt} - SumLoan_{jt-1})/SumLoan_{jt-1}$; Growth in Loan frequency, $(NumLoan_{jt} - NumLoan_{jt-1})/NumLoan_{jt-1}$. Growth in Loan (ALL) is from both Big4 national banks and Non-big4 national banks. Growth in Loan (Big4) is from collateral and non-collateral loans issued by Big4 national banks. Growth in Loan (NonBig4) is from collateral and non-collateral loans issued by Non-Big4 national banks. Growth in Loan (Big4/Collateral) is from collateral loans issued Big4 national banks. Growth in Loan (Big4/Non-Collateral) is from non-collateral loans issued Big4 national banks. Growth in Loan (NonBig4/Collateral) is from collateral loans issued by NonBig4 national banks. Growth in Loan (NonBig4/Non-Collateral) is from non-collateral loans issued by NonBig4 national banks. $Growth_{jt}$ is the growth rate for industry $j$ in during the $t$th five-year plan based on China Statistical Yearbook, $\log(Assets)_{jt}$ is the logarithm transformation of the industry median of assets, $P11\_5_{jt}$ is an indicator that equals 1 for the Eleventh Five-Year Plan and 0 otherwise, respectively.

| Variables | ALL | | | | ALL | | | |
|---|---|---|---|---|---|---|---|---|
| | Amount | | Freq. | | Amount | | Freq. | |
| *Panel A: Bank loan growth and five-year plan* | | | | | | | | |
| IP | 6.168 | | 0.918 | | −10.169 | | −8.086 | |
| | (2.07)** | | (0.36) | | (−1.06) | | (−1.18) | |
| SOE | – | | – | | 5.195 | | −3.246 | |
| | | | | | (0.70) | | (−0.46) | |
| *IP·SOE* | – | | – | | 24.250 | | 13.576 | |
| | | | | | (1.54) | | (1.34) | |
| Growth | −1.285 | | 2.796 | | −0.371 | | 3.013 | |
| | (−0.49) | | (1.39) | | (−0.14) | | (1.44) | |
| log(Assets) | 2.493 | | 0.820 | | −0.061 | | 0.394 | |
| | (0.95) | | (0.81) | | (−0.02) | | (0.32) | |
| P11_5 | −8.957 | | −17.07 | | −5.393 | | −16.295 | |
| | (−2.36)** | | (−4.53)*** | | (−1.49) | | (−4.39)*** | |
| Constant | −48.34 | | −6.975 | | 6.418 | | 4.365 | |
| | (−0.75) | | (−0.30) | | (0.09) | | (0.17) | |
| Observations | 58 | | 58 | | 58 | | 58 | |
| Adjusted R-squared | 0.11 | | 0.35 | | 0.13 | | 0.34 | |
| Variables | Big4/Collateral | | Big4/Non-Collateral | | Big4/Collateral | | Big4/Non-Collateral | |
| | Amount | Freq. | Amount | Freq. | Amount | Freq. | Amount | Freq. |
| *Panel B: Bank loan growth and five-year plan* | | | | | | | | |
| IP | 2.303 | 1.307 | 0.493 | 0.268 | −6.600 | −3.999 | −4.863 | 1.209 |
| | (2.07)** | (1.40) | (0.59) | (0.46) | (−2.25)** | (−1.72)* | (−1.71)* | (0.72) |
| SOE | – | – | – | – | 2.224 | −2.074 | −6.997 | 0.263 |
| | | | | | (0.54) | (−0.98) | (−1.80)* | (0.17) |
| *IP·SOE* | – | – | – | – | 14.113 | 8.351 | 9.525 | −1.584 |
| | | | | | (2.75)** | (2.16)** | (1.94)* | (−0.60) |
| Growth | −1.605 | −0.540 | 0.507 | 0.580 | −0.927 | −0.348 | 0.722 | 0.533 |
| | (−1.28) | (−1.07) | (0.69) | (0.89) | (−0.78) | (−0.63) | (0.92) | (0.77) |
| log(Assets) | 1.803 | 0.755 | 1.192 | 0.325 | 0.005 | 0.186 | 1.484 | 0.426 |
| | (2.01)* | (1.53) | (1.81)* | (1.30) | (0.00) | (0.36) | (2.34)** | (0.98) |
| P11_5 | −2.510 | −5.279 | −2.178 | −6.333 | −0.765 | −4.760 | −1.865 | −6.575 |
| | (−1.24) | (−2.99)*** | (−1.54) | (−3.67)*** | (−0.44) | (−2.58)** | (−1.32) | (−3.00)*** |
| Constant | −38.119 | −12.387 | −28.253 | −3.633 | 1.995 | 2.124 | −32.420 | −5.928 |
| | (−1.78)* | (−1.09) | (−1.75)* | (−0.55) | (0.09) | (0.19) | (−2.24)** | (−0.64) |
| Observations | 39 | 39 | 37 | 37 | 39 | 39 | 37 | 37 |
| Adjusted R-squared | 0.21 | 0.40 | 0.08 | 0.48 | 0.39 | 0.43 | 0.14 | 0.44 |
| | NonBig4/Collateral | | NonBig4/Collateral | | NonBig4/Collateral | | NonBig4/Collateral | |
| IP | −9.358 | 1.389 | −0.936 | −1.852 | −17.026 | −4.623 | 18.830 | −5.663 |
| | (−0.87) | (1.11) | (−0.16) | (−1.45) | (−0.54) | (−1.29) | (1.06) | (−1.45) |
| SOE | – | – | – | – | 53.380 | −0.394 | 45.523 | −4.035 |
| | | | | | (1.46) | (−0.11) | (1.53) | (−0.82) |
| *IP·SOE* | – | – | – | – | 9.520 | 8.987 | −32.628 | 6.513 |
| | | | | | (0.16) | (1.47) | (−0.99) | (1.39) |

(*continued on next page*)

Table 7 (*continued*)

| | NonBig4/Collateral | | NonBig4/Collateral | | NonBig4/Collateral | | NonBig4/Collateral | |
|---|---|---|---|---|---|---|---|---|
| Growth | −7.226 | −0.022 | 2.645 | 0.150 | −3.116 | 0.390 | 5.383 | 0.038 |
| | (−0.69) | (−0.03) | (1.11) | (0.42) | (−0.28) | (0.41) | (1.67) | (0.08) |
| log(Assets) | 8.654 | 0.756 | 2.018 | 0.430 | −0.131 | 0.322 | 0.223 | 0.178 |
| | (2.05)* | (1.60) | (1.08) | (1.33) | (−0.02) | (0.50) | (0.08) | (0.43) |
| P11_5 | 6.213 | −3.501 | −5.232 | −5.005 | 16.362 | −2.744 | −3.249 | −4.288 |
| | (0.34) | (−1.54) | (−1.00) | (−2.58)** | (0.69) | (−1.09) | (−0.62) | (−2.37)** |
| Constant | −183.950 | −13.362 | −43.153 | −4.748 | −16.735 | −3.733 | −33.387 | 3.265 |
| | (−1.81)* | (−1.19) | (−0.92) | (−0.60) | (−0.12) | (−0.28) | (−0.46) | (0.34) |
| Observations | 36 | 36 | 34 | 34 | 36 | 36 | 34 | 34 |
| Adjusted R-squared | −0.06 | 0.05 | −0.08 | 0.16 | −0.05 | 0.07 | 0.03 | 0.13 |

*** Represents significance level at 1%.
** Represents significance level at 5%.
* Represents significance level at 10%.

where $I_{NEWit}$ is the difference between total investment ($I_{TOTAL}$) and depreciation and amortization ($I_{MINTENANCE}$) for Firm $i$ in Period $t$. *VP* is Tobin's Q, measured as the sum of the market value of equity and net liabilities over the book value of tangible assets. *Leverage* is the ratio of total liabilities to total assets. *Cash* is cash and cash equivalents scaled by beginning total assets. *Age* is the log of listing years. *Size* is the log of total assets. *Stock Return* is the annual stock return. $I_{NEWit\text{-}1}$ is new investment in Period $t-1$. We estimate the coefficients and obtain the residual $\varepsilon$ [See Appendix B for regression results of the estimation model]. We compute the proportion of firms with $\varepsilon > 0$ for each industry, Freq[$\varepsilon > 0$]. The higher is the value of Freq[$\varepsilon > 0$] for an industry, the more severe is its overinvestment problem.

To determine if supported industries have more overinvestment, we estimate the following regression:

$$\text{Freq}[\varepsilon > 0]_{jt} = \beta_0 + \beta_1 IP_{jt} + \beta_2 Growth_{jt} + \beta_3 \log(Assets)_{jt-1} + \beta_4 P10\_5_{jt} + \beta_5 P11\_5_{jt} + e7_{jt}. \quad (7)$$

If the coefficient on $IP_{jt}$ is positive, we have evidence that supported industries have more overinvestment.

Panel A, Table 8 presents information on investment in various industries. The three industries with the highest level of new investments are the extractive (*MINES*), transportation and warehousing (*TRANS*), and construction (*CONSTR*) industries. This pattern is consistent with China's current investment situation in that investment in infrastructure is intense. Panel B, Table 8 compares investment in supported industries and non-supported industries. Total investment, new investment and overinvestment in supported industries all exceed those in non-supported industries.

Table 9 presents regression results. Supported industries have a higher level of new investment. The coefficient on *IP* is positive and significant (0.012, $t = 2.56$). On the other hand, supported industries also have a more severe level of overinvestment. In the overinvestment regression, the coefficient on *IP* is positive and significant (0.046, $t = 2.85$).

As seen earlier, industries with heavier state-ownership are more likely to obtain financing opportunities. We therefore examine the effect of state ownership on investment and overinvestment. We add *SOE* and *IP*·*SOE* and estimate the following regressions:

$$I_{NEWit} = \beta_0 + \beta_1 IP_{jt} + \beta_2 SOE_{jt} + \beta_3 IP_{jt} \cdot SOE_{jt} + \beta_4 Growth_{jt} + \beta_5 \log(Assets)_{jt-1} + \beta_6 P10\_5_{jt} + \beta_7 P11\_5_{jt} + e8_{jt}, \quad (8)$$

$$\text{Freq}[\varepsilon > 0]_{jt} = \beta_0 + \beta_1 IP_{jt} + \beta_2 SOE_{jt} + \beta_3 IP_{jt} \cdot SOE_{jt} + \beta_4 Growth_{jt} + \beta_5 \log(Assets)_{jt-1} + \beta_6 P10\_5_{jt} + \beta_7 P11\_5_{jt} + e9_{jt}. \quad (9)$$

If the coefficient on $IP_{jt}$·$SOE_{jt}$ is positive, we have evidence that state-owned firms invest more.

Results on the effect of state-ownership are presented in Table 9. When we use $I_{NEW}$, the coefficient on *IP* is positive and significant (0.013, $t = 1.79$) while the coefficient on *IP*·*SOE* is insignificant. When we use a measure of industry overinvestment, the coefficient on *IP* is positive and significant (0.083, $t = 2.65$) and

Table 8
Investment and five-year plans. $I_{TOTAL}$ is measured as cash payments for fixed assets, intangible assets, and other long-term assets from the cash flow statement, scaled by beginning total assets. $I_{NEWit}$ is the difference between total investment ($I_{TOTAL}$) and depreciation and amortization ($I_{MINTENANCE}$) for firm $i$ in $t$. Overinvestment, $\varepsilon$, is the residual estimated from the following model. $I_{NEWit} = \gamma_0 + \gamma_1 VP_{it-1} + \gamma_2 Leverage_{it-1} + \gamma_3 Cash_{it-1} + \gamma_4 Age_{it-1} + \gamma_5$-$-1 + \gamma_2 Leverage_{it-1} + \gamma_3 Cash_{it-1} + \gamma_4 Age_{it-1} + \gamma_5 Size_{it-1} + \gamma_6 Stock\ Return_{it-1} + \gamma_7 I_{NEWit-1} + Year + Industry + e_{it}$.

| Industry | $I_{TOTAL}$ | $I_{NEW}$ | Over-investment Freq[$\varepsilon > 0$] |
|---|---|---|---|
| Panel A: Investment and overinvestment | | | |
| *AGRIC* | 0.059 | 0.040 | 0.389 |
| *MINES* | 0.124 | 0.082 | 0.403 |
| *FDPROC* | 0.075 | 0.045 | 0.300 |
| *FDPROD* | 0.076 | 0.048 | 0.260 |
| *BEVRG* | 0.064 | 0.037 | 0.383 |
| *TXTLS* | 0.074 | 0.041 | 0.350 |
| *GARMTS* | 0.063 | 0.040 | 0.314 |
| *LETHR* | 0.034 | 0.018 | 0.354 |
| *WOOD* | 0.079 | 0.045 | 0.261 |
| *FURN* | 0.078 | 0.060 | 0.467 |
| *PAPER* | 0.090 | 0.049 | 0.392 |
| *PRINT* | 0.067 | 0.037 | 0.306 |
| *STAT* | 0.039 | 0.034 | 0.500 |
| *PTRLM* | 0.068 | 0.028 | 0.416 |
| *CHEMS* | 0.094 | 0.059 | 0.354 |
| *CHMSFIBR* | 0.075 | 0.034 | 0.308 |
| *RUBBR* | 0.069 | 0.030 | 0.389 |
| *PLASTICS* | 0.098 | 0.062 | 0.360 |
| *ELCTRCOMP* | 0.080 | 0.046 | 0.319 |
| *HHELCTR* | 0.027 | 0.011 | 0.292 |
| *GLASS* | 0.098 | 0.064 | 0.363 |
| *FERMTAL* | 0.083 | 0.036 | 0.262 |
| *NFERMTAL* | 0.089 | 0.059 | 0.301 |
| *MTLPR* | 0.073 | 0.051 | 0.345 |
| *GENMACHN* | 0.057 | 0.034 | 0.307 |
| *SPLMACHN* | 0.059 | 0.040 | 0.345 |
| *CARS* | 0.065 | 0.037 | 0.410 |
| *ELCTRMCHN* | 0.055 | 0.033 | 0.361 |
| *INSTR* | 0.054 | 0.035 | 0.352 |
| *MEDICAL* | 0.063 | 0.039 | 0.344 |
| *BIOLG* | 0.083 | 0.057 | 0.410 |
| *POWER* | 0.106 | 0.069 | 0.364 |
| *GAS* | 0.083 | 0.055 | 0.325 |
| *CONSTR* | 0.085 | 0.084 | 0.302 |
| *TRANS* | 0.103 | 0.074 | 0.374 |
| *IT* | 0.048 | 0.029 | 0.317 |
| *WHLSL* | 0.051 | 0.035 | 0.318 |
| *RLEST* | 0.021 | 0.013 | 0.324 |
| *SRVC* | 0.085 | 0.052 | 0.338 |
| *MEDIA* | 0.064 | 0.059 | 0.192 |
| *OTHR* | 0.051 | 0.033 | 0.270 |
| Sample avg. | 0.071 | 0.045 | 0.337 |
| Panel B: Supported industries versus non-supported industries | | | |
| *Supported* | | | |
| Mean | 0.077 | 0.051 | 0.357 |
| Median | 0.072 | 0.046 | 0.361 |
| N | 83 | 83 | 83 |

(*continued on next page*)

Table 8 (*continued*)

| Industry | $I_{TOTAL}$ | $I_{NEW}$ | Over-investment Freq[$\varepsilon > 0$] |
|---|---|---|---|
| *Non-supported* | | | |
| Mean | 0.065 | 0.038 | 0.312 |
| Median | 0.063 | 0.034 | 0.328 |
| N | 67 | 67 | 67 |
| *Support vs non-supported* | | | |
| Mean | 0.012 | 0.013 | 0.045 |
| Median | 0.009 | 0.012 | 0.033 |
| *T-test (Z-test)* | | | |
| *t*-statistics | 2.73*** | 2.82*** | 2.54** |
| *z*-statistics | 2.54** | 3.23*** | 2.62*** |

*Represents significance level at 10%.
*** Represents significance level at 1%.
** Represents significance level at 5%.

Table 9
Regressions of investment and five-year plans. $I_{TOTAL}$ is measured as cash payments for fixed assets, intangible assets, and other long-term assets from the cash flow statement, scaled by beginning total assets. $I_{NEWit}$ is the difference between total investment ($I_{TOTAL}$) and depreciation and amortization ($I_{MINTENANCE}$) for firm $i$ in $t$. Overinvestment, $\varepsilon$, is the residual estimated from the following model. $I_{NEWit} = \gamma_0 + \gamma_1 VP_{it-1} + \gamma_2 Leverage_{it-1} + \gamma_3 Cash_{it-1} + \gamma_4 Age_{it-1} + \gamma_5 Size_{it-1} + \gamma_6 Stock\ Return_{it-1} + \gamma_7 I_{NEWit} + {}_1 + Year + Industry + e_{it}$. Industrial policy $IP_{jt}$ equals 1 if Industry $j$ is supported by the government in Five-Year Plan $t$, and 0 otherwise. $SOE_{jt}$ is the proportion of state ownership for Industry $j$ during Five-Year Plan $t$. $Growth_{jt}$ is the growth rate for industry $j$ in during the $t$th five-year plan based on China Statistical Yearbook, $\log(Assets)_{jt}$ is the logarithm transformation of the industry median of assets, $P11\_5_{jt}$ is an indicator that equals 1 for the Eleventh Five-Year Plan and 0 otherwise, respectively.

| Variables | $I_{NEW}$ | Over-investment Freq[$\varepsilon > 0$] | $I_{NEW}$ | Over-investment Freq[$\varepsilon > 0$] |
|---|---|---|---|---|
| *IP* | 0.012 | 0.046 | 0.013 | 0.083 |
| | (2.56)** | (2.85)*** | (1.79)* | (2.65)** |
| *SOE* | – | – | −0.007 | 0.052 |
| | | | (−1.25) | (1.47) |
| *IP·SOE* | – | – | −0.002 | −0.071 |
| | | | (−0.19) | (−1.68)* |
| *Growth* | 0.002 | 0.014 | 0.002 | 0.015 |
| | (0.57) | (0.90) | (0.55) | (0.90) |
| log(*Assets*) | −0.002 | −0.016 | −0.002 | −0.016 |
| | (−0.49) | (−1.33) | (−0.47) | (−1.34) |
| *P11_5* | −0.007 | −0.014 | −0.007 | −0.012 |
| | (−1.38) | (−0.67) | (−1.44) | (−0.57) |
| *Constant* | 0.076 | 0.638 | 0.078 | 0.624 |
| | (1.03) | (2.50)** | (1.04) | (2.37)** |
| Observations | 150 | 150 | 150 | 150 |
| Adjusted R-squared | 0.04 | 0.04 | 0.05 | 0.06 |

*** Represents significance level at 1%.
** Represents significance level at 5%.
* Represents significance level at 10%.

the coefficient on *IP·SOE* is negative and significant (−0.071, $t = -1.68$), suggesting that while firms in supported industries tend to overinvest, state-owned firms actually overinvest less.

Ding et al. (2010) find that overinvestment exists in all types of Chinese firms, including non-state-owned firms with presumably better corporate governance and higher production efficiency. A possible explanation for our result is that major projects of state-owned firms all have to be approved by the government while the investment decision making of non-state-owned firms is more flexible, causing more overinvestment by non-state-owned firms.

Table 10
Stock returns and five-year plans. $BHAR_{jt}$ is the market adjusted buy-and-hold cumulative abnormal return. We use two measures of $BHAR_{jt}$ for industries: one is weighted based on firms' market value of tradable shares, $BHAR\_WOS_{jt}$; and the other one is weighted based on firms' market value of all shares, including non-tradable shares, $BHAR\_WTS_{jt}$.

| Industry | 5-Year buy-and-hold abnormal return | |
|---|---|---|
| | Weighted by outstanding share market value | Weighted by total share market value |
| Panel A: Means | | |
| *AGRIC* | 2.705 | 3.097 |
| *MINES* | 0.987 | 0.425 |
| *FDPROC* | 1.683 | 1.740 |
| *FDPROD* | 3.839 | 4.572 |
| *BEVRG* | 3.175 | 2.951 |
| *TXTLS* | 0.673 | 1.338 |
| *GARMTS* | 0.498 | 1.169 |
| *LETHR* | −0.546 | 0.052 |
| *WOOD* | 0.120 | 0.622 |
| *FURN* | −0.486 | 0.110 |
| *PAPER* | 0.225 | 0.854 |
| *PRINT* | −1.380 | −0.561 |
| *STAT* | −1.413 | −0.437 |
| *PTRLM* | 1.850 | 1.840 |
| *CHEMS* | 1.172 | 1.238 |
| *CHMSFIBR* | 0.828 | 1.457 |
| *RUBBR* | −0.181 | 0.634 |
| *PLASTICS* | 1.747 | 2.561 |
| *ELCTRCOMP* | 0.721 | 1.359 |
| *HHELCTR* | 0.390 | 0.712 |
| *GLASS* | 1.809 | 2.402 |
| *FERMTAL* | −0.922 | −0.293 |
| *NFERMTAL* | 2.309 | 2.259 |
| *MTLPR* | 0.547 | 0.892 |
| *GENMACHN* | 2.666 | 2.961 |
| *SPLMACHN* | 3.178 | 2.826 |
| *CARS* | 1.821 | 2.297 |
| *ELCTRMCHN* | 3.311 | 3.117 |
| *INSTR* | 3.177 | 3.278 |
| *MEDICAL* | 2.897 | 3.242 |
| *BIOLG* | 4.134 | 3.519 |
| *POWER* | 1.102 | 1.442 |
| *GAS* | −1.089 | −0.420 |
| *CONSTR* | −0.132 | 0.184 |
| *TRANS* | −0.387 | −0.073 |
| *IT* | 0.980 | 1.779 |
| *WHLSL* | 2.180 | 2.740 |
| *RLEST* | 0.770 | 1.061 |
| *SRVC* | 0.554 | 1.000 |
| *MEDIA* | 1.091 | 1.051 |
| *OTHR* | 0.916 | 1.191 |
| Sample avg. | 1.240 | 1.580 |
| Industry | 5-Year Buy-and-hold Abnormal Return | |
| | Weighted by Outstanding Share Market Value (*WOS*) | Weighted by Total Share Market Value (*WTS*) |
| Panel B: Supported industries versus non-supported industries | | |
| *Supported* | | |
| Mean | 1.210 | 1.386 |
| Median | 0.138 | 0.183 |
| N | 64 | 64 |

(*continued on next page*)

Table 10 (*continued*)

| Industry | 5-Year Buy-and-hold Abnormal Return | |
|---|---|---|
| | Weighted by Outstanding Share Market Value (*WOS*) | Weighted by Total Share Market Value (*WTS*) |
| *Non-supported* | | |
| Mean | 1.280 | 1.834 |
| Median | 0.374 | 0.553 |
| N | 49 | 49 |
| *Supported vs non-supported* | | |
| Mean | −0.070 | −0.448 |
| Median | −0.236 | −0.370 |
| *T-test* (*Z-test*) | | |
| *t*-statistics | −0.14 | −0.91 |
| *z*-statistics | −0.69 | −1.15 |

***Represents significance level at 1%.
**Represents significance level at 5%.
*Represents significance level at 10%.

### 5.5. Industry performance

It is important to determine if government engineering is associated with an improvement or deterioration in the performance of supported industries. Government engineering is a strategy that is not necessarily consistent with the free market mechanism. Therefore, supported industries may not perform well in the long run. On the other hand, the government may be able to identify industries that are promising in the future or are important for the national economy. If this is the case, supported industries can perform well in the long run.

It is also important to note that the economic performance of supported industries may not fit the original goals and purposes of government policies as the government often considers the aggregate interest of the whole economy and the aggregate interest may not be consistent with the interest of a certain industry. That is, the external benefit of supporting an industrial can be scattered in the society and not directly reflected within the industry that is the target of the policy. Therefore, even if we cannot find a link between government support and economic performance, we still cannot disapprove the rationale of government engineering.

#### 5.5.1. Buy-and-hold abnormal return, BHAR

*BHAR* is the market adjusted buy-and-hold cumulative abnormal return (Barber and Lyon, 1997; Lyon et al., 1999) for an industry. We compute $BHAR_{jt}$ for Industry $j$ starting from the beginning of Five-Year Plan $t$ to its end. We use two measures of *BHAR*: one is weighted based on firms' market value of tradable shares, *BHAR_WOS*; and the other is weighted based on firms' market value of all shares, including non-tradable shares, *BHAR_WTS*.[10]

Panel A, Table 10 presents values of these two return measures for various industries. Panel B, Table 10 compares these two measures for supported and non-supported industries. Without control variables, there is no significant difference in returns between supported and non-supported industries. We then estimate the following regression:

$$BHAR_{jt} = \beta_0 + \beta_1 IP_{jt} + \beta_2 Growth_{jt} + \beta_3 log(Assets)_{jt} + e10_{jt}. \quad (10)$$

The purpose of this analysis is to determine whether government supported industries fare better or worse in the long run in the stock market.

Regression results are reported in Table 11. Each observation is an industry-five-year-plan combination. The coefficients on *IP* are largely insignificant (0.654, $t = 1.56$ using *BHAR_WOS*; 0.429, $t = 1.15$ using *BHAR_WTS*).

Next, we add state-ownership *SOE* and *IP·SOE*, and estimate the following regression:

[10] Chinese state-owned firms often just sell a portion of their shares. Therefore, many of their shares are non-tradable.

Table 11
Regressions of stock returns and five-year plans. Industrial policy $IP_{jt}$ equals 1 if Industry $j$ is supported by the government in Five-Year Plan $t$, and 0 otherwise. $SOE_{jt}$ is the proportion of state ownership for Industry $j$ during Five-Year Plan $t$. $BHAR_{jt}$ is the market adjusted buy-and-hold cumulative abnormal return. We use two measures of $BHAR_{jt}$ for industries: one is weighted based on firms' market value of tradable shares, $BHAR\_WOS_{jt}$; and the other one is weighted based on firms' market value of all shares, including non-tradable shares, $BHAR\_WTS_{jt}$. Industrial policy $IP_{jt}$ equals 1 if Industry $j$ is supported by the government in Five-Year Plan $t$, and 0 otherwise. log $(Assets)_{jt}$ is the logarithm transformation of Industry $j$'s median total assets.

| | 5-Year buy-and-hold abnormal return | | | |
|---|---|---|---|---|
| Variables | Weighted by Outstanding Share Market Value (WOS) | Weighted by Total Share Market Value (WTS) | Weighted by Outstanding Share Market Value (WOS) | Weighted by Total Share Market Value (WTS) |
| *IP* | 0.654 | 0.429 | 5.652 | 4.469 |
| | (1.56) | (1.15) | (4.11)*** | (3.69)*** |
| *SOE* | – | – | 1.527 | 1.214 |
| | | | (1.40) | (1.23) |
| *IP·SOE* | – | – | −6.943 | −5.611 |
| | | | (−3.88)*** | (−3.51)*** |
| *Growth* | 0.269 | 0.235 | 0.255 | 0.222 |
| | (1.22) | (1.20) | (1.39) | (1.29) |
| log(*Assets*) | −0.199 | −0.249 | −0.105 | −0.170 |
| | (−0.92) | (−1.28) | (−0.46) | (−0.89) |
| *P10_5* | −0.164 | −0.600 | −0.513 | −0.886 |
| | (−0.45) | (−1.74)* | (−1.21) | (−2.36)** |
| *P11_5* | 3.058 | 3.405 | 2.355 | 2.827 |
| | (4.60)*** | (5.56)*** | (2.83)*** | (3.87)*** |
| *Constant* | 4.414 | 6.189 | 1.662 | 3.917 |
| | (0.85) | (1.32) | (0.33) | (0.91) |
| Observations | 113 | 113 | 113 | 113 |
| Adjusted R-squared | 0.28 | 0.41 | 0.35 | 0.46 |

*** Represents significance level at 1%.
** Represents significance level at 5%.
* Represents significance level at 10%.

$$BHAR_{jt} = \beta_0 + \beta_1 IP_{jt} + \beta_2 SOE_{jt} + \beta_3 IP_{jt} \cdot SOE_{jt} + \beta_4 Growth_{jt} + \beta_5 log(Assets)_{jt} + e11_{jt}. \quad (11)$$

With the addition of *SOE* and *IP·SOE*, the coefficients on *IP* are positive and significant (5.652, $t = 4.11$ using *BHAR_WOS*; 4.469, $t = 3.69$ using *BHAR_WTS*), suggesting that supported industries enjoy higher stock returns. However, when state ownership increases, stock performance declines. The coefficients on *IP·SOE* are negative and significant (−6.943, $t = -3.88$ using *BHAR_WOS*; −5.611, $t = -3.51$ using *BHAR_WTS*).

Based on this result, we can potentially conclude that low efficiency associated with state ownership dampens the positive effect of government support on industry stock performance. On the other hand, we perhaps can also argue that as some of the external benefit of government engineering cannot be internalized by the state sector, the performance of the state sector is not as good as that of the non-state sector which potentially absorbs some of the external benefit.

### 5.5.2. Operating cash flow

We also consider an accounting based measure of performance, the growth in operating cash flow, $CashFlow_{jt}$. It is the compounded average annual growth rate of net operating cash flow for Industry $j$ during Five-Year Plan $t$. We estimate the following regression:

$$CashFlow_{jt} = \beta_0 + \beta_1 IP_{jt} + \beta_2 Growth_{jt} + \beta_3 \log(Assets)_{jt} + e12_{jt}. \quad (12)$$

The purpose of this examination is that cash flow reflects another dimension of industry performance, complementing results based on industry stock returns.

Panel A, Table 12 provides information on cash flow in various industries. Panel B, Table 12 compares the growth in cash flow between supported and non-supported industries. There is some weak evidence that supported industries have higher cash flow growth (difference in mean = 0.050, $t = 1.83$). Regression results are

Table 12
Growth of operating cash flows and five-year plans. *Cashflow* is the average growth rate of net operating cash flow in every five-year plan.

| Industry | *Cashflow* |
|---|---|
| *AGRIC* | 0.066 |
| *MINES* | 0.224 |
| *FDPROC* | 0.048 |
| *FDPROD* | 0.182 |
| *BEVRG* | 0.194 |
| *TXTLS* | 0.170 |
| *GARMTS* | 0.072 |
| *LETHR* | −0.160 |
| *WOOD* | −0.061 |
| *FURN* | −0.147 |
| *PAPER* | 0.169 |
| *PRINT* | 0.041 |
| *STAT* | 0.190 |
| *PTRLM* | 0.147 |
| *CHEMS* | 0.181 |
| *CHMSFIBR* | 0.086 |
| *RUBBR* | 0.055 |
| *PLASTICS* | 0.051 |
| *ELCTRCOMP* | −0.005 |
| *HHELCTR* | 0.150 |
| *GLASS* | 0.101 |
| *FERMTAL* | 0.220 |
| *NFERMTAL* | 0.200 |
| *MTLPR* | 0.147 |
| *GENMACHN* | 0.184 |
| *SPLMACHN* | 0.102 |
| *CARS* | 0.072 |
| *ELCTRMCHN* | 0.086 |
| *INSTR* | 0.111 |
| *MEDICAL* | 0.435 |
| *BIOLG* | 0.195 |
| *POWER* | 0.042 |
| *GAS* | 0.151 |
| *CONSTR* | 0.118 |
| *TRANS* | 0.095 |
| *IT* | 0.164 |
| *WHLSL* | 0.254 |
| *RLEST* | 0.135 |
| *SRVC* | 0.156 |
| *MEDIA* | 0.123 |
| *OTHR* | 0.132 |
| Sample avg. | 0.066 |

| Industry | Cashflow |
|---|---|
| Panel B: Supported industries versus non-supported industries | |
| *Supported* | |
| Mean | 0.153 |
| Median | 0.137 |
| N | 85 |
| *Non-supported* | |
| Mean | 0.103 |
| Median | 0.128 |
| N | 64 |

(*continued on next page*)

Table 12 (*continued*)

| Industry | Cashflow |
|---|---|
| Supported vs non-supported | |
| Mean | 0.050 |
| Median | 0.009 |
| *T-test (Z-test)* | |
| *t*-statistics | 1.83* |
| *z*-statistics | 1.14 |

***Represents significance level at 1%.
**Represents significance level at 5%.
* Represents significance level at 10%

Table 13
Regressions of growth of operating cash flows and five-year plans. *Cashflow* is the average growth rate of net operating cash flow in every five-year plan. Industrial policy $IP_{jt}$ equals 1 if Industry $j$ is supported by the government in Five-Year Plan $t$, and 0 otherwise. $SOE_{jt}$ is one if the ultimate controller is state ownership for Industry $j$ during Five-Year Plan $t$. $Growth_{jt}$ is the growth rate for industry $j$ in during the $t$th five-year plan based on China Statistical Yearbook, $\log(Assets)_{jt}$ is the logarithm transformation of Industry $j$'s median total assets.

| Variables | *Cashflow* | *Cashflow* |
|---|---|---|
| *IP* | 0.058 | 0.107 |
| | (2.04)** | (2.12)** |
| *SOE* | – | 0.034 |
| | | (0.84) |
| *IP·SOE* | – | −0.099 |
| | | (−1.67)* |
| *Growth* | 0.009 | 0.010 |
| | (0.45) | (0.49) |
| log(*Assets*) | −0.002 | −0.004 |
| | (−0.09) | (−0.16) |
| *P11_5* | 0.028 | 0.028 |
| | (1.01) | (1.02) |
| *Constant* | 0.124 | 0.145 |
| | (0.23) | (0.26) |
| Observations | 149 | 149 |
| Adjusted R-squared | 0.01 | 0.02 |

***Represents significance level at 1%.
** Represents significance level at 5%.
* Represents significance level at 10%.

reported in Table 13. Each observation is an industry-five-year-plan combination. The coefficient on *IP* is positive and significant (0.058, $t = 2.04$), suggesting that supported industries enjoy higher cash flow growth.

Next, we add state-ownership *SOE* and *IP·SOE* and estimate the following regression:

$$Cash\ Flow_{jt} = \beta_0 + \beta_1 IP_{jt} + \beta_2 SOE_{jt} + \beta_3 IP_{jt} \cdot SOE_{jt} + \beta_4 Growth_{jt} + \beta_5 \log(Assets)_{jt} + e13_{jt}. \quad (13)$$

With the addition of *SOE* and *IP·SOE*, the coefficients on *IP* are positive and significant (0.107, $t = 2.12$), suggesting that supported industries enjoy higher growth of cash flow. However, as state ownership increases, the growth rate of cash flow declines. The coefficients on *IP·SOE* are negative and significant (−0.099, $t = -1.67$).

### *5.5.3. Non-performing loan ratio, NPLR*

The buy-and-hold return and cash flow analyses above capture performance in the stock market or in accounting terms. As we have earlier examined the effect of the government support in the loan market, we also estimate a performance measure for the loan market. We follow Morck et al. (2011) and compute the non-performing loan ratio $NPLR_{jt}$ for Industry $j$ during 2006–2010. Data come from hand-collected annual reports of the CBRC for 2006–2010.

Table 14
Non-performing loans and five-year plans. $NPLR_{jt}$ is non-performing loan ratio for Industry $j$ in Year $t$.

| Industry | *NPLR* |
|---|---|
| Panel A: Non-performing loans | |
| *AGRIC* | 0.217 |
| *MINES* | 0.017 |
| *MACHN* | 0.054 |
| *POWER* | 0.019 |
| *CONSTR* | 0.023 |
| *TRANS* | 0.016 |
| *IT* | 0.037 |
| *WHLSL* | 0.079 |
| *RESTAUNT* | 0.102 |
| *MONEY* | 0.005 |
| *RLEST* | 0.036 |
| *RENT* | 0.044 |
| *SICENCE* | 0.068 |
| *ENVIRONMNT* | 0.009 |
| *SRVC* | 0.033 |
| *EDU* | 0.027 |
| *HEALTH* | 0.030 |
| *CULTURE* | 0.078 |
| *PUBLIC* | 0.028 |
| Sample avg. | 0.049 |
| Panel B: Supported industries versus non-supported industries | |
| *Supported* | |
| Mean | 0.069 |
| Median | 0.032 |
| N | 25 |
| *Non-supported* | |
| Mean | 0.041 |
| Median | 0.024 |
| N | 70 |
| *Support vs. non-support* | |
| Mean | 0.028 |
| Median | 0.008 |
| *T-test (Z-test)* | |
| *t*-statistics | 1.14 |
| *z*-statistics | 1.15 |

Panel A, Table 14 shows the level of non-performing loans for various industries. Panel B, Table 14 compares the level of non-performing loans between supported and non-supported industries. We find no significant difference. Next, we take a logistic transformation of *NPLR* and estimate the following regressions:

$$\log[NPLR_{jt}/(1 - -NPLR_{jt}) = \beta_0 + \beta_1 IP_{jt} + \beta_2 \log(VA)_{jt} + e14_{jt}, \quad (14)$$

$$\log[NPLR_{jt}/(1 - -NPLR_{jt}) = \beta_0 + \beta_1 IP_{jt} + \beta_2 SOE_{jt} + \beta_3 IP_{jt} \cdot SOE_{jt} + \beta_4 log(VA)_{jt} + e15_{jt}, \quad (15)$$

where $VA_{jt}$ is value-added for Industry $j$. We use these equations to determine whether supported industries have more or less non-performing loans.

The issue of non-performing loans in China's banking system has been a topic of interest. China's banking system has experienced several major reforms and through the establishment of several big asset management firms, non-performing loans have been drastically reduced. Based on annual reports of China's Banking Regulatory Commission, the ratio of non-performing loans exhibits steady decline over 2005–2010. However, government industrial policies may distort the bank loan market, causing the ratio of non-performing loans to be higher in supported industries than in non-supported industries. This logic would be consistent with Allen et al. (2005) and Morck et al. (2011).

Table 15
Regressions of non-performing loans and five-year plans. Industrial policy $IP_{jt}$ equals 1 if Industry $j$ is supported by the government in Five-Year Plan $t$, and 0 otherwise. $SOE_{jt}$ is the proportion of state ownership for Industry $j$ during Five-Year Plan $t$. $NPLR_{jt}$ is non-performing loan ratio for Industry $j$. We take the logistic transformation of $NPLR_{jt}$. $VA_{jt}$ is value added Industry $j$.

| Variables | log[$NPLR$/(1 − $NPLR$)] | log[$NPLR$/(1 − $NPLR$)] |
|---|---|---|
| *IP* | 0.730 | 1.659 |
| | (1.28) | (1.64)* |
| *SOE* | – | −2.199 |
| | | (−3.12)*** |
| *IP·SOE* | – | −0.715 |
| | | (−0.64) |
| log(*VA*) | −0.230 | −0.595 |
| | (−0.87) | (−2.14)** |
| Constant | −1.726 | 2.730 |
| | (−0.75) | (1.08) |
| Observations | 95 | 95 |
| Adjusted R-squared | 0.03 | 0.22 |

*** Represents significance level at 1%.
** Represents significance level at 5%.
* Represents significance level at 10%.

Table 15 presents results covering 2006–2010. In this analysis, as we only have data for one five-year plan, each observation is an industry-year combination. The coefficient on *IP* is positive and marginally significant (1.659, $t = 1.64$), suggesting that the ratio of non-performing loans is higher in supported industries than in non-supported industries. This is evidence of a negative effect of government support, consistent with Morck et al. (2011) that government-led resource allocations can create distortion. The coefficient on *SOE* is negative and significant (−2.199, $t = -3.12$), suggesting that state-owned firms in non-supported industries actually have a lower non-performing loan ratio. The coefficient on *IP·SOE* is insignificant (−0.715, $t = -0.64$), suggesting no difference in the non-performing loan ratio between state-owned and non-state-owned firms in supported industries.

The above results are different from our stock market performance and cash flow growth analyses earlier. We do not attempt a formal reconciliation here. Five-year plans are multi-dimensional and an analysis of them has to be conducted from different angles. Finding different results enriches our understanding of this model and helps us more objectively evaluate its consequences. Of course, the evidence that state-owned firms in non-supported industries have a lower non-performing loan ratio may be specific for the time period 2006–2010 used in the analysis as the government established several asset management companies that took over many non-performing loans from banks.

## 6. Conclusion

Since the start of its economic reform in 1978, China has achieved rapid and sustained economic growth. What does China's rapid growth tell us? Is the China experiment useful to other economies? These are unavoidable questions of our era. Different from prior research on China's economy, we focus on an economic management model long used by the Chinese government – five-year plans. We examine the influence of four five-year plans from 1991 to 2010 on China's capital markets and their economic consequences.

We find that industries supported by the government enjoy faster growth in equity and debt finance. This pattern is more pronounced in industries with heavy state ownership. Further, as their respective market orientation improves, the government's control of the IPO, SEO and bank loan markets declines. We also find that government supported industries have higher stock market returns and cash flow growth that dampen as state ownership increases. Supported industries also have a higher ratio of non-performing loans. These findings provide a new perspective in understanding the role played by government economic engineering on corporate finance and its economic consequences.

**Appendix A. Capturing government engineering**

| Time | Event/Codes |
|---|---|
| *Eighth Five-Year Plan (1991–1995)* | |
| Dec. 30th, 1990 | The Seventh Plenum of the 13th Communist Party of China (CPC) Central Committee deliberated and adopted the CPC Central Committee's suggestions about making the ten-year program of national economic and social development and the Eighth Five-Year Plan. |
| Mar., 1990 | The Fourth Session of the 7th National People's Congress (NPC) deliberated and adopted the State Council's report about the outline of ten-year program of national economic and social development and the Eighth Five-Year Plan. |
| Deng Xiaoping's talk During Excursions to China's Southern Cities, 1992 | Marked by Deng Xiaoping's serious talk in 1992 and 14th National Congress of the Communist Party of China, China's reform, opening up and modernization entered a new stage in the Eighth Five-Year Period. Focuses are enhancing agriculture, basic industries and basic facilities, reorganizing and improving the processing industry, highlighting the development of electronic industry, developing the construction industry and the tertiary industry actively, establishing machinery, electronics, petrochemical, automobile manufacturing, and building industry as pillar industries. |
| Details | Machinery industry: equipment for transportation, energy, raw material industries, etc, especially basic machinery and basic components and parts; Electronics industry: integrated circuit, computer, communication equipment, and new generation household appliance; Petroleum industry: comprehensive utilization and deep processing of ethylene, synthetic fiber, synthetic resin, synthetic rubber and basic organic raw materials; Automobile industry: major car and light-weight vehicle enterprises; Construction industry: building materials industry. Tertiary industry: science and technology, education, information consultation industry; commercial, finance, insurance, tourism, and resident service industry. |
| *Ninth Five-Year Plan (1996–2000)* | |
| Sep. 28th, 1995 | The 5th Plenum of the 14th CPC Central Committee approved proposals for the Ninth Five-Year Plan of national economic and social development and long-term objectives through the year 2010. |
| Mar. 17th, 1996 | The 4th Session of the 8th NPC deliberated and adopted the outline on the Ninth Five-Year Plan of national economic and social development of and long-term objectives through the year 2010. |

| | |
|---|---|
| Details | Reinforcing agriculture should be the priority of the national economy. Officials at all major levels should work on developing agriculture and all industries should contribute to the development of agriculture and rural economy. The government should continue to strengthen basic facilities and basic industries. Energy industry (electric power, coal, petroleum and natural gas); transportation industry (focusing on increasing railroad transportation capability and taking advantage of various other modes of transportation, such as roads, waterways, air and pipelines); postal and telecommunication industry; raw material industry (iron and steel industry, nonferrous metal industry). Government should promote pillar industries and adjust and improve light textile industry. 1. Machinery industry: enhancing the development and manufacturing capability of large integrated equipment for producing electric power, chemical fertilizer, ethylene and so on, improving the performance and quality of major basic machinery like CNC machine tool and major machinery parts like hydraulic pressure, pneumatic, seal, instrument and meter, etc.; 2. Electronics industry: focusing on developing integrated circuits, new components, computer and communication equipment, and enhancing the capability of providing informatization system and equipment for economic and social development; 3. Petrochemical industry: developing deep processing and comprehensive utilization capability, focusing on developing synthetic fiber, synthetic resin and synthetic rubber; 4. Automobile industry: focusing on developing auto parts, economy cars and heavy vehicles, establishing independent automotive technology development system to carry out scale production; 5. Construction industry and building material industry: focusing on constructing urban and rural housing and public projects, improving and enhancing design capability, reinforcing construction management, guaranteeing project quality; 6. Light textile industry: Actively develop tertiary industries such as commercial service industry: continuing to develop commercial retail outlets, perfecting non-staple agricultural products, industrial consumer goods, and production material wholesales; tourism; information consultation industry. |
| *Tenth Five-Year Plan (2001–2005)* | |
| Oct. 11th, 2000 | The 5th plenum of the 15th CPC Central Committee approved Recommendations by the Chinese Communist Party Central Committee on the Formulation of the Tenth Five-Year National Economic and Social Development Plan. |
| Oct. 19th, 2000 | Premier Zhu Rongji explained recommendations for drawing up the Tenth Five-Year Plan. |
| Mar. 15th, 2001 | The 4th Session of the 9th NPC approved the plan. |

| | |
|---|---|
| Details | A fundamental economic task is enhancing agriculture and raising farmers' income. The plan calls for the optimization of industrial structure and the strengthening of international competitiveness. Raw material industry: Actively developing three main synthetic materials and fine chemical products, stainless steel and cold-rolled sheet, alumina, deep processing tombarthite, new type dry-process cement and efficient chemical fertilizer, drug and critical intermediate with large demand. Light textile industry: actively developing wood pulp, high-grade paper and paperboard, new appliances, differential fiber, industrial textiles, high-grade fabric, designer clothes and the deep processing of agricultural products and so on. The plan calls for enhancing the equipment manufacturing industry, elevating the importance of developing CNC machine tools, instrumentation and basis of parts and components; supporting the development of new efficient electricity generating equipment such as large gas turbines, large-scale pumped storage units and nuclear units, EHV DC transmission and transformation equipment, large metallurgy, chemical fertilizer and petrochemical equipment, urban rail transportation equipment, new papermaking and textile machinery and so on; developing agricultural machinery, civilian ships and economy cars, improving the manufacturing quality of cars and key parts, actively developing energy-efficient low-emission vehicle engines and hybrid power systems, and enhancing mechatronics. The government will actively develop the construction industry; popularize the usage of new building materials. The government will develop high-tech industries, mainly high-speed broadband information network, deep submicron integrated circuits, biotechnology projects, new turbofan regional aircraft, new space launch vehicles, etc., and promote the development for high-tech products like digital electronic products, new display devices, photoelectron materials and parts, modern traditional Chinese medicine, satellite application and so on. Industrialization should be driven by information. The plan also promotes the service industry to improve supply capacity. The plan aims at developing service industries that caters daily consumption: developing the real estate and home improvement industry; strengthening the construction of tourism infrastructure and supporting facilities to promote tourism as an economic growth source; further developing commercial retail businesses and the catering industry. The plan calls for developing industries that serve production: actively importing new business concepts and technologies, pushing chain operation, logistics and distribution, agency and multimodal transport, transforming and upgrading traditional retail business, transportation and postal service industry; actively developing information service, especially networking, information technology application consultation and database services; accelerating the development of information industry and vigorously promoting information technology. The plan promotes the development of electronic information product manufacturing industry: developing core technologies to enhance the manufacturing capacity of computer and network products, communication products, digital audio-visual products and new components and other products, developing integrated circuits and software industries. The plan also emphasizes the strengthening of infrastructure construction, improving the layout and structure, and the strengthening of water conservancy construction, improving integrated transport system, optimizing the energy structure. |
| *Eleventh Five-Year Plan (2005–2010)* | |
| Oct. 11th, 2005 | The 5th Plenum of the 16th CPC Central Committee approved proposals for formulating the national economic and social development plan for the Eleventh Five-Year Plan. |

| | |
|---|---|
| Details | Investment to the agriculture industry is the most important focus of government investment. The industrial structure of agriculture should be optimized: increasing the weight of the breeding industry, accelerating the development of animal farming and dairy farming, and developing the aquaculture and aquatic product processing.<br>Accelerating the development of high-tech industries. Enhancing the electronic information industry: including developing the integrated circuits, software, new electronic components and other core industries, focusing on optical communication, wireless communication, high-performance computing and network equipment and other information industries, setting up the software, microelectronics, optoelectronics and other industrial bases, promoting the formation of optoelectronics industry chain. Cultivate bioindustry: focusing on developing the bio-medicine, bio-agriculture, bio-energy and bio-manufacturing. Promoting the aerospace industry. Developing the new materials industry. Revitalizing the equipment manufacturing industry: including large and efficient clean power generation equipment, EHV transmission and substation equipment, large ethylene equipment, large coal-chemical equipment, large metallurgical equipment, integrated coal mining equipment, large ship's fitting, rail transit equipment, environmental protection and comprehensive utilization of resources equipment, numerical control machine. Optimizing the energy industry: orderly developing the coal, actively developing the electric power, accelerating the development of the oil and gas, and striving to develop the renewable energy sources. Adjusting the structure and layout of raw materials industry: optimizing the development of the metallurgical industry, actively developing the fine chemical industry, striving to develop the traditional Chinese medicine industry.<br>Accelerating the development of service industries. Giving priority to the development of transportation industry, striving to develop the modern logistics industry, and developing the financial services industry in an orderly manner, actively developing the information service industry, developing the real estate industry, vigorously developing the tourism industry, strengthening the municipal utilities industry, accelerating the development of community service industry, developing sports and the sports industry. |

## Appendix B. Regressions of estimating overinvestment (Richardson, 2006)

$I_{NEWit}$ is the difference between total investment ($I_{TOTAL}$) and depreciation and amortization ($I_{MINTENANCE}$) for Firm $i$ in Period $t$. *VP* is Tobin's Q, measured as the sum of the market value of equity and net liabilities over the book value of tangible assets. *Leverage* is the ratio of total liabilities to total assets. *Cash* is cash and cash equivalents scaled by beginning total assets. *Age* is the log of listing years. *Size* is the log of total assets. *Stock Return* is the annual stock return. $I_{NEWit-1}$ is new investment in Period $t-1$.

| Variables | N | Mean | S.D. | Min | Q1 | Q25 | Median | Q75 | Q99 | Max |
|---|---|---|---|---|---|---|---|---|---|---|
| *Panel A: Main variables* | | | | | | | | | | |
| $I_{TOTALt}$ | 12,692 | 0.068 | 0.078 | 0.000 | 0.000 | 0.014 | 0.042 | 0.092 | 0.395 | 0.409 |
| $I_{NEWt}$ | 12,692 | 0.042 | 0.080 | −0.417 | −0.048 | −0.003 | 0.016 | 0.062 | 0.347 | 0.887 |
| $VP_{t-1}$ | 12,692 | 2.510 | 1.625 | 0.907 | 0.907 | 1.430 | 2.012 | 3.008 | 9.373 | 10.596 |
| $Leverage_{t-1}$ | 12,692 | 0.481 | 0.185 | 0.008 | 0.077 | 0.350 | 0.487 | 0.617 | 0.909 | 1.000 |
| $Cash_{t-1}$ | 12,692 | 0.176 | 0.142 | 0.004 | 0.004 | 0.077 | 0.139 | 0.234 | 0.761 | 0.790 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| $Age_{t-1}$ | 12,692 | 1.669 | 0.737 | 0.000 | 0.000 | 1.099 | 1.792 | 2.197 | 2.773 | 2.944 |
| $Size_{t-1}$ | 12,692 | 21.220 | 1.005 | 14.937 | 19.124 | 20.544 | 21.121 | 21.818 | 24.000 | 26.762 |
| $Return_{t-1}$ | 12,692 | 0.345 | 0.954 | −0.751 | −0.751 | −0.273 | −0.006 | 0.704 | 4.183 | 4.183 |
| $I_{NEWt-1}$ | 12,692 | 0.046 | 0.084 | −0.274 | −0.048 | −0.003 | 0.019 | 0.068 | 0.374 | 0.880 |

| *Variables* | *VP = Tobin's Q* $I_{NEW}$ |
|---|---|
| *Panel B: Estimation model* | |
| $VP_{t-1}$ | 0.003 |
| | (4.94)*** |
| $Leverage_{t-1}$ | −0.020 |
| | (−5.19)*** |
| $Cash_{t-1}$ | 0.037 |
| | (7.55)*** |
| $Age_{t-1}$ | −0.007 |
| | (−6.56)*** |
| $Size_{t-1}$ | 0.003 |
| | (3.84)*** |
| *Stock Return*$_{t-1}$ | 0.002 |
| | (2.05)** |
| $I_{NEWt-1}$ | 0.359 |
| | (45.02)*** |
| Constant | −0.053 |
| | (−2.95)*** |
| *Year & Industry* | Yes |
| Observations | 12,692 |
| Adjusted R-squared | 0.21 |

* Represents significance level at 10%.
*** Represents significance level at 1%.
** Represents significance level at 5%.

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# The significance of research—Comments on the Five-Year Plan paper

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All accounting and financial behaviors are rooted in specific institutional environments. These behaviors pertain to specific firms, and firms operate in different economic systems. Therefore, institutions such as the political, legal, economic, cultural, and religious institutions that shape an economic entity will surely be reflected in firms' accounting and financial behaviors. Accounting and finance research that does not consider institutions lacks relevancy and vitality.

Modigliani and Miller (1958) are the starting point of modern corporate finance research. However, a series of assumptions in Modigliani and Miller (1958) is designed to limit or weaken the role played by the institutional environment on investors' behaviors. Subsequent research relaxes Modigliani and Miller's (1958) assumptions and introduces social institutions, such as taxes and bankruptcy costs. During the last three decades, accounting and finance studies published in influential academic journals have been based on capital markets and institutions in the United States. The discussion on institutions is not salient, as all authors, readers, editors, reviewers, and even critics are from or assumed to be from the United States, and they exchange stories under the same social scenarios.

Accounting and finance research based on Jensen and Mecklin's (1976) agency theory during the last three decades was undoubtedly mainstream. Such research has made the *Journal of Accounting and Economics* and the *Journal of Financial Economics* successful. Agency theory leads researchers' attention to firms' internal organization and market participants' characteristics. It has also made some assumptions on external environments related to the free market, protection intellectual properties, and a mature legal system. Research on capital structure, earnings management, and tax shields requires certain assumptions to be made of institutions, such as profit-seeking capital and discretionary decision making based on firm and shareholder value. Solving the so-called capital structure puzzle calls for attention to institutions.

At the end of the last century, China introduced a framework originating from US markets and institutions to conduct its accounting and finance research. The Shanghai and Shenzhen Exchanges are constantly supplying data for this kind of research. We have been making steady improvement in our research. Earlier replications have been modified by adding institutions (such as shareholder identities and state ownership) and using different Chinese settings or data. However, most of the research is literature-driven and not issue-driven, with the goal of answering questions, using Chinese settings and data that Western scholars are interested in but cannot answer. This kind of research already respects institutions and their effects on accounting and finance behaviors. However, it is not guided by institutions, nor is it issue-driven. Therefore, although we sometimes see statistical significance, we are often unable to explain reality and sometimes even see contradictory explanations. Unguided by real issues, accounting and finance research is often a tempest in a teacup and does not deal with important questions. Researchers should always aim to answer real theoretical and practical questions.

Real institution-guided and issue-driven research should stem from China's institutional environment or its business reality and discuss persistent and important questions in this market or economic system using current theories. If these theories cannot provide an explanation, they can become researchers' treasure troves. This is also the logic of Justin Lin's New Structural Economics.

The current accounting and finance theories were mainly formed during the 1990s. Although the US economy is still a free market economy, it has been experiencing big, if not fundamental, changes during the last 20 years due to the Internet, securitization, and big data. Businesses like Google, Uber, and Airbnb are occupying important places in the economy. This has reduced the ability of our current accounting and finance theories to explain these firms. Furthermore, our market is characterized by the coexistence of centralization, intense regulation, central-local government relationships, Confucian culture, the coexistence of SOEs and non-SOEs, and so on. Research exploring these common phenomena under such institutions and real business scenarios can thus be considered as institution-guided and issue-driven.

In short, accounting and financial behaviors pertain to specific firms, and firms operate in a given economic environment. Factors shaping and constraining economic environments are broadly defined as institutions, which include politics, law, economy, and culture. Professor TJ Wong once called for the paradigm of a "top-down" research approach, which requires accounting and finance research to start from its fundamental source. This begs the question of where the source is.

Now let's turn to the Five-Year Plan paper.

Although prior studies address microeconomic accounting and finance research in light of China's institutional characteristics, this paper starts from a point that appears to be somewhat disconnected: China's Five-Year Plans. By dissecting Five-Year Plans, the authors explore a more general idea: how macroeconomic policies influence microeconomic firm behaviors or the macroeconomic policy transmission mechanism. The focus of the paper is still firms' finance behaviors. The authors find that SOEs supported by the Five-Year Plans have access to more and cheaper capital and have more overinvestments and nonperforming loans, and that non-SOEs are crowded out.

The *China Journal of Accounting Research* (*CJAR*) seeks papers of this style. These papers start from China's institutional background and contribute distinct findings with a solid theoretical foundation to the accounting and finance literature. We expect that the authors and *CJAR* can work together to mainstream this type of research.

However, as a critical reader, I still have several issues to clarify.

First, what is the positioning of the research? Is this paper a Five-Year Plan study or a study on how Five-Year Plans affect firms' financial behaviors? If it is a Five-Year Plan study, the authors need to focus on which of the 13 Five-Year Plans is most effective, what kinds of Five-Year Plans are effective, and other such questions. To discuss the effectiveness of Five-Year Plans, they would need to use Justin Lin's comparative advantages and the roles of the government as theoretical foundations. The authors describe their results in such a way as to prevent readers from negative interpretations. They imply that Five-Year Plans cannot be considered simply as government interference in the market and that cheap finance obtained by state-owned firms cannot be considered as a negative effect of government action. If we leave the macroeconomy, then we cannot understand the microeconomy.

Of course, the *CJAR* does not reject macro research, although it is not a major theme of the journal. To make the paper more influential, we suggest that its position be revised: the influence of macro policies and institutions on firms' financial and accounting behaviors – evidence from Five-Year Plans. Such a position change would require some revision of the article. An important question should be discussed: why are Five-Year Plans an important factor? Of course, one can use Justin Lin's theories here, too. We suggest, if possible, that the authors build a framework of the determinants of Chinese firms' accounting and finance behaviors; this would make Five-Year Plans a key factor.

Second, if the focus is on how macro policies influence firms' behaviors, how does this link to La Porta, Lopez-deSilanes, Shleifer, and Vishny (LLSV) or other related studies? Answering this question would enhance readability. Alternatively, is it possible to infer a more general conclusion based on Five-Year Plans and firms' financial performance, like LLSV's conclusion that legal protection of investors' rights determines the prosperity of capital markets? Currently, the paper provides research findings but still lacks – or we have overlooked – such generalizability. Prior works, such as implicit contracts and perk consumption, have such qualities. The authors appear to combine macro and micro rationality and try to convey the idea that under different institutions, macro and micro rationality have different criteria. For example, state-owned firms supported by industrial policies have a low cost of capital. This would be considered discriminatory in the US free market. However, if one considers the rationale behind macro policies, then the criteria for micro rationality

can change. Alternatively, this could be a creative idea the authors are trying to convey. However, it appears that the authors have not expressed it clearly and readers can only sense it vaguely.

Third, what are the links from Five-Year Plans to corporate finance, accounting behaviors, and accounting-based performances? We suggest the authors explore a few cases where firms grow quickly because of support from Five-Year Plans.

Two key indicators in the paper, IPO and investment amount, are a result of government actions. When the China Securities Regulatory Commission screens IPO applications, it pays attention to whether they are consistent with industrial policies. If the applications are inconsistent, they are declined. Therefore, we can observe an almost mechanical relationship between financial resource allocation and Five-Year Plans. Similarly, in China, large capital investments are not solely determined by firms, as firms need to obtain permissions from the National Development and Reform Commission (NDRC) and Environmental Protection Agency. For example, Jianlin Wang has to obtain approvals to invest in amusement parks to compete with Disneyland. The Shanghai Disneyland needs to do that, too. Hence, it is reasonable to conjecture that industries supported by Five-Year Plans have priority in obtaining investment permissions.

These two measures would make sense when used to distinguish different mechanisms. Are there other mechanisms and other measures?

Fourth, why are non-state-owned firms crowded out in Five-Year Plans? Many studies show that the driving force of China's economic growth is the non-state sector. If Five-Year Plans crowd out non-state-owned firms, does this mean that Five-Year Plans are detrimental to China's economic development? Additionally, nonperforming loans are related to Five-Year Plans and state-owned firms in policy-supported industries perform even worse. This finding also needs further explanation.

A more general research question addresses the relationship between Five-Year Plans and formal and informal financing. What is the underlying logic here? Does it account for why Five-Year Plans can crowd out non-state-owned firms?

Informal financing must exist because formal financing channels are blocked or because of a high level of regulations. A study by Lu and Yao (2004) suggests that non-state-owned firms can obtain more capital and achieve better performance when financing channels are less regulated, consistent with findings in this paper. That said, why do Five-Year Plans crowd out non-state-owned firms? Is it because of official disapproval or cost disadvantages? Is the crowding out of non-state-owned firms inconsistent with privatization? Does the paper consider the effect of these institutional factors?

Fifth, are human behaviors discussed thoroughly enough? Under the framework of Justin Lin's New Institutional Economics, the government is rational. To obtain a good reputation, government officials are willing to implement "nationwide welfare maximization" policies. The authors' judgment of the competitive advantages of a nation or a region is correct in general.

From our perspective, the authors could focus more on human behaviors. Are policymakers purely rational without any self-interest or concerns? Perhaps the authors could more thoroughly consider the topic from the cultural perspective.

Irrational behaviors exist naturally. How does this idea affect Five-Year Plans? For example, do NDRC members' past experiences and geographic origins affect the formation and implementation of Five-Year Plans, and if so, to what degree? In implementing Five-Year Plans, is there any agency cost, and what would it be? How would it affect the mechanisms (e.g., nonlinear, multidirectional forms)? The authors subsequently examine the associations between industrial policies and insider trading, analyst behaviors, information environment, and so on. As this paper is the first study of a series, perhaps the authors should consider thinking outside the box.

I hope that papers published in the *CJAR* can explore the secrets of "the China miracle" in an ideology-neutral sense, without the priori assumption that government is the engine of the miracle. Maybe it is really the masses that create the miracle. Is it possible that we adopt an attitude of truth-seeking and objectively examine the transmission from macro policies to firm behaviors or discuss the formation of the development of China's accounting and financial system? Without such an attitude, we are not taking research seriously.

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# How much control causes tunneling? Evidence from China

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ABSTRACT

We study the dynamic causal effects of the shareholding ratio of controlling shareholder on tunneling behavior in China. We use control-right-transfers as the event to conduct the study. We obtain 394 control-right-transfer samples in China corporate control market from 2001 to 2008. We use related party transactions amount to capture control shareholders' tunneling activities, and make the following findings. Firstly, tunneling behavior is significantly affected by the shareholding ratio of controlling shareholder. Secondly, the relationship between tunneling and shareholding ratio of controlling shareholder takes an N shape (incline-decline-incline). There are at least two turning points in the relationship. Furthermore, firms with shareholding ratios of controlling shareholder that range from 34.46% to 39.01% (8.99–18.04%) exhibit the most (least) severe tunneling. Firm size is significantly positively related to tunneling activities. In addition, the shareholding ratios of the board and the tunneling activities are significantly negatively correlated. These findings imply the shareholding ratio decision of controlling shareholder in control transfers lead to agency problems manifested in China in a particular form of tunneling.


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## 1. Introduction

Ever since the tunneling behavior of controlling shareholders was first identified, it has been studied extensively. Companies with concentrated ownership structures[1] typically have one controlling shareholder.[2] Controlling shareholders can access benefits by either creating or transferring a company's wealth. When creating wealth, controlling shareholders derive benefits from the general value enhancement that results from improved management, which is known as the alignment (incentive) effect. Conversely, when engaging in wealth transfers, controlling shareholders obtain private benefits by expropriating minority shareholder benefits, which is also known as the tunneling (entrenchment) effect (Shleifer and Vishny, 1986; Johnson et al., 2000). It is generally believed that ownership structure affects controlling shareholders' tunneling and alignment decisions and that in turn, tunneling behavior affects firm value.

Most of the research on this topic examines the relationship between ownership structure and firm value, with the assumption that ownership structure (particularly with respect to the difference between control rights and cash-flow rights) affects the controlling shareholders' tunneling behavior, which affects firm value. The general findings in this direction support the inverted U-shaped (or concave) relationship between ownership structure and firm value (Morck et al., 1988; Stulz, 1988; McConnell and Servaes, 1990). In addition, some research finds that a disparity between control rights and cash-flow rights triggers tunneling activity, which decreases firm value (Lins, 2003; Claessens et al., 2002).

Subsequent studies have investigated the relationship between tunneling and firm value and have arrived at results that are consistent with the conclusions discussed above. Tunneling activity and firm value are negatively correlated, and more severe tunneling activity leads to lower firm value (Jiang et al., 2010).

Thus far, no studies have examined the direct relationship between the shareholding ratio of controlling shareholder and tunneling. Although previous studies assume that certain ownership structures will trigger tunneling and eventually affect firm value, none of the previous research directly examines how the shareholding ratio of controlling shareholder affects tunneling. The theoretical models of Johnson et al. (2000) and LLSV (2002) imply that controlling shareholders' equity holdings affect their tunneling behavior, but there is no empirical evidence to support this theoretical conjecture.

In this paper, we aim to offer a comprehensive study of the causal effects of the shareholding ratio of controlling shareholder on tunneling behavior in China; our primary purpose was to study the direct relationship between the shareholding ratio of controlling shareholder and tunneling activity. We use control-rights-transfer events to study the research question in the China corporate control market from 2001 to 2008. Theoretically, we modify and extend the theoretical models of Johnson et al. (2000) and LLSV (2002). We explicitly study the direct relationship between the shareholding ratio of controlling shareholder and tunneling. We then offer empirical findings and analysis to verify our theoretical conjectures.

Our primary findings are as follows: (1) tunneling activities are likely to be a consequence of the controlled shareholding ratio, whereas the shareholding ratio of controlling shareholder is not significantly impacted by tunneling activities; (2) in addition to being a monotonic or quadratic function relation, the relationship between tunneling activities and the shareholding ratio of controlling shareholder is a cubic function relation, an "incline-decline-incline" trend (an N-shaped) relationship; and (3) firms with shareholding ratios of controlling shareholders in the 34.46–39.01% range have the most severe tunneling activities, whereas firms in the 8.99–18.04% range have the least tunneling activities.

We make five major contributions to the literature (Johnson et al., 2000; Bae et al., 2002; Bertrand et al., 2002; Baek et al., 2006; Urzúa I, 2009; Atanasov et al., 2010; Jiang et al., 2010; Siegel and Choudhury, 2012; Buchuk et al., 2014, and Piotroski and Zhang, 2014). First, we provide direct evidence of the relationship between the shareholding ratio of controlling shareholder and tunneling behavior. Second, we construct a theoretical model to depict the cubic function relation between the two variables. Third, we design a set of

[1] Over the past decade, studies have shown that corporate ownership structures are concentrated rather than dispersed in most countries, particularly those with weak investor protections (La Porta et al, 1998, 1999).

[2] The controlling shareholder is either the shareholder that controls the company and owns 50% or more equity or the shareholder that owns less than 50% equity but dominates the company's daily operations and decision-making and uses the company's property by virtue of his superior position.

multiple regression models both to capture the relationship between the two variables and to test our theoretical conjecture. Fourth, we complement the current literature by conducting the study using control-right-transfer samples. Finally, we find that there are two turning points of the shareholding ratio of controlling shareholder that trigger more severe or less severe tunneling activities.

The remainder of the paper is structured as follows. Section 2 reviews the current literature, and Section 3 introduces the institutional background and data. Section 4 presents the theoretical model and the hypotheses. In section 5, we design a set of regression models to test the theoretical conjecture and the hypotheses. Section 6 contains the robustness test, and Section 7 concludes the paper.

## 2. Literature Review

Morck et al. (1988) first define the "entrenchment effect" as a decrease in the value of corporate assets when managed by a manager with high levels of control rights and low levels of cash-flow rights. La Porta et al. (2000) find that Czech markets have been plagued by massive expropriation from minority shareholders and introduce the concept of "tunneling" to describe the expropriation of assets from both firms and mutual funds by controlling shareholders. More specifically, La Porta et al. (2002) define "tunneling" as the activity of controlling shareholders who divert firm profits to themselves before distributing the remainder as dividends. Such diversion or tunneling can take the form of salaries, transfer pricing, subsidized personal loans, non-arm's-length asset transactions and even outright theft. Researchers (La Porta et al., 2000, 2002; Johnson et al., 2000) generally refer to tunneling activity as a situation in which controlling shareholders transfer a company's property or profit counter to the interests of minority shareholders by virtue of their superior control positions. We adopt this latter definition.

The literature focuses on the relationship between the structure of ownership control and firm value (La Porta et al., 2000, 2002; Claessens et al., 2002; Lemmon and Lins, 2003; Offenberg, 2009; Jiang et al., 2010). Claessens et al. (2002) find that firm value increases when the controlling shareholder has commensurate cash flow ownership, which is, of course, consistent with a positive incentive effect. However, firm value decreases when the control rights of the controlling shareholder exceed its cash-flow ownership, which is consistent with the tunneling effect. Faccio and Lang (2002) and Lins (2003) report similar findings. Chan et al. (2003) suggest a non-monotonic function relation between the cash-flow ownership of the controlling shareholder and firm value. Morck et al. (1988) present an inverted U-shaped (Claessens et al., 2002) relationship between managerial control rights and firm value. Stulz (1988) depicts a concave relationship between managerial control rights and firm value, and McConnell and Servaes (1990) provide empirical support for such a concave relationship. Shleifer and Vishny (1997) suggest that when managerial control rights exceed a certain level, the controlling shareholders prefer to gain private benefits through tunneling; their findings also support the inverted U-shaped relationship between a controlling shareholder's control right and firm value. The general findings on this topic are consistent with the inverted U-shaped or concave relationship between the managerial control right and firm value, which implies that a managerial control right is positively related to firm value before reaching a certain level, at which it becomes negative and tunneling begins. As discussed above, most current studies focus on the effects of a managerial control rights on firm value instead of the effects of the shareholding ratio of controlling shareholder on tunneling behavior.

Indeed, few studies directly examine the relationship between the controlled shareholding ratio and tunneling. It is generally believed that the relationship between tunneling and the shareholding ratio of controlling shareholder is not stable and may be affected either by time or by company operations (Xi and Yu, 2006; Bai and Wu, 2008). Johnson et al. (2000) deduce a theoretical model with implications for a concave relationship between the shareholding ratio of controlling shareholder and tunneling behavior; however, there is no empirical evidence to support this theoretical conjecture. In this paper, we consider transfers of control rights involving public Chinese companies as events and then study how a highly concentrated ownership structure and tunneling behavior influence one another.

We choose to use transfers of control rights through equity transfer agreements as our key events because when control rights are transferred, controlling shareholders will carefully reselect the shareholding ratio to maximize their private benefit (La Porta et al., 2002). The current controlling shareholder transfers control rights to the bidder that offers the largest "bribe" (including possibly illegal actions) instead of to the bidder

Table 1
Ownership structure of public companies in China from 2001 to 2008. *Data source:* China Stock Market Accounting Research (CSMAR).

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|
| State-owned shares | 0.81 | 0.77 | 0.68 | 0.64 | 0.61 | 0.59 | 0.57 | 0.58 |
| Legal person shares | 0.15 | 0.19 | 0.31 | 0.34 | 0.36 | 0.38 | 0.37 | 0.35 |
| Private shares | 0.04 | 0.04 | 0.01 | 0.03 | 0.03 | 0.03 | 0.07 | 0.07 |

with the greatest ability to maximize performance (Bayne, 1963; Jennings, 1956). Thus, the controlling shareholder's behavior would lead to unsuccessful acquisitions because of the controlling shareholder's greed in attempting to maximize private benefits when transferring control rights (Kahan, 1993; Bebchuk, 1994). Bae et al. (2002) show that controlling shareholder blocs' acquisition prices are established to enhance those blocs' value, to the detriment of minority shareholders. Prior studies also show that controlling shareholders' incentives to obtain the private benefits of control are closely related to the proportion of ownership held during the period of a control rights transfer and therefore, they have a significant influence on firm value after that transfer (La Porta et al., 2002; Bayne, 1963; Jennings, 1956; Kahan, 1993; Bebchuk, 1994). Thus, the transfer of control rights is a major event through which controlling shareholders can pursue tunneling.

## 3. Institutional background and data

### *3.1. Institutional background*

As an emerging financial market, China has highly concentrated firm ownership and lacks a comprehensive legal system to protect the interests of minority investors (Aharony et al., 2000; Allen et al., 2005; Fan et al., 2007; Jiang et al., 2010; Berkowitz et al., 2015). More specifically, regulators in China have a long tradition of protecting state interests and little experience with litigation driven by private plaintiffs (Allen et al., 2005; MacNeil, 2002). As a rapidly developing transitional economy, China is an excellent laboratory in which to study the direct relationships between the controlling shareholders' tunneling behavior and firm value.

A special feature of China's corporate control market consists of state-owned enterprises (SOEs). Green (2003) reports that the Chinese stock market was organized by the government as a vehicle for SOEs to raise capital and improve their operating performance. To make this vehicle effective, the state aimed to retain sufficient equity interests to control public firms. Thus, the ownership of public Chinese companies is heavily concentrated in the hands of the state. As shown in Table 1, from 2001 to 2008, the ownership structure of public companies changed from 81% state-owned shares, 15% legal person shares and 4% private shares to 58% state-owned shares, 35% legal person shares and 7% private shares. The ratio of shares owned by the state is decreasing. But the sum of shares owned by both the state and legal person still accounts for a significant share (more than 90%) of the ownership structure.

Table 2 shows the development of China' s corporate control market from 2001 to 2008 using our sample. During our sample period, China's corporate control market grew rapidly. From 2001 to 2008, the number of transfers of corporate control increased from 30 to 134, with the highest number (134) in 2008. In addition, in July 2005, the Chinese government announced a policy to convert non-tradable shares[3] into tradable shares. This "Share Segregation Reform" policy aimed to achieve a balance among the interests of non-tradable shareholders and tradable shareholders through a consultative mechanism and therefore to eliminate differences in the share transfer system in the A-share market. Generally, non-tradable shareholders of listed companies had to pay a certain consideration (compensation) to holders of tradable shares (typically minority shareholders) to secure the liquidity rights of their share blocs. As of October 30, 2006, the capitalization of reformed companies comprised more than 94% of the total Shanghai and Shenzhen stock markets. The policy had been completely implemented by the end of 2007. Thus, the market began to bloom in 2005 and reached its zenith in 2008.

[3] Non-tradable shares refer to block shares (state-owned shares and legal person shares) that could not be traded in the market before 2005 (Jiang et al. (2010)).

Table 2
China's corporate control market development from 2001 to 2008. *Data source:* CSMAR.

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|
| Control transfers | 30 | 27 | 21 | 21 | 43 | 22 | 96 | 134 |

Table 3
The tunneling activity of public companies from 2001 to 2008. This table presents the tunneling activity of public companies of China from 2001 to 2008. We use Ln(RPT) to measure tunneling severity. The higher the RPT, the more sever the tunneling. *Data source:* CSMAR.

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|
| Ln(RPT) | 17.80 | 17.53 | 18.29 | 18.21 | 18.92 | 18.88 | 19.24 | 19.78 |

In China, tunneling by controlling shareholders is commonly observed (Tang and Wei, 2002; Li et al., 2004; Wang and Zhang, 2004). Unlike most developed markets, China's controlling-shareholder activity is much more consistent with the tunneling effect than with the alignment effect because of China's immature market for corporate control and its imperfect legal system and because the ownership structures of public Chinese companies are heavily concentrated in the hands of the state (70% on average) (Green, 2003), as discussed above. Thus, the influence of a highly concentrated ownership structure on tunneling behavior is an important topic to investigate both to improve the level of investor protection and to develop an appropriate regulatory framework.

Our primary measure of tunneling is the related party transactions (RPT) amount. Previous studies suggest that related party transactions are popular means of tunneling (Bae et al., 2002; Joh, 2003; Baek et al., 2006; Cheung et al., 2006, 2010; Jiang et al., 2010). Liu and Lu (2007) indicate that tunneling behavior in China primarily occurs in the form of loans from controlled companies to majority shareholders, in addition to other types of related-party transactions. Peng et al. (2011) also find that related-party transactions were used to effect tunneling activities in China from 1998 to 2004.

As noted previously, over the past decade, tunneling has been commonly observed in China. Table 3 shows public Chinese companies' tunneling activities from 2001 to 2008.

Tunneling activities were widespread from 2001 to 2008; the highest Ln (RPT) value reached 19.78 in 2008. In 2007, the China Securities Regulatory Commission amended the "Administration of the Takeover of Listed Companies Procedures" and revised the regulation of public company acquisition according to its newly revised "Securities Law" to improve the efficiency of the country's capital markets.

In another study, Gao and Kling (2008) analyze the tunneling data for public Chinese firms from 1998 to 2002 and find that improvements in corporate governance have prevented operational tunneling. However, Li (2010) studies the tunneling effect from 2002 to 2007 and finds that privately controlled public companies engage in more tunneling despite having better corporate governance.

### *3.2. Data description and preliminary analysis*

We select sample companies that have had control rights transferred through equity transfer agreements from January 2001 to December 2008. We search for the name and ownership of each of the top ten shareholders disclosed in the CSMAR Database.[4] Next, we collected the financial data and corporate governance data obtained from the CSMAR Database, including "The Mergers and Acquisitions of Public Companies in China Database," "China's Corporate Governance Structure Database" and "Shareholders of China's Public Companies Research Database". Stata 14 software is used as for processing the data.

Our data selection criteria are as follows:

(1) We select public companies that witnessed their controlling shareholder change during the sample period.

[4] Website: http://www.gtadata.com/.

(2) For companies that were the subject of two or more control rights transfers in a three-year period, we select only the last event as a sample event to exclude the stack effect.
(3) To avoid a situation in which the company's actual controlling shareholder did not change, we eliminate companies in which control-rights transfers occurred between a parent company and either a subsidiary company or an affiliated (sister) company.
(4) We eliminate financial companies from our analysis.
(5) We eliminate companies for whom the transactions have not been completed or were terminated.
(6) We eliminate companies that had transactions that were free of charge.
(7) We eliminate companies that have individual data missing and/or that have abnormal extremes.

We obtain 394 control-rights-transfer samples during the study period.

Table 4 reports descriptive statistics for the sample companies in the sample period.

Table 4 shows that public companies with control transfers had an average non-negative cumulative abnormal return ("CAR") of 0.0088, which indicates that on average, the reaction of the market to control transfers was positive during the sample period. The mean RPT value, the average tunneling activity value is 19.0122, which indicates that our sample firms exhibited noticeable tunneling activity during the sample period. The average shareholding ratio of controlling shareholder (HLD) is approximately 0.3541, and the average board size is greater than 9. The average return on assets (ROA) is 0.0452. The average debt ratio is 0.5224. The average firm size is 21.2559. It is notable that most firms have substantial RPT on their balance sheets.

To examine the dynamic relationship between the shareholding ratio of controlling shareholder and tunneling behavior, we divide the sample into 10 deciles based on the shareholding ratio of controlling shareholder during the pre-event period ($T-1$), and we compute Ln (RPT) at time $T$ (the event year). The results are reported in Table 5.

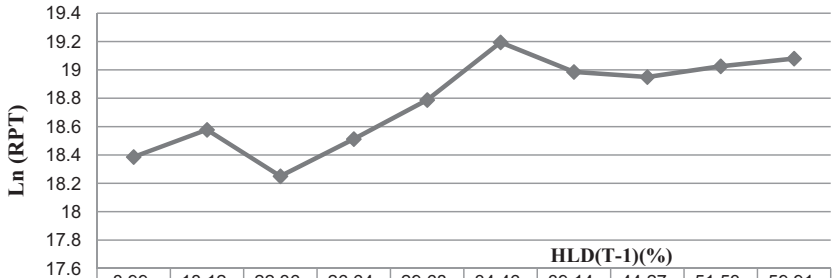
Table 5 reports the RPT values of the 10 controlled shareholding deciles for the control transfer samples. Decile 6 has the highest RPT values, whereas decile 1 has the lowest RPT values, which indicate that firms with shareholding ratio of controlling shareholders in the 34.46–39.01% range have the most severe tunneling activity, whereas firms in the 8.99–18.04% range have the least tunneling activity. Tunneling increases first and then decreases as the shareholding ratio of controlling shareholder increases until the 9th decile, at which point tunneling increases again, which clearly indicates that the relationship between the shareholding ratio of controlling shareholder and tunneling activity is not simply monotonic.

Prior research reports not only that there is an inverted U-shaped relationship between firm value and the shareholding ratio of the controlling shareholder (Claessens et al., 2002; Li et al., 2004) but also that the change in firm value is caused by tunneling behavior; however, there is no clear evidence of how tunneling behaviors change with the shareholding ratio of controlling shareholder. From the above findings, we can infer not only that the shareholding ratio of controlling shareholder and tunneling activities are not related in a monotonic or quadratic function relation but also that there is more than one turning point in the trend.

Table 4
Descriptive statistics. Ln(RPT) is to measure tunneling severity. Other firm characteristics are as follows: (1) HLD represents the shareholding ratio of the controlling shareholder; (2) ROA is the return on total assets and measures the overall operation performance; (3) LEV is the asset-liability ratio and represents the financial risks of the company; (4) SIZE is the logarithm of the firm's total assets and represents firm size; (5) Boardsize is the size of the board of directors, and different board sizes have different balancing abilities with respect to the activity of the controlling shareholder; (6) Boardhold is the shareholding ratio of the board of directors; (7) CAR is the cumulative abnormal return measured with a value-weighted market model estimated over the period [−42, 126]. All variables are averaged across the period and across firms. All observations are processed by excluding singular values (we winsorize all continuous variables, except the dummy variables, at the 1st and 99th percentiles).

| Variable | CAR | Ln(RPT) | HLD | ROA | LEV | SIZE | Boardsize | Boardhold |
|---|---|---|---|---|---|---|---|---|
| N | 394 | 394 | 394 | 394 | 394 | 394 | 394 | 394 |
| Mean | 0.0088 | 19.0122 | 0.3541 | 0.0452 | 0.5224 | 21.2559 | 9.3655 | 0.0144 |
| Std.dev. | 0.5984 | 2.2279 | 0.1512 | 0.0733 | 0.2131 | 1.0849 | 1.9855 | 0.0631 |
| Min | −1.8710 | 11.9184 | 0.0899 | −0.3326 | 0.0743 | 18.8781 | 5 | 0 |
| Max | 1.5429 | 28.2885 | 0.7303 | 0.2381 | 1.7329 | 24.3459 | 15 | 0.3687 |

Table 5
The tunneling behavior under different ranges of shareholding ratio of controlling shareholder. The sample is divided into 10 deciles based on the shareholding ratio of controlling shareholder in the pre-event period ($T-1$), and the RPT are computed at time $T$ (the event year) for the Transfer samples.




| | 8.99-18.04 | 18.12-22.19 | 22.36-26.43 | 26.64-29.67 | 29.68-34.43 | 34.46-39.01 | 39.14-44.08 | 44.27-51.51 | 51.53-59.76 | 59.91-73.03 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean of RPTs | 18.3861 | 18.5777 | 18.2502 | 18.5125 | 18.7881 | 19.1945 | 18.986 | 18.9497 | 19.0258 | 19.08 |

Therefore, we should employ a more comprehensive design to study the effect of the interaction between these two variables.

## 4. Theoretical model and hypotheses

Johnson et al. (2000) and LLSV (2002) establish a basic theoretical framework for tunneling behavior.

We extend the models of Johnson et al. (2000) and LLSV (2002) to control rights transfer events. Specifically, in one extension, we divide the entire sample into two subsets—Good Transfers and Bad Transfers—and study the direct relationship between the two variables in these two sub-samples. We consider this extension to be one of the contributions of this study.

Assumptions:

(1) The controlling shareholder owns share $\alpha$ of the firm, and outsiders own share $(1-\alpha)$.
(2) The total assets of the target firm are denoted by TA, and the CARs related to the control transfer are denoted by $R$.
(3) The controlling shareholder usurps $s$ of the total assets (TA) of the target in the control transfer.
(4) The cost of tunneling (usurping $s$) is $c(k,s)=\frac{1}{2k}s^2$, and a higher value of $k$ represents either weaker corporate governance regulation, a weaker legal system or both (i.e., it is less costly to usurp assets from the target).
(5) The cost of tunneling is greater than zero but less than the total stealing amount to trigger tunneling; that is, $0<\frac{1}{2k}s^2\leqslant s$, which implies that $0<\frac{1}{k}s\leqslant 2$.

The controlled optimization problem may be written as follows:

$$\mathrm{Max}U(s;R,k,\alpha)=\mathrm{Max}\left[\alpha R(\mathrm{TA}-s)+s-\frac{1}{2k}s^2\right] \tag{1}$$

Differentiating Eq. (1) with respect to $\alpha$ yields the following:

$$\frac{\partial U/\partial s}{\partial U/\partial \alpha}=\frac{RS-R*\mathrm{TA}}{1-\alpha R-\frac{s}{k}} \tag{2}$$

When the CARs of control transfers are greater than zero ($R>0$), we obtain the following:

$(Rs-R*\mathrm{TA})<0$ because $s<TA$ and $R>0$
Because $0<\frac{1}{k}s\leqslant 2$ (Assumption (5)),

when $\alpha$ is small, $0 \leqslant s \leqslant k$, $s/k \leqslant 1$, we obtain the following:
$(1 - \alpha R - \frac{s}{k}) > 0$, which yields $\frac{\partial s}{\partial \alpha} < 0$;
when $\alpha$ is large, $k < s \leqslant 2k$, $1 < s/k \leqslant 2$, we obtain the following:
$(1 - \alpha R - \frac{s}{k}) \leqslant 0$, which yields $\frac{\partial s}{\partial \alpha} \geqslant 0$.
Therefore, our first hypothesis is as follows:

**H1.** The relationship between the tunneling behavior and the shareholding ratio of controlling shareholder exhibits a "decline-incline" trend, which resembles a U shape graphically (see Fig. 1).

As discussed above, corporate governance laws and mechanisms are underdeveloped in China. If corporate governance rules were more developed, the tunneling behavior of controlling shareholders would be punished. The cost of tunneling decreases sharply when controlling shareholders own most of the shares of the target. In this instance, we define the cost of tunneling as follows:

$$\frac{(1-\alpha)^{\gamma}}{2k}s^2, \text{where } 0 < \gamma \ll 1, 0 < \alpha < 1$$

Eq. (2) can be revised as follows:

$$\frac{\partial s}{\partial \alpha} = \frac{RS - R * \mathrm{TA} - \frac{\gamma s^2}{2k}(1-\alpha)^{\gamma-1}}{1 - \alpha R - \frac{s}{k}(1-\alpha)^{\gamma}} \tag{3}$$

Because $\gamma \ll 1$, we obtain the following:

$$\frac{\gamma s^2}{2k}(1-\alpha)^{\gamma-1} \approx 0$$

Eq. (5) can be written as follows:

$$\frac{\partial s}{\partial \alpha} = \frac{RS - R * \mathrm{TA}}{1 - \alpha R - \frac{s}{k}(1-\alpha)^{\gamma}} \tag{4}$$

When the CARs of a control transfer are less than zero ($R < 0$), we obtain the following:
when $\alpha \to 1$ and $(1-\alpha)^{\gamma} \to 0$,
we obtain $\left\{1 - \alpha R - \frac{s}{k}(1-\alpha)^{\gamma} \approx 1 - \alpha R > 0\right\}$,
which implies that Eq. (4) is greater than zero, or $\frac{\partial s}{\partial \alpha} > 0$.

Thus, we present another important hypothesis:

**H2.** Given that controlling shareholders in China control more than 80% of the shares of firms on average, the relationship between the tunneling and the shareholding ratio of controlling shareholder exhibits an "incline-decline-incline" trend, which resembles an N-shape graphically (see Fig. 2).

Our theoretical conjectures above extend the findings of previous studies and offer a more complete picture of the relationship between the shareholding ratio of controlling shareholder and tunneling behavior.

To test the validity of our theoretical conjectures, we use control-rights-transfer events of publically listed Chinese companies as the setting in which to empirically test the relationship between the shareholding structure and tunneling activities empirically.

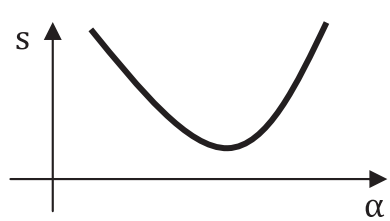



Figure 1. The quadratic function relation between the shareholding ratios of controlling shareholders and the tunneling activities.

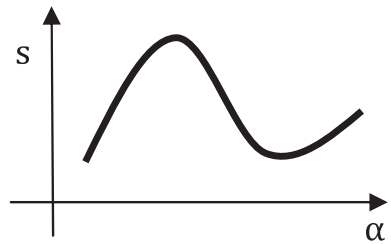



Figure 2. The cubic function relation between the shareholding ratios of controlling shareholders and the tunneling activities.

## 5. Model specification and empirical results

The findings above indicate that tunneling activity is significantly affected by the shareholding ratio of controlling shareholder and that the relationship between tunneling activity and shareholding ratios is not simply monotonic or quadratic.

We borrow the method of La Porta et al. (1998) and construct a multivariate analysis model to examine the dynamic relationship. Our primary proxy for tunneling is RPT amount.[5] We also use other tunneling proxies (PBC) for robust tests. The data source for RPT is the CSMAR database. CSMAR database provides deal-level information on RPT for all A-share listed firms in China since 1997. For each transaction, CSMAR database provides information about the type of transaction, the relationship between the listed firm and its counter party, and the amount of money involved in the transaction. We include only RPT in which a listed firm experienced a control transfer and the information on the amount is provided.

Jiang et al. (2010) and Li et al. (2004) indicate that the factors affecting tunneling behavior include the size of a company's board of directors, the ratio of independent directors and other corporate governance characteristics. Therefore, we use governance characteristics as control variables to differentiate the effects of a company's governance characteristics on tunneling from other factors.

Based on our preliminary data analysis in Section 3 and theoretical conjecture in Section 4, we design Model 1 to tests the monotonic function relation.

**Model 1:**

$$\begin{aligned}\mathrm{Ln(RPT)} = {} & \alpha_0 + \beta_1 \mathrm{HLD} + \beta_2 \mathrm{ROA} + \beta_3 \mathrm{LEV} + \beta_4 \mathrm{Size} + \beta_5 \mathrm{Boardsize} + \beta_6 \mathrm{Indbsize} + \beta_7 \mathrm{Boardhold} \\ & + \beta_8 \mathrm{Ceoduality} + \beta_9 \mathrm{Normal} + \beta_{10} \mathrm{State} + \beta_{11} \mathrm{Mindex} + \beta_i \mathrm{Industry} + \mathrm{year} \end{aligned} \quad (5)$$

where:

Ln(RPT) is a measure of the level of tunneling severity of the controlling shareholder;

HLD represents the shareholding ratio of the controlling shareholder;

ROA is return on total assets and measures the overall operational performance of the company;

LEV is the asset-liability ratio and represents the financial risk of the company;

SIZE is the logarithm of the firm's total assets and indicates firm size;

Boardsize is the size of the board of directors; different board sizes have different balancing capabilities relative to the activity of the controlling shareholder;

Boardhold is the shareholding ratio of the board of directors;

Indbsize represents the ratio of independent directors on the board of directors;

Ceoduality represents whether the posts of general manager and chairman of the board of public companies are held by the same person, where 1 represents the general manager and chairman of the board being the same person and 0 represents the general manager and chairman of the board being separate individuals;

Normal represents whether the public company has a normal trading status, where 1 represents the company with a normal trading status and 0 represents non-normal trading status;

[5] Previous studies show that it is difficult to measure tunneling accurately. The proxies for tunneling are according to either the value implications or the RPT.

State represents the actual type of the company's controlling shareholder, where 1 represents a state-owned holding and 0 represents a holding that is not state-controlled;
Mindex refers to the area's degree of marketization—which will affect the level of corporate governance—in which we use the market index (1997–2007) created by Fan et al. (2009), with 2008 following the index of 2007; and
Industry is an industry dummy variable, and according to the industry classification standard of the China Securities Regulatory Commission (2001), we set 21 dummy variables (excluding the financial industry, the manufacturing industry classified by the second category, and other industries classified by the main category standard).

Model 1 tests the monotonic function relation between the two variables that can be inferred from previous studies. If $\beta_1$ is significant and negative, the shareholding ratio of controlling shareholder negatively influences tunneling activity. If $\beta_1$ is significant and positive, the shareholding ratio of controlling shareholder positively affects tunneling activity.

Next, we add the square of the shareholding ratio of the controlling shareholder ($HLD^2$) to the Model for testing the quadratic function relation. It is our second model.

**Model 2:**

$$\begin{aligned}\mathrm{Ln(RPT)} = {} & \alpha_0 + \beta_1 \mathrm{HLD}^2 + \beta_2 \mathrm{ROA} + \beta_3 \mathrm{LEV} + \beta_4 \mathrm{Size} + \beta_5 \mathrm{Boardsize} + \beta_6 \mathrm{Indbsize} \\ & + \beta_7 \mathrm{Boardhold} + \beta_8 \mathrm{Ceoduality} + \beta_9 \mathrm{Normal} + \beta_{10} \mathrm{State} + \beta_{11} \mathrm{Mindex} + \beta_{\mathrm{i}} \mathrm{Industry} \\ & + \mathrm{year} \end{aligned} \tag{6}$$

$HLD^2$ represents the square of the shareholding ratio of the controlling shareholder.

The other control variables are the same as in Model 1; Model 2 is the second stage for testing the quadratic function relation between tunneling and the shareholding ratio of controlling shareholder.

If, for the control transfer sample, the coefficient of $HLD^2$ is significantly positive, and there is a U-shaped relation between tunneling and the shareholding ratio of the controlling shareholder. Thus, we can confirm H1.

Finally, we add the cube of the shareholding ratio ($HLD^3$) to the Model for testing the cubic function relation. It is our last model.

**Model 3:**

$$\begin{aligned}\mathrm{Ln(RPT)} = {} & \alpha_0 + \beta_1 \mathrm{HLD}^3 + \beta_2 \mathrm{ROA} + \beta_3 \mathrm{LEV} + \beta_4 \mathrm{Size} + \beta_5 \mathrm{Boardsize} + \beta_6 \mathrm{Indbsize} \\ & + \beta_7 \mathrm{Boardhold} + \beta_8 \mathrm{Ceoduality} + \beta_9 \mathrm{Normal} + \beta_{10} \mathrm{State} + \beta_{11} \mathrm{Mindex} + \beta_{\mathrm{i}} \mathrm{Industry} \\ & + \mathrm{year} \end{aligned} \tag{7}$$

$HLD^3$ represents the cube of the shareholding ratio of the controlling shareholder.

All other variables are defined as in Models 1 and 2.

Model 3 is designed to test the cubic function relation between tunneling and the shareholding ratio of the controlling shareholder. If, for our control transfer sample, the coefficient of $HLD^3$ is significantly positive, there will be an N-shaped relation, and we can thus confirm H2.

Table 6 presents the results of Multiple regression analysis of the shareholding ratio and the tunneling of controlling shareholders. For Model 1, the coefficient of HLD is significantly positive. It indicates that tunneling activity and shareholding ratio of controlling shareholder are positively correlated, and bigger shareholding ratio of controlling shareholder leads to more severe tunneling activities. For Model 2, the coefficient of $HLD^2$ is significantly positive. This result confirms H1 of our theoretical conjecture, which posits that the quadratic relationship between the shareholding ratio of controlling shareholder and tunneling is a U shape. For Model 3, the coefficient of $HLD^3$ is significantly positive. This result indicates that the cubic function relation between the shareholding ratio of controlling shareholder and tunneling is an N shape (incline-decline-incline), which confirms H2 of our theoretical conjecture. The coefficients of Size are significantly positive in all three Models. It means the bigger the company, the more tunneling activities. The leverage (LEV)

Table 6
Multiple regression analysis of the relationship between shareholding ratio and tunneling of controlling shareholders. Model 1 tests the monotonic function relation between the two variables. Model 2 tests H1, the quadratic function relation between the two variables. Model 3 tests H2, the cubic function relation between the two variables. RPT is a measure of the level of tunneling severity of the controlling shareholder; HLD represents the shareholding ratio of the controlling shareholder; ROA is return on total assets and measures the overall operational performance of the company; LEV is the asset-liability ratio and represents the financial risk of the company; SIZE is the logarithm of the firm's total assets and indicates firm size; Boardsize is the size of the board of directors; different board sizes have different balancing capabilities relative to the activity of the controlling shareholder; Boardhold is the shareholding ratio of the board of directors; Indbsize represents the ratio of independent directors on the board of directors; Ceoduality represents whether the posts of general manager and chairman of the board of public companies are held by the same person, where 1 represents the general manager and chairman of the board being the same person and 0 represents the general manager and chairman of the board being separate individuals; Normal represents whether the public company has a normal trading status, where 1 represents the company with a normal trading status and 0 represents non-normal trading status; State represents the actual type of the company's controlling shareholder, where 1 represents a state-owned holding and 0 represents a holding that is not state-controlled; Mindex refers to the area's degree of marketization—which will affect the level of corporate governance—in which we use the market index (1997–2007) created by Fan (2009), with 2008 following the index of 2007; and Industry is an industry dummy variable, and according to the industry classification standard of the China Securities Regulatory Commission (2001), we set 21 dummy variables (excluding the financial industry, the manufacturing industry classified by the second category, and other industries classified by the main category standard). $HLD^2$ represents the square of the shareholding ratio of the controlling shareholder; $HLD^3$ represents the cube of the shareholding ratio of the controlling shareholder.

| Variables | Ln(RPT) | | |
|---|---|---|---|
| | Model 1 | Model 2 | Model 3 |
| HLD | 1.918 | | |
| | (0.004)*** | | |
| $HLD^2$ | | 2.189 | |
| | | (0.009)*** | |
| $HLD^3$ | | | 2.884 |
| | | | (0.018)** |
| ROA | −0.615 | −0.578 | −0.510 |
| | (0.649) | (0.669) | (0.706) |
| LEV | 0.920 | 0.948 | 0.971 |
| | (0.090)* | (0.080)* | (0.073)* |
| Size | 1.165 | 1.161 | 1.159 |
| | (0.000)*** | (0.000)*** | (0.000)*** |
| Boardsize | −0.020 | −0.019 | −0.019 |
| | (0.646) | (0.655) | (0.666) |
| Boardhold | −4.417 | −4.460 | −4.511 |
| | (0.001)*** | (0.001)*** | (0.001)*** |
| Indbsize | 1.482 | 1.433 | 1.386 |
| | (0.070)* | (0.079)* | (0.089)* |
| Ceoduality | −0.109 | −0.117 | −0.127 |
| | (0.662) | (0.642) | (0.617) |
| State | −0.239 | −0.230 | −0.218 |
| | (0.234) | (0.253) | (0.280) |
| Normal | 0.217 | 0.231 | 0.241 |
| | (0.505) | (0.478) | (0.462) |
| Mindex | 0.022 | 0.022 | 0.023 |
| | (0.608) | (0.607) | (0.595) |
| Industry | Control | Control | Control |
| Constant | −7.839 | −7.442 | −7.312 |
| | (0.000)*** | (0.000)*** | (0.000)*** |
| Observations | 394 | 394 | 394 |
| *R*-squared | 0.442 | 0.439 | 0.437 |
| White's test | Prob > 0.9983 | Prob > 0.9992 | Prob > 0.9994 |
| Mean VIF | 2 | 2 | 2 |

Robust *p*-values are report in parentheses. We also do the White's test to ensure our results reported are robust and no evidence shows heteroskedasticity in our models.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

Table 7
Hausman specification test.

| Test: Ho: difference in coefficients not systematic |
|---|
| $chi^2(1) = (b - B)'\ [(V\_b - V\_B)^(-1)](b - B)$ |
| $= 0.00$ |
| $Prob > chi^2 = 0.9514$ |
| ($V\_b - V\_B$ is not positive definite) |

Table 8
Robustness test. This table reports re-estimation results for the relationship between shareholding ratio and tunneling of controlling shareholders with an alternative proxy of tunneling.

| Variables | ORECTA | | |
|---|---|---|---|
| | Model 1 | Model 2 | Model 3 |
| HLD | 0.091 | | |
| | (0.077)* | | |
| $HLD^2$ | | 0.139 | |
| | | (0.039)** | |
| $HLD^3$ | | | 0.218 |
| | | | (0.031)** |
| ROA | −0.228 | −0.234 | −0.234 |
| | (0.017)** | (0.014)** | (0.014)** |
| LEV | 0.098 | 0.099 | 0.099 |
| | (0.060)* | (0.058)* | (0.057)* |
| Size | −0.016 | −0.016 | −0.017 |
| | (0.039)** | (0.034)** | (0.031)** |
| Boardsize | 0.002 | 0.002 | 0.002 |
| | (0.542) | (0.570) | (0.599) |
| Boardhold | −0.160 | −0.164 | −0.166 |
| | (0.093)* | (0.083)* | (0.080)* |
| Indbsize | −0.127 | −0.128 | −0.129 |
| | (0.030)** | (0.029)** | (0.027)** |
| Ceoduality | 0.014 | 0.015 | 0.015 |
| | (0.392) | (0.367) | (0.363) |
| State | −0.011 | −0.012 | −0.012 |
| | (0.353) | (0.314) | (0.325) |
| Normal | −0.029 | −0.027 | −0.027 |
| | (0.263) | (0.282) | (0.283) |
| Mindex | −0.000 | −0.000 | −0.000 |
| | (0.889) | (0.866) | (0.884) |
| Industry | Control | Control | Control |
| Constant | 0.369 | 0.388 | 0.400 |
| | (0.005)*** | (0.002)*** | (0.002)*** |
| Observations | 241 | 241 | 241 |
| *R*-squared | 0.345 | 0.351 | 0.354 |
| White's test | Prob > 0.3118 | Prob > 0.3160 | Prob > 0.3119 |
| Mean VIF | 1.92 | 1.92 | 1.92 |

Robust *p*-values are report in parentheses. We also do the White's test to ensure our results reported are robust and no evidence shows heteroskedasticity in our models.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

and the ratio of independent directors (Indbsize) are positively related to tunneling behavior of control shareholders, while the shareholding ratio of the board and the tunneling activities are significantly negatively correlated. It shows that the more shares the board holds, the less tunneling activities happen.

## 6. Robustness

### 6.1. Endogeneity

Because there is no heteroskedasticity in the models reported in Table 6, we use a Hausman specification test to find any endogenous variables in the 2SLS model. Table 7 indicates that all the variables in Model 3 are exogenous.

### 6.2. Alternative measures of tunneling

We use another tunneling measurement, other receivables over total assets (ORECTA) as a measure of tunneling activity. According to Jiang et al. (2010), controlling shareholders used inter-corporate loans to siphon billions of RMB from hundreds of Chinese public companies during the 1996–2006 period, and a substantial portion of these loans (between 30% and 40% of total OREC[6] in the top three deciles) were made for the benefit of controlling shareholders and/or their affiliates. Thus, inter-corporate lending is a major method of tunneling.

We re-estimate the three Models using ORECTA as the tunneling proxy. Table 8 reports that the relationship between shareholding ratio and tunneling of controlling shareholders is an N shape (incline-decline-incline), which confirms our conclusion.

## 7. Conclusion

In this paper, we present a theoretical conjecture depicting the causal effects of the shareholding ratio of controlling shareholder on tunneling activity in control transfers. We test the theoretical conjectures using data for 394 control rights transfer samples from 2001 to 2008. We use related party transactions amount to capture control shareholders' tunneling activities.

The results confirm the theoretical predictions and show that shareholding ratio of controlling shareholder has a significant effect on tunneling behavior, although the impact paths are different from the previous studies. The effect reveals a cubic function (an N shape) relationship. Furthermore, firms with shareholding ratio of controlling shareholders that range from 34.46% to 39.01% (8.99–18.04%) exhibit the most (least) severe tunneling. Firm size is significantly positively related to tunneling activities. In addition the shareholding ratio of the board and the tunneling activities are significantly negatively correlated. These findings imply the shareholding ratio decision of controlling shareholder in control transfers leads to agency problems manifested in China in a particular form of tunneling. The overall findings also expand the understanding of tunneling behavior in a transitional economy, and suggest a market-based governance mechanism to protect minority shareholders from expropriation.

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[6] In their study, Jiang et al. (2010) indicate that tens of billions in renminbi (RMB) have been siphoned from hundreds of Chinese firms by controlling shareholders. Typically reported as part of "other receivables" (OREC), these loans are found on the balance sheets of a majority of Chinese firms and collectively represent a large portion of the assets and market values of such firms. This situation has been referred to as the OREC problem.

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# Influence of Chinese entrepreneurial companies' internationalization on independent innovation: Input incentive effect and efficiency improvement effect

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ABSTRACT

Within the special environment of the ChiNext market, we study how an internationalization strategy affects the independent innovation of Chinese entrepreneurial companies from two dimensions: R&D input and patent output. An internationalization strategy has a significant incentive effect on R&D input and a significant efficiency improvement effect on patent output. Entrepreneurial companies with higher degrees of internationalization have higher R&D inputs and patent outputs. After endogeneity is controlled, these effects still exist. Internationalization strategy has more pronounced effects on independent innovation in strategic emerging industries. The results elucidate the internationalization strategy and independent innovation of Chinese entrepreneurial companies, and have valuable implications for Chinese regulators in making international development policies for strategic emerging industries and independent innovation.



## 1. Introduction

In the context of a rapidly growing knowledge economy and increasing economic globalization, independent innovation and internationalization have become inevitable means for many companies to achieve lasting survival and development and a lasting competitive edge. In view of the significance and urgency of indepen-

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dent innovation and internationalization, China has established a development strategy focused on building an innovative nation and "going global." Innovation and internationalization are the "new normal" for Chinese companies' strategic behaviors. However, the mutual influence of the two major strategies, the independent innovation strategy and the internationalization strategy, has not been fully recognized, which is not helpful for implementing them or forming synergies. The core issue is whether internationalization can promote Chinese companies' independent innovation and improve their capacity for innovation. In the long run, investigating this question may reveal the mechanisms underlying how internationalization affects corporate behavior and firm performance. To become strong in innovation, China must better integrate global resources to deepen and promote Chinese companies' independent innovation and further accelerate its sustainable development. Therefore, exploring the effects of companies' internationalized operations on independent innovation not only improves Chinese companies' capacity for independent innovation using foreign resources, but also facilitates an understanding of the economic consequences of internationalization and evaluates its outcomes. This way, it can guide the implementation of the Chinese going global strategy.

Research on the relations between companies' internationalized operations and innovation is important in both economics and management sciences. However, no universal conclusion about their relations has been reached. Scholars have various views regarding whether companies' internationalization can promote independent innovation (Hitt et al., 1997; Von Zedtwitz and Gassmann, 2002; Sanna-Randaccio and Veugelers, 2007; Lileeva and Trefler, 2010; Bustos, 2011; Bratti and Felice, 2012). The empirical evidence has not been converged. In addition, according to recent research, a self-selection effect exists between internationalization and independent innovation (Clerides et al., 1998; Bernard and Jensen, 1999; Melitz, 2003). Independent innovation and internationalization have reverse causality. Innovation-driven competitive edge can promote internationalization and expand overseas markets (Roper and Love, 2002; López and García, 2005; Cassiman and Golovko, 2011; Altomonte et al., 2013). Therefore, the endogeneity problem exists between companies' internationalization and independent innovation, which causes inconsistent and even opposite conclusions regarding their relations. Controlling endogeneity is a key strategy for identifying the relations between companies' internationalization and independent innovation.

In China, some scholars have studied the influence of internationalization on productivity from the perspective of exports (Zhang et al., 2008, 2009; Qian et al., 2011) and have provided a preliminary understanding of whether local companies' internationalization can promote productivity. However, few scholars have focused on the evidence showing that internationalization influences independent innovation. Thus, in-depth research using the actual conditions in China is necessary.

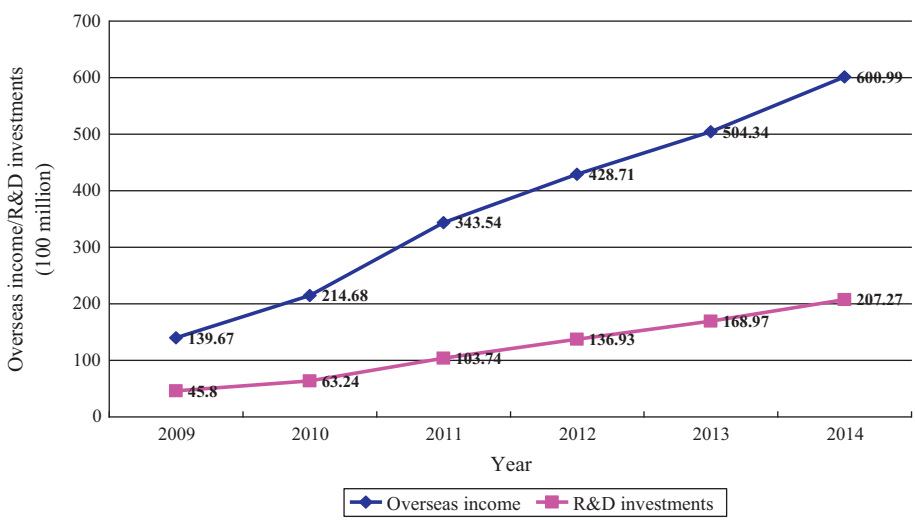


Figure 1. Trend in the overseas income and R&D investments of Chinese ChiNext companies.

Since its establishment in 2009, the ChiNext market has provided a large amount of capital support for cultivating and developing strategic and emerging industries and optimizing and upgrading industrial structures. Various high-tech companies, such as LENS Technology Co., Ltd., LEPU Medical Co., Ltd. and JINFU Technology Co., Ltd., have emerged and driven China's innovative economy. According to statistics from Wind Database, the total R&D input of ChiNext market companies jumped from 4.58 billion yuan in 2009 to 20.727 billion yuan in 2014, with an annual average growth rate of 70.5%. ChiNext companies have actively implemented internationalization strategies to expand overseas markets. Correspondingly, the total revenue of overseas businesses also jumped from 13.967 billion yuan in 2009 to 60.099 billion yuan in 2014, with an annual average growth rate of 92.3% (see Fig. 1). In particular, the proportion of the overseas revenue of LENS Technology has topped 95%. Thus, ChiNext companies have become typical examples of combining internationalization and independent innovation. In this context, studying whether Chinese companies' internationalization positively affects independent innovation is of policy significance and urgency.

We use Chinese ChiNext companies as research objects and study the influence of Chinese entrepreneurial companies' internationalization strategies on independent innovation[1] from the dimensions of R&D input and patent output. We consider the special environment of the Chinese ChiNext market as a natural setting in which to examine the influence of entrepreneurial companies' internationalization on independent innovation and to test relevant theories. First, Chinese ChiNext companies are positioned to promote emerging industries and innovative companies. Thus, independent innovation is an important standard for Chinese ChiNext companies. By the end of 2012, the proportion of companies in strategic emerging industries to all ChiNext companies was as high as 64%. Compared with companies on the main board and the small and medium enterprise board, ChiNext companies better reflect the influence of internationalization on independent innovation. Second, innovation and internationalization levels are influenced by organizational scale. However, choosing Chinese ChiNext companies as research objects eliminate the scale effect on internationalization and innovation. In innovation economics, company scale is a key factor influencing innovation (Schumpeter, 1942). However, the relation between scale and innovation is still controversial. Schumpeter (1942) argues that only large companies can afford R&D expenditures, take failures through large-scale innovation and enjoy the advantages of innovation, namely the "Schumpeter Hypothesis." However, Porter (1985) and Barney (1991) argue that although small companies have no scale advantages, they can flexibly focus on their competitive technological fields. Different from small companies, large companies can bear the high sunk costs and exploration costs of overseas markets and the high risks of international trade. Therefore, large companies can expand into overseas markets more easily (Teece, 1986; Clerides et al., 1998; Melitz, 2003). Studies have also proved that export-oriented manufacturers are large in scale (Bernard and Jensen, 1999; Greenaway et al., 2005). Thus, it is necessary to control the scale effect on internationalization and innovation. As most ChiNext companies are small companies in the start-up and growth phases, the scale effects of large companies can be eliminated, improving the study of the influence of small companies' internationalization on independent innovation. Third, in economics, product diversification exerts extensive influences on innovation (Schumpeter, 1942; Hoskisson and Johnson, 1992; Hitt et al., 1997; Miller, 2004). Thus, the influence of industrial diversification on innovation should be controlled in studying internationalization. *Interim Measures on Administration of Initial Public Offering and Listing on ChiNext* promulgated by the China Securities Regulatory Commission on March 31, 2009 and *Measures on Administration of Initial Public Offering and Listing on ChiNext* on February 11, 2014 explicitly state that "issuers in the ChiNext market shall mainly engage in one main business." Accordingly, emphasis on business simplification excludes the possibility of diversification, providing a natural setting in which to study the influence of internationalization on independent innovation.

We make a number of theoretical contributions to the literature. First, we depict internationalization from several dimensions, such as export sales intensity, export sales proportion and overseas institutions. We also study the influence of Chinese entrepreneurial companies' internationalization on independent innovation from the dimensions of R&D input and patent output. This facilitates a comprehensive understanding of the influence of internationalization on independent innovation. We supplement empirical evidence of the

[1] There exist different dimensions and perspectives of innovation. The innovation discussed herein refers to technology innovation. The authors appreciate the referee's advice very much.

influence of internationalization on innovation output and partly reveal the mechanisms underlying the influence of internationalization on companies' behaviors and firm performance. After controlling endogenous factors, internationalization strategies exert input incentive effects on R&D and companies with higher degrees of internationalization have higher R&D inputs; furthermore, internationalization strategies exert efficiency improvement effects on patent production and companies with higher degrees of internationalization have higher patent output efficiencies. Second, different from studies in which mature companies are the objects, we mainly study Chinese entrepreneurial companies. Third, we study in-depth how an internationalization strategy affects the independent innovation of strategic emerging industries in the Chinese ChiNext market. In strategic emerging industries, internationalization has a more pronounced input incentive effect and efficiency improvement effect on independent innovation. This provides evidence of and policy references for the implementation of the going global strategy of Chinese companies and industries.

The remainder of this paper is organized as follows. Section 2 reports the theoretical analysis and research hypotheses. Section 3 describes the research design. Section 4 documents the empirical results and analysis. Section 5 discusses the influence of internationalization on strategic emerging industries. Section 6 concludes the paper.

## 2. Theoretical analysis and research hypothesis

The relationship between international operation and innovation has always been an important topic in economics and management, but no unified conclusion has been reached on this issue. Recent empirical evidence has given rise to three hypotheses.

### *2.1. Internationalization promotes innovation*

In this hypothesis, internationalization, as the process of studying and knowledge accumulation, can help companies obtain more resources, information, ideas, technologies and opportunities (Kotabe, 1990; Kobrin, 1991; Hitt et al., 1997); use the international market to dilute and reduce R&D costs (Cheng and Bolon, 1993; Granstrand et al., 1993; Kotabe et al., 2002); and form innovative strategic alliances (Santos et al., 2004). The learning effect (Grossman and Helpman, 1991; Bratti and Felice, 2012; Love and Ganotakis, 2013) and the competitive incentive effect (Hitt et al., 1997; Bratti and Felice, 2012) of internationalization can increase companies' attention to innovation, improve their capacity for innovation and earn more exclusive income of innovation (Teece, 1986; Kafouros et al., 2008). The learning effect of internationalization is the significant theoretical basis of the hypothesis that internationalization promotes innovation, and is the focus of empirical research. Thus, a company's internationalization has a positive effect on innovation.

### *2.2. Internationalization hinders innovation*

In this hypothesis, internationalization increases companies' risk of leaking knowledge and technology (Sanna-Randaccio and Veugelers, 2007); increases costs in management, coordination and information exchange; and increases misunderstandings between different R&D teams and opportunistic behavior (Fisch, 2003), impeding R&D team cohesion (Von Zedtwitz and Gassmann, 2002). Therefore, internationalization increases the risks and costs of company innovation, thereby hindering it.

### *2.3. Internationalization is irrelevant to innovation: Self-selection*

In this hypothesis, companies enter the international market and possess higher innovative capability as a result of the self-selection effect. In the global market, companies undertake extremely high sunk costs, high risk and more fierce competition, so they must demonstrate heterogeneity in scale, technical innovation and performance, which generates the self-selection effect of internationalization (Clerides et al., 1998; Melitz, 2003; Helpman et al., 2004). Unlike non-international companies, international companies possess higher innovative capabilities and higher productivities before they enter overseas markets. In addition, they can bear high sunk costs, developing costs and high-risk international transactions, making them more likely to expand

into overseas markets (Bernard and Jensen, 1999; Melitz, 2003). Recently, the self-selection effect has been supported by more empirical evidence (Baldwin and Gu, 2004; Greenaway et al., 2005), which challenges the causal relationship of the hypothesis that internationalization promotes innovation.

Moreover, recent research has found that corporate innovation has the reverse effect on the internationalization of companies (Altomonte et al., 2013) and that innovation can strengthen companies' market power and thus facilitates international expansion (Roper and Love, 2002; López and García, 2005; Cassiman and Golovko, 2011). Internationalization itself can also be seen as an innovative firm process (Bilkey and Tesar, 1977; Prashantham, 2005). Therefore, strong endogeneity exists between the internationalization and innovation of an enterprise, which has led to inconsistencies in the research.

Some of the typical microeconometric studies summarized in Table 1 show that no consistent understanding has been achieved regarding whether internationalization promotes independent innovation. There are various contradictions and controversies surrounding the empirical evidence, especially that from different regions and countries. Empirical research has focused more on total factor productivity (TFP) to measure companies' innovation and performance. However, productivity is not the most appropriate and direct innovation measure. First, sales revenue is used to calculate productivity. As price and quantity data cannot be separated, they cannot distinguish between the influence of price (market force) and quantity (productivity). Second, productivity indirectly measures innovation, but it cannot embody companies' learning effects. However, Grossman and Helpman (1991) argue that companies' innovation demonstrates the learning effect. Thus, the proxy variable that directly measures innovation is used to further study the learning effect of internationalization.

Griliches (1990) points out that innovation is an activity that at least includes R&D input and patent output. A patent is the direct output of R&D, and R&D input and patent output reflect innovation to some degree. We use R&D input and patent output to measure companies' innovation, which can demonstrate the influence of internationalization on independent innovation from the input-output perspective.

Internationalization and innovation are two engines of economic growth. However, compared with the priority and establishment of the internationalization strategy, Chinese attention to innovation is far behind. In view of China's resource endowment, the Chinese government established the export-oriented strategy in the 1980s. Currently, exports contribute much more to China's GDP than innovation. At the micro level, this macroeconomic outcome reflects that companies engage in export and other international behavior earlier than they do independent innovation. In the context of economic development transformation, internationalization can promote independent innovation, which can improve companies' sustainable development and China's sustainable economic growth. In China, some scholars have studied the impact of internationalization on productivity from the export perspective (Zhang et al., 2008, 2009; Qian et al., 2011), which provides an initial understanding of the influence of local companies' internationalization on productivity. However, the domestic literature still lacks direct evidence of how internationalization affects independent innovation. Bernard et al. (2006) indicate that it is of little significance to argue the learning effect or the self-selection effect on companies' productivity in developing countries. Instead, the focus should be shifted from technology introduction and learning to independent innovation according to the different developmental stages of developing countries, and to the relevant realization conditions and feasible paths. Thus, the key is to promote independent innovation through internationalization and boost the sustainable improvement of productivity. Given the insufficient evidence of the influence of internationalization on R&D input and patent output, in-depth research on the basis of China's special situation is necessary. Therefore, we propose the following hypotheses.

**Hypothesis 1.** If the other conditions remain unchanged, internationalization has an incentive effect on corporate R&D, and higher internationalization entails higher R&D input.

**Hypothesis 2.** If the other conditions remain unchanged, internationalization can improve the efficiency of companies' patent outputs, and higher internationalization entails higher patent output.

Table 1
Empirical evidence of internationalization and technology innovation.

| Study | Sample | Journal | Results and conclusions |
|---|---|---|---|
| Hitt, Hoskisson and Kim (1997) | 295 US listed companies from 1988 to 1990 | Academy of Management Journal | They find that companies' international diversification has a positive effect on R&D input intensity.They think that international diversification provides more income support for innovation investment.In the meantime, they point out that internationalization and innovation interact. |
| Clerides, Lach and Tybout (1998) | Cross-country research: All Colombian companies with more than 10 people from 1981 to 1991, 2800 large Mexican companies from 1986 to 1990, all Moroccan companies with more than 10 people from 1984 to 1991 | Quarterly Journal of Economics | A self-selection effect exists in Colombian and Mexican companies, whereas the learning effect exists in Moroccan companies. |
| Bernard and Jensen (1999) | 50,000 to 60,000 American manufacturing companies from 1984 to 1992 | Journal of International Economics | They find that there is a self-selection effect and, unlike noninternational companies, international companies with heterogeneous characteristics are more innovative before entry into overseas markets. They achieve better performance and become export-oriented companies. |
| Baldwin and Gu (2004) | 10,106 Canadian companies from 1984 to 1990 and 9036 Canadian companies from 1990 to 1996 | Oxford Review of Economic Policy | They find that export-oriented market participation is positively related with company productivity. The learning effect, the international market competition effect and economies of scale promote productivity. The participation of the international market enables companies to increase R&D input. However, before and after entry into overseas markets, export-oriented companies are more innovative than non-export-oriented companies and a self-selection effect exists. |
| Greenaway, Gullstrand and Kneller (2005) | 3570 Swedish manufacturing companies from 1980 to 1997 | Review of World Economics | Export-oriented companies and non-export-oriented companies have incredibly similar performance characteristics and there is no heterogeneity. Before and after these companies enter overseas markets, there is no significant difference between their productivities. |
| Van Biesebroeck (2005) | Cross-country research: 105 Burundi companies in 1993, 234 Cameroonian companies from 1992 to 1994, 207 Ethiopian companies in 1996, 209 Ghanaian companies from 1991 to 1993, 188 Ivory Coast companies from 1994 to 1995, 267 domestic Kenyan companies from 1992 to 1994, 241 Tanzanian companies from 1992 to 1994, 262 Zambian companies from 1992 to 1994 and 203 Zimbabwean companies from 1992 to 1994 | Journal of International Economics | There is a learning effect in nine Sub-Saharan African countries. Export-oriented companies have better productivities than non-export-oriented companies. After entry into overseas markets, the productivity of export-oriented companies improves. |
| Salomon and Jin (2010) | 1744 Spanish manufacturing companies from 1990 to 1997 | Strategic Management Journal | Exporting is associated with the ex post increase in innovative productivity for both technologically leading and lagging firms. However, subsequent to exporting, technologically leading firms apply for more patents than technologically lagging firms. |

| | | | |
|---|---|---|---|
| Bratti and Felice (2012) | 1635 Italian manufacturing companies from 1998 to 2003 | The World Economy | Support the theory of promotion and find that export can increase the probability of introducing product innovation. The learning effect exists. |
| Altomonte, Aquilante, Békés and Ottaviano (2013) | Cross-country research: 14,759 European manufacturing companies from the EFIGE database in 2008, such as those from Austria, France, Germany, Hungary, Italy, Spain and the UK | Economic Policy | Export itself is only an aspect of companies' internationalization. Internationalization is more than exportation.Companies' internationalization is significantly related with innovation. In the long term, companies' internationalization is probably driven by innovation. |
| Love and Ganotakis (2013) | 412 UK small and medium-sized high-tech companies from 2001 to 2004 | International Business Review | Support the theory of promotion and find that after export, the probability of company innovation is higher than that for non-export companies, but that innovation intensity does not increase. |

Table 2
Variable definitions.

| | Variable | Symbol | Definition |
|---|---|---|---|
| Dependent variables | R&D intensity | RD_intensity | R&D intensity = R&D expenditures/total assets at year-end. |
| | Changes in R&D intensity | △RD_intensity | △RD_intensity = (R&D expenditures for this year − R&D expenditures for last year)/total assets at last year-end. |
| | Technological innovation performance | △Patents | The number of new patents granted by the China Intellectual Property Office in the year, including the number of inventions, utility patents and design patents. |
| Explanatory variables | Internationalization of firm | Overseas_Sales | Overseas revenue intensity = overseas sales revenue/total assets at year-end. |
| | | Export_Rate | The proportion of overseas revenue = overseas revenue/total revenue at year-end. |
| | | Overseas_Agency | Dummy variable. If the company has overseas branches or investment institutions, the value is 1; otherwise, the value is 0. |
| | Changes in companies' internationalization | △Overseas_Sales | Changes in overseas revenue intensity = (overseas revenue for this year − overseas revenue for last year)/total assets at last year-end. |
| | | △Export_Rate | Changes in the proportion of overseas revenue = (overseas revenue for this year − overseas revenue for last year)/total revenue at last year-end. |
| Control variables | Total sales of firm | Total_Sales | Total_Sales = (domestic revenue for this year + overseas revenue for this year)/total assets at year-end. |
| | Changes in total sales of firm | △Total_Sales | △Total_Sales = (domestic revenue for this year + overseas revenue for this year − domestic revenue for last year − overseas revenue for last year)/total assets at year-end. |
| | Domestic revenue of firm | Domes_Sales | Domestic revenue intensity = domestic revenue for this year/total assets at year-end. |
| | Changes in domestic revenue of firm | △Domes_Sales | △Domes_Sales = (domestic revenue for this year − domestic revenue for last year)/total revenue at last year-end. |
| | Firm investment opportunities | Tobin's Q | Tobin's Q = firm's market value/firm's replacement cost = (number of tradable shares * this year's closing price + non-tradable shares * book value of net assets per share + book value of liabilities)/total assets at year-end. |
| | Changes in investment opportunities of firm | △Tobin's Q | Tobin's Q = (number of tradable shares * this year's closing price + non-tradable shares * book value of net assets per share of this year + book value of liabilities of this year − number of tradable shares * last year's closing price + non-tradable shares * book value of net assets per share of last year + book value of liabilities of last year)/total assets at last year-end. |
| | Financial risk | Lev | Asset-liability ratio = total liabilities/total assets at year-end. |
| | Change in financial risk | △Lev | (Total liabilities for this year − total liabilities last year)/total assets at year-end. |
| | CEO gender | Ceo_Gender | If the CEO is male, the value is 1; otherwise, the value is 0. |
| | CEO age | Ceo_Age | The age of the CEO. |
| | Educational background of CEO | Ceo_Education | If the CEO has a Bachelor's, Master's or Doctoral degree, the value is 1; otherwise, the value is 0. |
| | Overseas experience of CEO | Ceo_Experience | If the CEO has experience studying or working abroad, the value is 1; otherwise, the value is 0. |
| | CEO duality | Dual | Dummy variable equal to 1 for CEO duality and 0 otherwise. |
| | Proportion of the largest shareholder | First_Stake | The proportion of the largest shareholder's shareholding in the companies. |
| | Nature of the controlling owner | Property | A dummy variable equal to 1 for a state-owned listed company and 0 otherwise. |
| | Venture capital | VC | If the firm is venture capital backed, the value is 1; otherwise, the value is 0. |
| | Firm life cycle | Age | The survival time of the firm from the beginning to this year. |
| | Stock knowledge of firm | Patents_past_total | The number of patents the firm accumulated in past years. |
| | Firm size | Size | Size = Natural logarithm of total assets at year-end. |
| | Industry effects | Industry | First-level industry classification according to the CSRC industry standard. We define eight dummy variables for which the benchmark is L, representing the communication and culture industry. |
| | Year effects | Year | We define three dummy variables, for which the benchmark year is 2009. |

## 3. Research design

### 3.1. Sample selection and data sources

We use Chinese ChiNext companies from 2009 to 2012 as research samples and financial data from the China Stock Market and Accounting Research (CSMAR) Database. Using the annual reports of listed companies, we hand collect the R&D data, overseas income structures and overseas institutions. The patent data of listed companies are from the *China Patent Database* published by China Intellectual Property Office Intellectual Property Press. We classify and arrange the patents owned by listed companies according to year. After excluding the missing data, we obtain a final sample of 825 firm-year observations. Of these observations, 36, 153, 281 and 355 correspond to 2009, 2010, 2011 and 2012, respectively.

### 3.2. Model specifications and variable definitions

To test Hypothesis 1, we build the following regression models, Models (1)–(4), according to the relevant literature (Himmelberg and Petersen, 1994; Hubbard, 1998). The model variables are defined in Table 2. All of the behaviors related to cross-border expansion can be regarded as companies' internationalization; the sales, manufacturing or R&D in different areas or overseas markets embody internationalization (Hitt et al., 1994, 1997). Therefore, according to the relevant literature (Hitt et al., 1997; Lu and Beamish, 2004; Altomonte et al., 2013), we adopt overseas sales intensity (Overseas_Sales), the proportion of overseas revenue (Export_Rate) and overseas institutions (Overseas_Agency) to measure the degree of internationalization. Due to the different institutions in Hong Kong, Macao, Taiwan and mainland China, the sales revenues in these three areas are included in the overseas sales revenue.

$$\begin{aligned} RD\_intensity_t = {} & \beta_0 + \beta_1 Total\_Sales_t + \beta_2 Tobins'Q_t + \beta_3 Lev_t + \beta_4 Ceo\_Gender_t + \beta_5 Ceo\_Age_t \\ & + \beta_6 Ceo\_Education_t + \beta_7 Ceo\_Experience_t + \beta_8 Dual_t + \beta_9 First\_Stake_t + \beta_{10} Property_t \\ & + \beta_{11} VC_t + \beta_{12} Size_t + \beta_{13} Industry + \beta_{14} Year + \zeta \end{aligned} \tag{1}$$

$$\begin{aligned} RD\_intensity_t = {} & \beta_0 + \beta_1 Overseas\_Sales_t + \beta_2 Domes\_Sales_t + \beta_3 Tobins'Q_t + \beta_4 Lev_t + \beta_5 Ceo\_Gender_t \\ & + \beta_6 Ceo\_Age_t + \beta_7 Ceo\_Education_t + \beta_8 Ceo\_Experience_t + \beta_9 Dual_t + \beta_{10} First\_Stake_t \\ & + \beta_{11} Property_t + \beta_{12} VC_t + \beta_{13} Size_t + \beta_{14} Industry + \beta_{15} Year + \zeta \end{aligned} \tag{2}$$

$$\begin{aligned} RD\_intensity_t = {} & \beta_0 + \beta_1 Export\_Rate_t + \beta_2 Tobins'Q_t + \beta_3 Lev_t + \beta_4 Ceo\_Gender_t + \beta_5 Ceo\_Age_t \\ & + \beta_6 Ceo\_Education_t + \beta_7 Ceo\_Experience_t + \beta_8 Dual_t + \beta_9 First\_Stake_t + \beta_{10} Property_t \\ & + \beta_{11} VC_t + \beta_{12} Size_t + \beta_{13} Industry + \beta_{14} Year + \zeta \end{aligned} \tag{3}$$

$$\begin{aligned} RD\_intensity_t = {} & \beta_0 + \beta_1 Overseas\_Agency_t + \beta_2 Total\_Sales_t + \beta_3 Tobins'Q_t + \beta_4 Lev_t + \beta_5 Ceo\_Gender_t \\ & + \beta_6 Ceo\_Age_t + \beta_7 Ceo\_Education_t + \beta_8 Ceo\_Experience_t + \beta_9 Dual_t + \beta_{10} First\_Stake_t \\ & + \beta_{11} Property_t + \beta_{12} VC_t + \beta_{13} Size_t + \beta_{14} Industry + \beta_{15} Year + \zeta \end{aligned} \tag{4}$$

To alleviate the impact of endogeneity, we build Models (5), (6) and (7) to further investigate the influence of companies' internationalization on R&D input according to Models (1), (2) and (3). The definitions of the main variables are presented in Table 2.

$$\Delta RD\_intensity = \beta_0 + \beta_1 \Delta Total\_Sales + \beta_2 \Delta Tobins'Q + \beta_3 \Delta Lev + \beta_4 Industry + \beta_5 Year + \zeta \tag{5}$$

$$\begin{aligned} \Delta RD\_intensity = {} & \beta_0 + \beta_1 \Delta Overseas\_Sales + \beta_2 \Delta Domes\_Sales + \beta_3 \Delta Tobins'Q + \beta_4 \Delta Lev + \beta_5 Industry \\ & + \beta_6 Year + \zeta \end{aligned} \tag{6}$$

$$\Delta RD\_intensity = \beta_0 + \beta_1 \Delta Export\_Rate + \beta_2 \Delta Tobins'Q + \beta_3 \Delta Lev + \beta_4 Industry + \beta_5 Year + \zeta \tag{7}$$

To better alleviate the impact of endogeneity, we also use the two-stage least squares (TSLS) method to test the influence of companies' internationalization on R&D. We follow the literature (Lileeva and Trefler, 2010; Bustos, 2011; Bratti and Felice, 2012) and choose the proportion of assets of foreign-funded firms in ChiNext companies with output values of over 5 million yuan (Foreign_ratio) as an instrumental variable for internationalization. The data are from the *Industrial Statistics Data* of the National Bureau of Statistics. The proportion of foreign assets in ChiNext companies with output values over 5 million yuan is a good indicator of the degree of internationalization. It also has no direct interaction with corporate independent innovation and is irrelevant to the regression residuals of Models (2), (3) and (4). That is, it meets the instrumental variables' exogeneity requirements. The TSLS regression process is as follows. During the first stage, Overseas_Sales, Export_Rate and Overseas_Agency are adopted to conduct the regression of Foreign_ratio and all control variables except for Overseas_Sales, Export_Rate and Overseas_Agency from Models (2), (3) and (4), including Domes_Sales (only in Overseas_Sales), Tobin's Q, Lev, Ceo_Gender, Ceo_Age, Ceo_Education, Ceo_Experience, Dual, First_Stake, Property, VC, Size, Year and Industry. The following induction model is used:

$$Overseas\_Sales_i/Export\_Rate_i/Overseas\_Agency_i = \varphi_0 + \varphi_1 Foreign\_ratio_i + \sum_{j=1}^{m} \varphi_{1+m}\text{Other- exogenous -variable}_{ji} + \varepsilon \quad (8)$$

where other exogenous variables include Domes_Sales (only in Overseas_Sales), Tobin's Q, Lev, Ceo_Gender, Ceo_Age, Ceo_Education, Ceo_Experience, Dual, First_Stake, Property, VC, Size, Year and Industry. The fitted values of Overseas_Sales, Export_Rate and Overseas_Agency are extracted using the preceding equation. During the second stage, the fitted values of Overseas_Sales, Export_Rate and Overseas_Agency replace Overseas_Sales, Export_Rate and Overseas_Agency in Models (2), (3) and (4) to conduct the regression analysis. To test Hypothesis 2, we construct the Poisson regression in Models (9), (10) and (11) according to related studies (Pakes and Griliches, 1980; Bound et al., 1984; Hausman et al., 1984). The variables are defined in Table 2. Patent output has strong lagged effects and results from current and lagged R&D expenditures. We control the lagged one period and lagged two period of companies' R&D inputs ($RD\_intensity_{t-1}$ and $RD\_intensity_{t-2}$).

$$\begin{aligned}\Delta Patents_t = {} & \beta_0 + \beta_1 RD\_intensity_t + \beta_2 RD\_intensity_{t-1} + \beta_3 RD\_intensity_{t-2} + \beta_4 Overseas\_Sales_t \\ & + \beta_5 Domes\_Sales_t + \beta_6 Patent\_past\_total_t + \beta_7 Ceo\_Gender_t + \beta_8 Ceo\_Age_t \\ & + \beta_9 Ceo\_Education_t + \beta_{10} Ceo\_Experience_t + \beta_{11} Dual_t + \beta_{12} Age_t + \beta_{13} First\_Stake_t \\ & + \beta_{14} Property_t + \beta_{15} VC_t + \beta_{16} Size_t + \beta_{17} Lev_t + \beta_{18} Industry + \beta_{19} Year + \zeta \end{aligned} \quad (9)$$

$$\begin{aligned}\Delta Patents_t = {} & \beta_0 + \beta_1 RD\_intensity_t + \beta_2 RD\_intensity_{t-1} + \beta_3 RD\_intensity_{t-2} + \beta_4 Export\_Rate_t \\ & + \beta_5 Patent\_past\_total_t + \beta_6 Ceo\_Gender_t + \beta_7 Ceo\_Age_t + \beta_8 Ceo\_Education_t \\ & + \beta_9 Ceo\_Experience_t + \beta_{10} Dual_t + \beta_{11} Age_t + \beta_{12} First\_Stake_t + \beta_{13} Property_t + \beta_{14} VC_t \\ & + \beta_{15} Size_t + \beta_{16} Lev_t + \beta_{17} Industry + \beta_{18} Year + \zeta \end{aligned} \quad (10)$$

$$\begin{aligned}\Delta Patents_t = {} & \beta_0 + \beta_1 RD\_intensity_t + \beta_2 RD\_intensity_{t-1} + \beta_3 RD\_intensity_{t-2} + \beta_4 Overseas\_Agency_t \\ & + \beta_5 Patent\_past\_total_t + \beta_6 Ceo\_Gender_t + \beta_7 Ceo\_Age_t + \beta_8 Ceo\_Education_t \\ & + \beta_9 Ceo\_Experience_t + \beta_{10} Dual_t + \beta_{11} Age_t + \beta_{12} First\_Stake_t + \beta_{13} Property_t + \beta_{14} VC_t \\ & + \beta_{15} Size_t + \beta_{16} Lev_t + \beta_{17} Industry + \beta_{18} Year + \zeta \end{aligned} \quad (11)$$

The empirical literature indicates that dependent variables (RD_intensity and △Patents) and independent variables (Overseas_Sales, Export_Rate and Overseas_Agency) may be influenced by company characteristics (Bernard and Jensen, 1999; Melitz, 2003; Greenaway et al., 2005) and manager characteristics[2] (Faleye, 2011;

[2] The authors are grateful for the referees' suggestions.

Table 3
Industry affiliation of ChiNext companies.

| Industry | 2009 | | 2010 | | 2011 | | 2012 | |
|---|---|---|---|---|---|---|---|---|
| | Number | Percentage (%) | Number | Percentage (%) | Number | Percentage (%) | Number | Percentage (%) |
| *Panel A Industry affiliations of the full sample* | | | | | | | | |
| A (Agriculture, Forestry, Animal Husbandry and Fishery) | 0 | 0 | 4 | 2.61 | 6 | 2.14 | 7 | 1.97 |
| B (Mining) | 0 | 0 | 1 | 0.65 | 4 | 1.42 | 5 | 1.4 |
| C (Manufacturing) | 21 | 58.33 | 101 | 66.01 | 187 | 66.55 | 229 | 64.51 |
| E (Construction) | 0 | 0 | 1 | 0.65 | 2 | 0.71 | 3 | 0.85 |
| F (Transportation and Storage) | 1 | 2.78 | 1 | 0.65 | 2 | 0.71 | 3 | 0.85 |
| G (Information Technology) | 8 | 22.22 | 30 | 19.61 | 55 | 19.57 | 77 | 21.69 |
| H (Wholesale and Retail) | 2 | 5.56 | 2 | 1.31 | 2 | 0.71 | 2 | 0.56 |
| K (Social Service) | 3 | 8.33 | 7 | 4.58 | 14 | 4.98 | 18 | 5.07 |
| L (Communication and Culture) | 1 | 2.78 | 6 | 3.93 | 9 | 3.21 | 11 | 3.1 |
| Total | 36 | 100 | 153 | 100 | 281 | 100 | 355 | 100 |
| Strategic emerging industries | | | | | | | | |
| *Panel B Strategic emerging industries affiliations of sample firms* | | | | | | | | |
| Energy saving and environmental protection industry | 1 | 4 | 6 | 5.83 | 9 | 4.92 | 11 | 4.8 |
| New generation of information technology | 8 | 32 | 27 | 26.21 | 50 | 27.32 | 73 | 31.88 |
| Biomedicine | 6 | 24 | 15 | 14.56 | 31 | 16.94 | 37 | 16.16 |
| High-end equipment manufacturing | 6 | 24 | 25 | 24.27 | 49 | 26.78 | 56 | 24.45 |
| New energy | 2 | 8 | 13 | 12.62 | 16 | 8.74 | 17 | 7.42 |
| New materials | 1 | 4 | 15 | 14.56 | 23 | 12.57 | 29 | 12.66 |
| New energy automobile | 1 | 4 | 2 | 1.95 | 5 | 2.73 | 6 | 2.63 |
| Total | 25 | 100 | 103 | 100 | 183 | 100 | 229 | 100 |

Table 4
Overseas income of ChiNext companies.

| Industry | Non-exporters | Exporters | Entrants | Quitters | Switchers |
|---|---|---|---|---|---|
| A (Agriculture, Forestry, Animal Husbandry and Fishery) | 5 | 2 | 0 | 0 | 0 |
| B (Mining) | 3 | 2 | 0 | 0 | 0 |
| C (Manufacturing) | 22 | 143 | 62 | 0 | 2 |
| E (Construction) | 0 | 2 | 1 | 0 | 0 |
| F (Transportation and Storage) | 1 | 2 | 0 | 0 | 0 |
| G (Information Technology) | 50 | 24 | 2 | 1 | 0 |
| H (Wholesale and Retail) | 0 | 2 | 0 | 0 | 0 |
| K (Social Service) | 0 | 8 | 10 | 0 | 0 |
| L (Communication and Culture) | 0 | 5 | 5 | 0 | 1 |
| Total | 81 | 190 | 80 | 1 | 3 |

Note: Switchers refer to two situations: there is no overseas income in one year, but there is overseas income before and after that year; there is overseas income in one year, but there is no overseas income before or after that year.

Debrulle and Maes, 2015; Naldi et al., 2015; Sala and Yalcin, 2015). For example, venture companies or adventurous managers tend to choose the internationalization strategy. These kinds of companies or managers are more inclined to invest in innovative high-risk projects. Therefore, we select firm size (Size), firm investment opportunities (Tobin's Q), financial risk (Lev), CEO duality (Dual), proportion of the largest shareholder (First_Stake), nature of the controlling owner (Property), venture capital (VC), firm life cycle (Age), CEO gender (Ceo_Gender), CEO age (Ceo_Age), educational background of CEO (Ceo_Education) and overseas experience of CEO (Ceo_Experience) as our control variables.

## 4. Empirical results

### *4.1. Descriptive statistics*

Table 3 shows the industry affiliations of ChiNext companies. Panel A shows 229 and 77 companies in the manufacturing and information technology industries, respectively. Panel B presents the sample by strategic emerging industries, with 73 companies in new generation of information technology and 56 companies in high-end equipment manufacturing. The number of companies in energy saving and environmental protection and new energy automotive is relatively small.

Table 4 presents the descriptive statistics of overseas income for ChiNext companies. Of the 355 ChiNext companies, 81 (22.82%) are non-exporters that never export, 190 (53.52%) are exporters that always export, 80 are entrants (22.82%) that begin exporting and 1 is a quitter that no longer exports. This shows that the degree of internationalization of ChiNext companies is higher and that most companies actively explore the international market to earn overseas income.

Table 5 presents the descriptive statistics of export region distribution for ChiNext companies. It shows that ChiNext companies have expanded their businesses in five continents, with a considerable number of companies selling their products and services to Europe, North America and South America. From the dynamic trend, the export region of ChiNext companies is mainly in Asia (excluding Hong Kong, Macao and Taiwan) and Hong Kong, and Macao and Taiwan. Asia is the area with the largest overseas export of ChiNext companies in China. In 2012, 182 companies exported their products to Asia (excluding Hong Kong, Macao and Taiwan) and 62 companies exported their products to Hong Kong, and Macao and Taiwan. Moreover, under the guidance of the "going out" strategy, ChiNext companies have actively explored markets in Europe and North America. The companies that export to Europe and North America have maintained increasing trends.

Table 6 presents the descriptive statistics for the sample of ChiNext companies. The mean value of RD_intensity$_t$, RD_intensity$_{t-1}$ and RD_intensity$_{t-2}$ of the sample companies are 2.32%, 2.23% and 2.36%, respectively, which are higher than 2%, the basic survival line recognized by the OECD. This indicates that under the guidance of the national strategy for building an innovative nation, great value has been attached to independent innovation by Chinese enterprises. Investment in technological innovation has also greatly increased.

Table 5
Export region distribution of ChiNext companies.

| Year | Europe | Asia (except Hong Kong, Macao and Taiwan) | North America | South America | Africa | Oceania | HongKong, Macao and Taiwan province[a] |
|---|---|---|---|---|---|---|---|
| 2009 | 9[b] | 17[b] | 6 | 4 | 3 | 2 | 8 |
| 2010 | 29 | 170 | 33 | 14 | 11 | 6 | 35 |
| 2011 | 30 | 163 | 35 | 14 | 14 | 9 | 40 |
| 2012 | 43 | 182 | 46 | 15 | 10 | 5 | 62 |

Note: As the data disclosure of ChiNext companies in terms of their income details and regional segment reports is not clear or complete, the values in Table 5 are repeatedly calculated.

[a] Hong Kong, Macao and Taiwan are listed individually due to the different institutions between the mainland, Hong Kong, Macao and Taiwan. We find that the vast majority of ChiNext companies disclose information for Hong Kong, Macao and Taiwan separately.

[b] Nine ChiNext companies had overseas income from Europe and seventeen ChiNext companies had overseas income from Asia (excluding Hong Kong, Macao and Taiwan) in 2009. The other values in Table 5 can be deduced from this.

Table 6
Descriptive statistics.

| Variables | N | Mean | Max | Min | Median | SD |
|---|---|---|---|---|---|---|
| $RD\_intensity_t$ | 825 | 0.0232 | 0.1400 | 0.0000 | 0.0200 | 0.0171 |
| △RD_intensity | 470 | 0.0043 | 0.0698 | −0.0216 | 0.0022 | 0.0087 |
| $△Patents_t$ | 825 | 10.7624 | 349.0000 | 0.0000 | 4.0000 | 21.0348 |
| $Overseas\_Sales_t$ | 825 | 0.0584 | 0.7783 | 0.0000 | 0.0050 | 0.1083 |
| △Overseas_Sales | 470 | 0.0002 | 0.2256 | −0.3015 | 0.0000 | 0.0443 |
| $Export\_Rate_t$ | 825 | 0.1272 | 0.9930 | 0.0000 | 0.0145 | 0.2135 |
| △Export_Rate | 470 | 0.0014 | 0.3965 | −0.3964 | 0.0017 | 0.0700 |
| $Overseas\_Agency_t$ | 825 | 0.6424 | 1.0000 | 0.0000 | 1.0000 | 0.4796 |
| $Total\_ Sales_t$ | 825 | 0.4179 | 1.8800 | 0.0800 | 0.3801 | 0.2154 |
| △Total_Sales | 470 | 0.0339 | 0.8788 | −0.3390 | 0.0306 | 0.1055 |
| $Domes\_Sales_t$ | 825 | 0.3596 | 1.8800 | 0.0100 | 0.3300 | 0.2134 |
| △Domes_Sales | 470 | 0.0337 | 0.8788 | −0.3300 | 0.0251 | 0.0995 |
| Tobin's $Q_t$ | 825 | 2.6290 | 4.6293 | 0.9737 | 1.4799 | 0.4659 |
| △Tobin's Q | 470 | 0.0678 | 2.2879 | −2.0606 | 0.0862 | 0.4469 |
| $Lev_t$ | 825 | 0.1741 | 0.7670 | 0.0110 | 0.1417 | 0.1264 |
| △Lev | 470 | 0.0783 | 1.3677 | −0.1681 | 0.0406 | 0.1301 |
| $Ceo\_Gender_t$ | 825 | 0.9358 | 1.0000 | 0.0000 | 1.0000 | 0.2453 |
| $Ceo\_Age_t$ | 825 | 46.5467 | 66.0000 | 27.0000 | 47.0000 | 5.8692 |
| $Ceo\_Education_t$ | 825 | 0.7648 | 1.0000 | 0.0000 | 1.0000 | 0.4244 |
| $Ceo\_Experience_t$ | 825 | 0.1018 | 1.0000 | 0.0000 | 0.0000 | 0.3026 |
| $Dual_t$ | 825 | 0.4836 | 1.0000 | 0.0000 | 0.0000 | 0.5000 |
| $First\_Stake_t$ | 825 | 0.3380 | 0.6887 | 0.0877 | 0.3125 | 12.7597 |
| $Property_t$ | 825 | 0.0400 | 1.0000 | 0.0000 | 0.0000 | 0.1961 |
| $VC_t$ | 825 | 0.6206 | 1.0000 | 0.0000 | 1.0000 | 0.4855 |
| $Age_t$ | 825 | 9.1952 | 26.0000 | 1.0000 | 9.0000 | 4.4421 |
| $RD\_intensity_{t-1}$ | 825 | 0.0223 | 0.2015 | 0.0000 | 0.0223 | 0.0244 |
| $RD\_intensity_{t-2}$ | 825 | 0.0236 | 0.1990 | 0.0000 | 0.0235 | 0.0295 |
| $Patents\_past\_total_t$ | 825 | 16.9285 | 859.0000 | 0.0000 | 6.0000 | 46.7520 |
| $Size_t$ | 825 | 2.1974 | 2.2824 | 2.1353 | 2.1939 | 0.0259 |

This phenomenon reflects the clear positioning of the ChiNext market, which is committed to supporting the growth and strength of high-tech and high-growth enterprises. The mean value of △RD_intensity is 0.43%, representing the increase in momentum of R&D in ChiNext companies. The mean value of △Patent is 10.7624, which shows that ChiNext companies have strong capabilities for innovation. However, new patents are distributed unevenly with a great standard deviation of 21.0348, which reflects significant differences in the innovation capabilities of the sample companies.

In terms of internationalization, the mean value of Export_Rate is 12.72%, indicating that on average 12.72% of ChiNext companies' incomes come from overseas markets. The means of △Export_Rate and

Table 7
Regression results for the internationalization and R&D input of ChiNext companies (Level model).

| Variables | Predicted sign | RD_intensity Full sample Model (1) | RD_intensity Full sample Model (2) | RD_intensity Companies with non-overseas income Model (3) | RD_intensity Companies with overseas income Model (4) | RD_intensity Full sample Model (5) | RD_intensity Full sample Model (6) |
|---|---|---|---|---|---|---|---|
| Total_Sales | + | 0.046*** | | | | | 0.014*** |
| | | (3.24) | | | | | (5.22) |
| Overseas_Sales | + | | 0.017*** | | 0.017*** | | |
| | | | (3.36) | | (3.33) | | |
| Domes_Sales | + | | 0.015*** | 0.005* | 0.027*** | | |
| | | | (5.28) | (1.68) | (6.72) | | |
| Export_Rate | + | | | | | 0.001* | |
| | | | | | | (1.77) | |
| Overseas_Agency | + | | | | | | 0.006*** |
| | | | | | | | (5.17) |
| Ceo_Gender | + | 0.002 | 0.002 | −0.002 | 0.002 | 0.003 | 0.001 |
| | | (0.99) | (0.74) | (−0.59) | (0.74) | (1.27) | (0.68) |
| Ceo_Age | − | −1.06E−04 | −8.5E−05 | −1.53E−04 | −5.05E−05 | −1.01E−04 | −0.15E−05 |
| | | (−1.17) | (−0.95) | (−0.93) | (−0.50) | (−1.11) | (−0.47) |
| Ceo_Education | + | 0.004*** | 0.004*** | 0.004 | 0.006*** | 0.004*** | 0.005*** |
| | | (3.56) | (3.53) | (1.46) | (4.33) | (3.41) | (3.99) |
| Ceo_Experience | + | −0.004** | −0.003* | −0.004 | −0.004** | −0.004**88 | −0.004*** |
| | | (−2.14) | (−1.94) | (−1.02) | (−2.24) | (−2.19) | (−2.63) |
| Dual | +/− | 0.002 | 0.002 | 0.003* | 0.001 | 0.001 | 0.002 |
| | | (1.53) | (1.39) | (1.77) | (1.11) | (1.30) | (1.46) |
| First_Stake | +/− | −9.84E−05** | −1.17E−04*** | −5.56E−05 | −1.83E−04*** | −1.07E−04*** | −1.00E−04** |
| | | (−2.42) | (−2.91) | (−0.77) | (−3.94) | (−2.63) | (−2.54) |
| Property | +/− | 0.006** | 0.004 | 0.001 | 0.006** | 0.005* | 0.004* |
| | | (2.04) | (1.53) | (0.31) | (2.05) | (1.74) | (1.87) |
| VC | + | 8.31E−04 | 0.001 | 0.001 | 3.13E−04 | 0.001 | 7.90E−04 |
| | | (0.78) | (0.95) | (0.71) | (0.26) | (0.54) | (0.76) |
| Tobin's Q | + | 0.005*** | 0.006*** | 0.008*** | 0.003** | 0.006*** | 0.006*** |
| | | (3.67) | (5.04) | (4.15) | (2.14) | (4.50) | (5.25) |
| Lev | − | −0.005 | −0.014*** | −0.008 | −0.015*** | −0.006 | −0.014*** |
| | | (−1.18) | (−3.05) | (−1.03) | (−2.83) | (−1.24) | (−2.98) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Size | + | −5.41E−04 | 0.001 | 0.002 | 0.004 | −0.001 | 0.001 |
| | | (−0.23) | (0.41) | (0.42) | (1.41) | (−0.36) | (0.06) |
| Constant | ? | 0.015 | −0.006 | 0.002 | −0.043 | 0.019 | −0.016 |
| | | (0.70) | (−0.27) | (0.05) | (−1.64) | (0.84) | (−0.36) |
| Industry | | Yes | Yes | Yes | Yes | Yes | Yes |
| Year | | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistics | | 15.27*** | 15.88*** | 7.77*** | 13.85*** | 14.63*** | 17.52*** |
| Prob > F | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Adj. $R^2$ | | 0.2848 | 0.3024 | 0.3168 | 0.3706 | 0.2756 | 0.3248 |
| $N$ | | 825 | 825 | 322 | 503 | 825 | 825 |

T-statistics in parentheses are robust.
* Statistical significance at the 10% level for two-tailed tests.
** Statistical significance at the 5% level for two-tailed tests.
*** Statistical significance at the 1% level for two-tailed tests.

Table 8
Regression results for the internationalization and R&D input of ChiNext companies (Change model).

| Variables | Predicted sign | △RD_intensity Full sample Model (1) | △RD_intensity Full sample Model (2) | △RD_intensity Companies with non-overseas income Model (3) | △RD_intensity Companies with overseas income Model (4) | △RD_intensity Full sample Model (5) |
|---|---|---|---|---|---|---|
| △Total_Sales | + | 0.014*** | | | | |
| | | (3.75) | | | | |
| △Overseas_Sales | + | | 0.022** | | 0.023*** | |
| | | | (2.41) | | (2.74) | |
| △Domes_Sales | + | | 0.013*** | 0.013** | 0.013** | |
| | | | (3.21) | (2.10) | (2.41) | |
| △Export_Rate | + | | | | | 0.001* |
| | | | | | | (1.77) |
| △Tobin's Q | + | 0.002** | 0.002** | 0.003* | 0.001 | 0.003** |
| | | (2.15) | (2.11) | (1.80) | (0.58) | (2.33) |
| △Lev | − | −0.008*** | −0.008*** | −0.009* | −0.012*** | −0.008** |
| | | (−2.58) | (−2.60) | (−1.87) | (−2.79) | (−2.09) |
| Constant | ? | 0.002 | 0.002 | 0.003 | −0.004 | 0.001 |
| | | (0.57) | (0.64) | (0.90) | (−0.44) | (0.05) |
| Industry | | Yes | Yes | Yes | Yes | Yes |
| Year | | Yes | Yes | Yes | Yes | Yes |
| F-statistics | | 2.83*** | 2.68*** | 2.84** | 2.44*** | 1.85** |
| Prob > F | | 0.0006 | 0.0009 | 0.0172 | 0.0030 | 0.0402 |
| Adj. $R^2$ | | 0.0482 | 0.0478 | 0.0494 | 0.0647 | 0.0331 |
| $N$ | | 470 | 470 | 178 | 292 | 300 |

T-statistics in parentheses are robust.
* Statistical significance at the 10% level for two-tailed tests.
** Statistical significance at the 5% level for two-tailed tests.
*** Statistical significance at the 1% level for two-tailed tests.

△Overseas_Sales are 0.14% and 0.02%, respectively, showing the increase in momentum of the proportion of overseas incomes of ChiNext companies. In addition, the mean value of Overseas_Agency is 0.6424, which suggests that 64.24% of the companies have set up branches abroad.

As for the control variables, the mean value of Ceo_Gender is 0.9358, indicating that 93.58% of the sample companies have male CEOs. The mean value of Ceo_Education is 0.7648, implying that the vast majority of ChiNext companies' CEOs are highly educated. The mean and median of Ceo_Experience are 0.1018 and 0.0000, respectively, showing that CEOs with overseas experience are rarely seen in ChiNext companies. Only 10.18% of the sample companies have CEOs with overseas experience. Moreover, the mean and median of Lev are 0.1741 and 0.1417, respectively, meaning that the financial risks of ChiNext companies are generally low. The mean, median and standard deviation of First_Stake are 0.3380, 0.3125 and 12.7597, respectively. Thus, large shareholders are commonly seen in ChiNext companies and the proportions of the largest shareholders vary drastically. The mean and median of Property are 0.0400 and 0.0000, respectively, denoting that the vast majority of ChiNext companies are non-state-owned companies. The mean of VC is 0.6206, which suggests that the vast majority of ChiNext companies are associated with the equity support of venture capital.

### *4.2. Multivariate regression analysis*

Table 7 examines the impacts of the internationalization of ChiNext companies on R&D investments. According to the regression results, the F-statistics of all of the models are significant at the 1% level, indicating high-fitting precision. All of the values of adjusted $R^2$ are greater than 27%, signifying that the explanation is reliable. With all other related factors controlled, there is a significant positive relationship between

Table 9
Two-stage regression results for the internationalization and R&D input of ChiNext companies (Foreign_ratio).

| Variables | Predicted sign | Full sample RD_intensity Model (1) | Full sample RD_intensity Model (2) | Full sample RD_intensity Model (3) |
|---|---|---|---|---|
| Overseas_Sales | + | 0.201*** | | |
| | | (4.67) | | |
| Domes_Sales | + | 0.044*** | | |
| | | (6.06) | | |
| Export_Rate | + | | 0.114*** | |
| | | | (4.61) | |
| Overseas_Agency | + | | | 0.031*** |
| | | | | (4.61) |
| Ceo_Gender | + | −0.004* | −0.003 | 0.001 |
| | | (−1.69) | (−1.24) | (0.62) |
| Ceo_Age | − | 2.19E−04* | 3.60E−04*** | 1.58E−04 |
| | | (1.92) | (2.67) | (1.49) |
| Ceo_Education | + | 0.003*** | 0.002 | 0.007*** |
| | | (2.65) | (1.54) | (5.13) |
| Ceo_Experience | + | −0.004** | −0.008*** | −0.010*** |
| | | (−2.31) | (−4.18) | (−4.58) |
| Dual | +/− | 5.09E−04 | −8.33E−04 | 0.002 |
| | | (0.46) | (−0.69) | (1.50) |
| First_Stake | +/− | −2.26E−04*** | −2.21E−04 | −2.52E−05 |
| | | (−4.78) | (−4.67) | (−0.57) |
| Property | +/− | 0.005* | 0.011*** | 0.009*** |
| | | (1.85) | (3.76) | (3.20) |
| VC | + | 0.002* | −0.002 | −4.18E−04 |
| | | (1.79) | (−1.39) | (−0.39) |
| Tobin's Q | + | 0.011*** | 0.011*** | 0.007*** |
| | | (6.64) | (6.47) | (5.43) |
| Lev | − | −0.046*** | −0.014*** | −0.007 |
| | | (−5.27) | (−2.86) | (−1.50) |
| Size | + | 0.010*** | 0.009*** | −0.004* |
| | | (3.15) | (2.83) | (−1.82) |
| Constant | ? | −0.109*** | −0.089*** | 0.015 |
| | | (−3.37) | (−2.78) | (0.71) |
| Industry | | Yes | Yes | Yes |
| Year | | Yes | Yes | Yes |
| F-statistics | | 16.51*** | 15.93*** | 15.93*** |
| Prob > F | | 0.0000 | 0.0000 | 0.0000 |
| Adj. *R*2 | | 0.3112 | 0.2942 | 0.2942 |
| *N* | | 825 | 825 | 825 |

T-statistics in parentheses are robust.
* Statistical significance at the 10% level for two-tailed tests.
** Statistical significance at the 5% level for two-tailed tests.
*** Statistical significance at the 1% level for two-tailed tests.

Total_Sales and RD_intensity in Model (1). The regression coefficient is 0.046, which is significant at the 1% level. This indicates that R&D intensity is stronger when the sales income of a company is higher. We conduct further tests in Model (2), dividing the sales revenues of companies into Overseas_Sales and Domes_Sales

Table 10
Regression results for the internationalization and patent output of ChiNext companies.

| Variables | Predicted sign | △Patents Full sample Model (1) | △Patents Companies with non-overseas income Model (2) | △Patents Companies with overseas income Model (3) | △Patents Full sample Model (4) | △Patents Full sample Model (5) |
|---|---|---|---|---|---|---|
| RD_intensity | + | 17.134*** | 12.307*** | 7.693*** | 16.392*** | 12.967*** |
| | | (24.09) | (3.87) | (9.92) | (23.43) | (18.03) |
| $RD\_intensity_{t-1}$ | + | 2.631*** | 4.672*** | 3.018*** | 2.341*** | 2.687*** |
| | | (6.03) | (3.30) | (5.14) | (5.29) | (6.11) |
| $RD\_intensity_{t-2}$ | + | 3.277*** | 7.457*** | 6.681*** | 3.456*** | 3.023*** |
| | | (6.42) | (5.44) | (10.29) | (6.72) | (5.81) |
| Overseas_Sales | + | 0.280*** | | 3.561*** | | |
| | | (5.03) | | (15.88) | | |
| Domes_Sales | + | 0.191*** | 0.583*** | 0.331*** | | |
| | | (2.76) | (3.31) | (3.00) | | |
| Export_Rate | + | | | | 0.288*** | |
| | | | | | (6.35) | |
| Overseas_Agency | + | | | | | 0.722*** |
| | | | | | | (22.99) |
| Patents_past_total | + | 0.004*** | 0.021*** | 0.004*** | 0.004*** | 0.003*** |
| | | (36.43) | (26.61) | (29.99) | (39.12) | (35.40) |
| Ceo_Gender | + | 0.240*** | 1.103*** | 0.373*** | 0.213*** | 0.217*** |
| | | (4.51) | (5.32) | (5.25) | (4.01) | (4.07) |
| Ceo_Age | − | −0.015*** | 0.019*** | 0.018*** | 0.014*** | 0.011*** |
| | | (7.20) | (3.38) | (6.57) | (6.73) | (5.08) |
| Ceo_Education | + | 0.110*** | 0.059 | 0.189*** | 0.108*** | 0.175*** |
| | | (3.88) | (0.73) | (4.96) | (3.81) | (6.17) |
| Ceo_Experience | + | 0.027 | 0.585*** | 0.140*** | 0.025 | 0.139*** |
| | | (0.70) | (6.92) | (2.87) | (0.65) | (3.53) |
| Dual | +/− | −0.004 | 0.282*** | −0.154*** | −0.009 | 0.018 |
| | | (−0.16) | (4.45) | (−4.71) | (−0.38) | (0.73) |
| Age | − | −0.014*** | −0.058*** | −0.012*** | −0.013*** | 0.012*** |
| | | (−5.15) | (−7.97) | (−3.30) | (−4.72) | (4.63) |
| First_Stake | +/− | 0.009*** | 0.003 | 0.006*** | 0.008*** | 0.009*** |
| | | (9.82) | (1.33) | (5.04) | (9.60) | (9.96) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Property | +/− | 0.188*** | 0.333** | 0.701*** | 0.198*** | 0.271*** |
| | | (4.03) | (2.50) | (12.83) | (4.24) | (5.79) |
| VC | + | 0.351*** | 0.333*** | 0.508*** | 0.352*** | 0.328*** |
| | | (13.99) | (5.27) | (14.96) | (14.08) | (13.15) |
| Size | + | 10.816*** | 7.496*** | 8.142*** | 11.196*** | 10.474*** |
| | | (24.86) | (5.88) | (12.86) | (25.80) | (24.31) |
| Lev | − | 0.180* | 1.399*** | −1.083*** | 0.024 | −0.025 |
| | | (1.82) | (6.00) | (−7.17) | (0.26) | (−0.26) |
| Constant | ? | −24.247*** | −17.077*** | −16.495*** | −25.083*** | −24.073*** |
| | | (−25.24) | (−6.09) | (−11.46) | (−26.21) | (−25.28) |
| Industry | | Yes | Yes | Yes | Yes | Yes |
| Year | | Yes | Yes | Yes | Yes | Yes |
| LR $\chi^2$ | | 5,003.97*** | 1,416.41 *** | 2,900.44 *** | 5,035.52 *** | 5,586.99 *** |
| Prob > $\chi^2$ | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Pseudo $R^2$ | | 0.2630 | 0.3618 | 0.2372 | 0.2647 | 0.2937 |
| $N$ | | 825 | 322 | 503 | 825 | 825 |

We use the Poisson model.

T-statistics in parentheses are robust.

* Statistical significance at the 10% level for two-tailed tests.

** Statistical significance at the 5% level for two-tailed tests.

*** Statistical significance at the 1% level for two-tailed tests.

Table 11
Regression results for the internationalization and patent output of ChiNext companies (robustness tests).

| Variables | Predicted sign | Ln(△Patents + 1) Full sample Model (1) | Ln(△Patents + 1) Companies with non-overseas income Model (2) | Ln(△Patents + 1) Companies with overseas income Model (3) | Ln(△Patents + 1) Full sample Model (4) | Ln(△Patents + 1) Full sample Model (5) |
|---|---|---|---|---|---|---|
| RD_intensity | + | 12.900*** | 4.162* | 3.708*** | 11.934*** | 8.092*** |
| | | (4.27) | (1.81) | (3.14) | (4.05) | (2.79) |
| $RD\_intensity_{t-1}$ | + | 2.295 | 2.411 | 3.377 | 2.503 | 2.259 |
| | | (1.09) | (0.92) | (1.16) | (1.19) | (1.11) |
| $RD\_intensity_{t-2}$ | + | 2.259 | 0.216 | 3.081 | 2.110 | 2.213 |
| | | (1.22) | (0.08) | (1.30) | (1.14) | (1.23) |
| Overseas_Sales | + | 0.234* | | 0.702* | | |
| | | (1.83) | | (1.71) | | |
| Domes_Sales | + | 0.405* | 0.799*** | 0.029* | | |
| | | (1.70) | (2.87) | (1.82) | | |
| Export_Rate | + | | | | 0.437** | |
| | | | | | (2.19) | |
| Overseas_Agency | + | | | | | 0.679*** |
| | | | | | | (7.58) |
| Patents_past_total | + | 0.008*** | 0.027*** | 0.006*** | 0.008*** | 0.007*** |
| | | (9.33) | (8.67) | (6.82) | (9.39) | (8.83) |
| Ceo_Gender | + | 0.226 | 0.439* | 0.051 | 0.191 | 0.198 |
| | | (1.33) | (1.78) | (0.24) | (1.33) | (1.21) |
| Ceo_Age | − | −0.002 | −0.005 | 0.001 | −0.001 | 0.002 |
| | | (−0.30) | (−0.44) | (0.07) | (−0.16) | (0.30) |
| Ceo_Education | + | 0.157 | 0.058 | 0.255** | 0.159 | 0.232** |
| | | (1.57) | (0.37) | (2.07) | (1.59) | (2.39) |
| Ceo_Experience | + | −0.118 | 0.067 | 0.376** | −0.118 | 0.252* |
| | | (−0.85) | (0.31) | (2.26) | (−0.86) | (1.87) |
| Dual | +/− | 0.062 | 0.199 | 0.067 | 0.061 | 0.088 |
| | | (0.71) | (1.58) | (0.60) | (0.69) | (1.04) |
| Age | − | −0.004 | −0.058*** | 0.001 | −0.004 | −0.005 |
| | | (−0.41) | (−7.97) | (0.09) | (−0.40) | (−0.58) |
| First_Stake | +/− | 0.329 | 0.197 | 0.847** | 0.306 | 0.428 |
| | | (1.01) | (1.59) | (2.00) | (0.94) | (1.36) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Property | +/− | 0.352 | 0.480 | 0.546* | 0.354 | 0.457** |
| | | (1.62) | (1.60) | (1.91) | (1.63) | (2.17) |
| VC | + | 0.154* | 0.081 | 0.150 | 0.156* | 0.142* |
| | | (1.80) | (0.66) | (1.37) | (1.83) | (1.72) |
| Size | + | 4.173** | 3.837 | 3.829* | 4.728*** | 3.732** |
| | | (2.47) | (1.54) | (1.71) | (2.82) | (2.31) |
| Lev | − | 0.362 | 1.268** | −0.062 | 0.177 | 0.161 |
| | | (0.96) | (2.46) | (−0.13) | (0.50) | (0.47) |
| Constant | ? | −8.690** | −7.357 | −8.514* | −10.130*** | −8.527** |
| | | (−2.31) | (−1.34) | (−1.70) | (−2.73) | (−2.38) |
| Industry | | Yes | Yes | Yes | Yes | Yes |
| Year | | Yes | Yes | Yes | Yes | Yes |
| F-statistics | | 9.63*** | 6.62*** | 5.46*** | 10.02*** | 12.57*** |
| Prob > F | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Adj. *R*2 | | 0.2385 | 0.3292 | 0.2036 | 0.2402 | 0.2884 |
| *N* | | 825 | 322 | 503 | 825 | 825 |

We use the OLS model.

T-statistics in parentheses are robust.

* Statistical significance at the 10% level for two-tailed tests.

** Statistical significance at the 5% level for two-tailed tests.

*** Statistical significance at the 1% level for two-tailed tests.

Table 12
Univariate analysis of the influence of internationalization on R&D input and patent output (exporters vs. non-exporters).

| Variable | Mean (*N*) | | Mean difference test | Median (*N*) | | Median difference test |
|---|---|---|---|---|---|---|
| | Exporters | Non-exporters | | Exporters | Non-exporters | |
| RD_intensity | 0.0326 (190) | 0.0237 (81) | 1.6792* | 0.0198 (190) | 0.0121 (81) | 3.573*** |
| Variable | Mean (*N*) | | Mean difference test | Median (*N*) | | Median difference test |
| | Exporters | Non-exporters | | Exporters | Non-exporters | |
| △Patents | 14.2017 (190) | 4.71080 (81) | 6.1218 *** | 7.0000 (190) | 1.0000 (81) | 10.616**** |

** Statistical significance at the 5% level for two-tailed tests.
* Statistical significance at the 10% level for two-tailed tests.
*** Statistical significance at the 1% level for two-tailed tests.

according to the source of sales revenue. A significant positive relationship is discovered between Overseas_Sales, Domes_Sales and RD_intensity. The regression coefficients are 0.017 and 0.015, respectively, which are significant at the 1% level. This shows that more overseas and domestic incomes lead to stronger R&D intensity. Furthermore, overseas income, which measures a company's degree of internationalization, contributes more to R&D investments than domestic income ($0.017 > 0.015$). The results demonstrate that an internationalization strategy has a significant incentive effect on R&D inputs. The entrepreneurial companies with higher degrees of internationalization have higher R&D inputs.

To obtain robust results, we conduct further tests grouped by the existence of overseas income. One group consists of ChiNext companies without internationalization, which means that all of their revenues are domestic. The other group is made up of ChiNext companies that have overseas revenues. The results are displayed in Models (3) and (4). Overseas_Sales is significantly positively related to RD_intensity in Model (4). The regression coefficient is 0.017, which is significant at the 1% level. Thus, an internationalization strategy has a significant incentive effect on R&D input. The entrepreneurial companies with higher degrees of internationalization have higher R&D inputs.

Using Export_Rate and Overseas_Agency as proxy variables of internationalization, further tests are conducted in Models (5) and (6). Export_Rate is significantly positively related to RD_intensity in Model (5). The regression coefficient is 0.001, which is significant at the 10% level. This illustrates that companies with higher degrees of internationalization have higher R&D inputs. Additionally, Overseas_Agency is significantly positively related to RD_intensity in Model (6). The regression coefficient is 0.006, which is significant at the 1% level. This implies that setting up branches overseas has a significant positive effect on domestic R&D. Overall, these results provide support for Hypothesis 1. An internationalization strategy has a significant incentive effect on R&D input. The entrepreneurial companies with higher degrees of internationalization have higher R&D inputs.

In terms of the control variables, Tobin's Q is significantly positively related to RD_intensity. This shows that better investment opportunities increase R&D intensity investments.

To obtain more robust results, the Change model is used to further investigate the impacts of ChiNext companies' internationalization on R&D. The results are shown in Table 8. A significant positive relationship between △Total_Sales and △RD_intensity is shown in Model (1). The regression coefficient is 0.014, which is significant at the 1% level. This shows that changes in sales revenues cause changes in R&D investments in the same direction. △Overseas_Sales and △Domes_Sales are significantly positively related to △RD_intensity in Model (2). The regression coefficients are 0.022 and 0.013, respectively, which are significant at the 5% and 1% levels, respectively. This shows that greater changes in overseas and domestic income lead to greater changes in R&D intensity. Furthermore, overseas income, which measures a company's degree of internationalization, contributes more to changes in R&D investments than domestic income ($0.022 > 0.013$). This supports the conclusion that an internationalization strategy has an incentive effect on R&D. Changes in the degree of internationalization beget changes in RD_intensity in the same direction.

To make our test results more robust, we conduct further tests grouped by the existence of overseas income. One group consists of ChiNext companies without internationalization, which means that all of their revenues

Table 13
Regression results for the internationalization and R&D input of ChiNext companies (subsample test by strategic emerging industries).

| Variables | Strategic emerging industries RD_intensity Full sample Model (1) | Non-strategic emerging industries RD_intensity Full sample Model (2) | Strategic emerging industries RD_intensity Full sample Model (3) | Non-strategic emerging industries RD_intensity Full sample Model (4) | Strategic emerging industries RD_intensity Full sample Model (5) | Non-strategic emerging industries RD_intensity Full sample Model (6) | Strategic emerging industries RD_intensity Companies with overseas income Model (7) | Non-strategic emerging industries RD_intensity Companies with overseas income Model (8) |
|---|---|---|---|---|---|---|---|---|
| Overseas_Sales | 0.023*** | 0.007 | | | | | 0.017** | 0.011 |
| | (4.03) | (0.68) | | | | | (2.57) | (1.30) |
| Domes_Sales | 0.024*** | 0.009* | | | | | 0.024*** | 0.031*** |
| | (6.36) | (1.88) | | | | | (4.39) | (5.14) |
| Export_Rate | | | 0.004** | −0.006 | | | | |
| | | | (2.25) | (−1.16) | | | | |
| Overseas_Agency | | | | | 0.005*** | 0.013*** | | |
| | | | | | (3.48) | (5.57) | | |
| Total_Sales | | | | | 0.002 | 0.009** | | |
| | | | | | (0.57) | (2.15) | | |
| Ceo_Gender | −0.004 | 0.008** | −0.003 | 0.010** | −0.003 | 0.010*** | −0.002 | 0.008** |
| | (−1.57) | (2.16) | (−1.25) | (2.47) | (−1.35) | (2.61) | (−0.68) | (2.39) |
| Ceo_Age | −1.63E−04 | −7.56E−05 | −1.43E−04 | −1.12E−04 | −1.20E−04 | −5.49E−05 | −1.80E−04 | 2.66E−04* |
| | (−1.58) | (−0.45) | (−1.33) | (−0.66) | (−1.13) | (−0.34) | (−1.30) | (1.80) |
| Ceo_Education | 0.004*** | 0.004 | 0.003** | 0.004 | 0.004 | 0.004* | 0.007*** | 0.004* |
| | (2.89) | (1.45) | (2.53) | (1.62) | (2.88) | (1.66) | (3.98) | (1.83) |
| Ceo_Experience | −0.004** | 0.001 | −0.004* | 0.001 | −0.005** | −0.001 | −0.006** | 0.002 |
| | (−1.97) | (0.35) | (−1.95) | (0.31) | (−2.38) | (−0.37) | (−2.41) | (0.55) |
| Dual | 0.003** | −6.23E−04 | 0.002** | −4.69E−04 | 0.003** | 4.24E−04 | 0.004*** | −0.005** |
| | (2.31) | (−0.27) | (2.03) | (−0.21) | (2.06) | (0.19) | (2.81) | (−2.39) |
| First_Stake | −1.75E−04*** | −1.11E−04 | −1.61E−04 | −1.08E−04 | −1.51E−04*** | −2.16E−05 | −2.49E−04*** | −1.18E−04 |
| | (−3.94) | (−1.35) | (−3.49) | (−1.30) | (−3.32) | (−0.27) | (−4.21) | (−1.62) |
| Property | −8.57E−05 | 0.009* | −6.08E−04 | 0.009* | −7.05E−04 | 0.014*** | 0.002 | 0.012*** |
| | (−0.03) | (1.84) | (−0.18) | (1.87) | (−0.21) | (3.07) | (0.36) | (2.65) |
| VC | −2.51E−04 | 0.003 | −0.001 | 0.002 | −0.002 | 0.002 | −6.98E−04 | 0.003* |
| | (−0.21) | (1.15) | (−1.09) | (1.05) | (−1.27) | (1.10) | (−0.45) | (1.68) |

*continued on next page*

Table 13 (*continued*)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Tobin's Q | 0.005*** | 0.008*** | 0.005*** | 0.007*** | 0.005*** | 0.006*** | 0.004** | 0.005* |
| | (3.31) | (3.50) | (3.48) | (3.12) | (3.63) | (3.00) | (2.21) | (1.68) |
| Lev | −0.017*** | −0.006 | −0.006 | −0.001 | −0.006 | −2.65E−04 | −0.009 | −0.026*** |
| | (−3.31) | (−0.65) | (−1.15) | (−0.07) | (−1.24) | (−0.03) | (−1.24) | (−2.84) |
| Size | 0.005** | −0.007 | 0.003 | −0.008* | 0.003 | −0.009** | 0.005 | 0.004 |
| | (2.01) | (−1.41) | (1.32) | (−1.73) | (1.07) | (−1.97) | (1.40) | (0.83) |
| Constant | −0.008 | 0.059 | 0.012 | 0.079* | 0.015 | 0.073* | 1.21E−04 | −0.069 |
| | (−0.36) | (1.26) | (0.50) | (1.72) | (0.61) | (1.68) | (0.01) | (−1.38) |
| Industry | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistics | 17.36*** | 6.19*** | 14.58*** | 6.33*** | 14.92*** | 8.00*** | 13.19*** | 6.35*** |
| Prob > F | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Adj. *R*2 | 0.3403 | 0.3050 | 0.2874 | 0.3016 | 0.3051 | 0.3716 | 0.3901 | 0.4101 |
| *N* | 540 | 285 | 540 | 285 | 540 | 285 | 325 | 178 |

T-statistics in parentheses are robust.

* Statistical significance at the 10% level for two-tailed tests.

** Statistical significance at the 5% level for two-tailed tests.

*** Statistical significance at the 1% level for two-tailed tests.

Table 14
Regression results for the internationalization and R&D input of ChiNext companies (Change model, subsample test by strategic emerging industries).

| Variables | Strategic emerging industries Full sample △RD_intensity Model (1) | Non-strategic emerging industries Full sample △RD_intensity Model (2) | Strategic emerging industries Full sample △RD_intensity Model (3) | Non-strategic emerging industries Full sample △RD_intensity Model (4) | Strategic emerging industries Companies with overseas income △RD_intensity Model (5) | Non-strategic emerging industries Companies with overseas income △RD_intensity Model (6) | Strategic emerging industries Companies with non-overseas income △RD_intensity Model (7) |
|---|---|---|---|---|---|---|---|
| △Overseas_Sales | 0.030*** | 0.008 | | | 0.022** | 0.010 | |
| | (3.11) | (0.41) | | | (1.97) | (0.75) | |
| △Domes_Sales | 0.022*** | 0.004 | | | 0.010 | 0.017** | 0.011* |
| | (4.02) | (0.59) | | | (1.22) | (2.47) | (1.84) |
| △Export_Rate | | | 0.005** | −0.006 | | | |
| | | | (2.46) | (−0.49) | | | |
| △Tobin's Q | 0.001 | 0.003* | 0.006** | 0.003* | 0.001 | 0.001 | 0.001*** |
| | (0.45) | (1.97) | (2.45) | (1.85) | (0.01) | (0.88) | (2.97) |
| △Lev | −0.009** | −0.007 | −0.005 | −0.008** | −0.010** | −0.010* | −0.017*** |
| | (−2.11) | (−1.45) | (−0.85) | (−2.14) | (−2.16) | (−1.93) | (−4.46) |
| Constant | 0.002 | 0.002 | −0.006 | 0.003 | 0.001 | −0.003 | 0.003 |
| | (0.56) | (0.47) | (−1.45) | (0.49) | (0.07) | (−0.79) | (0.90) |
| Industry | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistics | 2.61*** | 1.87** | 1.94** | 2.07** | 2.63** | 2.84*** | 2.42*** |
| Prob > F | 0.0019 | 0.0378 | 0.0372 | 0.0255 | 0.018 | 0.0025 | 0.0100 |
| Adj. $R^2$ | 0.0634 | 0.067 | 0.0521 | 0.1048 | 0.0487 | 0.1823 | 0.1167 |
| $N$ | 311 | 159 | 189 | 111 | 192 | 100 | 119 |

T-statistics in parentheses are robust.
* Statistical significance at the 10% level for two-tailed tests.
** Statistical significance at the 5% level for two-tailed tests.
*** Statistical significance at the 1% level for two-tailed tests.

Table 15
Regression results for the internationalization and patent output of ChiNext companies (subsample test by strategic emerging industries).

| Variables | Strategic emerging industries | | | Non-strategic emerging industries | | | Strategic emerging industries | |
|---|---|---|---|---|---|---|---|---|
| | | | Full sample | | | Full sample | Companies with overseas income | Companies with non-overseas income |
| | △Patents Model (1) | △Patents Model (2) | △Patents Model (3) | △Patents Model (4) | △Patents Model (5) | △Patents Model (6) | △Patents Model (7) | △Patents Model (8) |
| RD_intensity | 16.289*** | 15.143*** | 8.877*** | 19.169*** | 17.996*** | 14.713*** | 18.043*** | 18.564*** |
| | (18.71) | (18.32) | (14.64) | (12.30) | (11.76) | (6.44) | (14.37) | (7.40) |
| $RD\_intensity_{t-1}$ | 4.147*** | 4.420*** | 4.687*** | 3.752*** | 4.252** | 3.662*** | 2.012* | 6.783*** |
| | (5.12) | (5.45) | (5.68) | (4.64) | (5.24) | (4.48) | (1.98) | (4.49) |
| $RD\_intensity_{t-2}$ | 4.914*** | 4.967*** | 5.161*** | −0.097 | −0.318 | −0.244 | 5.967*** | 2.888* |
| | (6.92) | (6.96) | (7.24) | (−0.15) | (−0.50) | (−0.39) | (7.20) | (1.78) |
| Overseas_Sales | 0.756*** | | | 0.212* | | | 1.037*** | |
| | (5.45) | | | (1.86) | | | (6.54) | |
| Domes_Sales | 0.260*** | | | 0.571*** | | | 0.101* | 1.167*** |
| | (2.88) | | | (4.12) | | | (1.81) | (5.70) |
| Export_Rate | | 0.182*** | | | 0.521*** | | | |
| | | (2.89) | | | (5.38) | | | |
| Overseas_Agency | | | 0.506*** | | | 1.062*** | | |
| | | | (14.45) | | | (13.54) | | |
| Patents_past_total | 0.003*** | 0.003*** | 0.003*** | 0.022*** | 0.022*** | 0.021*** | 0.003*** | 0.017*** |
| | (28.08) | (28.42) | (26.15) | (37.45) | (37.45) | (34.38) | (23.30) | (20.68) |
| Ceo_Gender | 0.117* | 0.113* | 0.072 | 0.153 | 0.086 | 0.181* | 0.060 | 0.322* |
| | (1.82) | (1.76) | (1.12) | (1.49) | (0.84) | (1.77) | (0.87) | (1.78) |
| Ceo_Age | −0.023*** | −0.022*** | −0.017*** | 0.008** | 0.007** | 0.010*** | −0.017*** | −0.054*** |
| | (−8.77) | (−8.63) | (−6.59) | (2.14) | (2.03) | (2.79) | (−5.43) | (−9.59) |
| Ceo_Education | 0.085*** | 0.096*** | 0.144*** | 0.246*** | 0.236*** | 0.320*** | −0.027 | 0.342*** |
| | (2.56) | (2.92) | (4.36) | (4.25) | (4.08) | (5.69) | (−0.74) | (3.67) |
| Ceo_Experience | −0.062 | −0.060 | −0.117** | 0.107 | 0.092 | −0.083 | −0.355*** | 0.447*** |
| | (−1.29) | (−1.25) | (−2.42) | (1.33) | (1.14) | (−1.01) | (−6.05) | (5.07) |
| Dual | 0.138*** | 0.137*** | 0.151*** | −0.268*** | −0.253*** | −0.195*** | −0.040 | 0.581*** |
| | (4.61) | (4.61) | (5.08) | (−5.57) | (−5.29) | (−4.06) | (−1.11) | (8.98) |
| First_Stake | 1.034*** | 0.960*** | 0.953*** | 0.248 | 0.065 | 0.168 | 0.708*** | 0.277 |
| | (9.61) | (9.07) | (8.91) | (1.39) | (0.38) | (0.97) | (13.28) | (1.12) |
| Property | 0.475*** | 0.479*** | 0.454*** | −0.725*** | −0.632*** | −0.466*** | 0.487*** | 0.250 |
| | (7.06) | (7.12) | (6.71) | (−8.49) | (−7.63) | (−5.45) | (6.44) | (1.32) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| VC | 0.344*** | 0.360*** | 0.319*** | 0.088* | 0.081* | 0.131*** | 0.297*** | 0.434*** |
| | (11.10) | (11.66) | (10.41) | (1.85) | (1.70) | (2.70) | (8.26) | (6.45) |
| Tobin's Q | 0.224*** | 0.218*** | 0.160*** | 0.190*** | 0.229*** | 0.298*** | 0.269*** | 0.079 |
| | (5.66) | (5.52) | (4.07) | (3.14) | (4.12) | (5.13) | (5.55) | (1.00) |
| Lev | −0.290** | 0.161 | 0.072 | −0.312 | −0.692*** | −0.958*** | −0.955*** | −2.499*** |
| | (−2.49) | (1.43) | (0.63) | (−1.43) | (−3.69) | (−5.05) | (−6.37) | (−10.99) |
| Size | 12.249*** | 12.421*** | 11.940*** | 4.428*** | 5.605*** | 5.380*** | 12.998*** | 7.145*** |
| | (23.89) | (24.32) | (23.50) | (4.90) | (6.12) | (5.89) | (21.75) | (5.64) |
| Constant | −24.813*** | −25.288*** | −24.662*** | −9.314*** | −11.906*** | −12.879*** | −26.568*** | −14.148*** |
| | (−21.91) | (−22.46) | (−22.05) | (−4.71) | (−5.94) | (−6.35) | (−20.20) | (−5.08) |
| Industry | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| LR $\chi^2$ | 3,192.39*** | 3,169.24*** | 3,385.06*** | 2,916.10*** | 2,922.18*** | 3,103.89*** | 2,152.64*** | 1,415.67*** |
| Prob > $\chi 2$ | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Pseudo $R^2$ | 0.2500 | 0.2482 | 0.2651 | 0.5018 | 0.5028 | 0.5341 | 0.2568 | 0.3766 |
| $N$ | 540 | 540 | 540 | 285 | 285 | 285 | 325 | 215 |

We use the Poisson model.

T-statistics in parentheses are robust.

* Statistical significance at the 10% level for two-tailed tests.

** Statistical significance at the 5% level for two-tailed tests.

*** Statistical significance at the 1% level for two-tailed tests.

Table 16
Regression results for the internationalization and patent output of ChiNext companies (subsample test by strategic emerging industries, robustness tests).

| Variables | Strategic emerging industries | | | Non-strategic emerging industries | | | Strategic emerging industries | |
|---|---|---|---|---|---|---|---|---|
| | Full sample | | | Full sample | | | Companies with overseas income | Companies with non-overseas income |
| | Ln(△Patents + 1) Model (1) | Ln(△Patents + 1) Model (2) | Ln(△Patents + 1) Model (3) | Ln(△Patents + 1) Model (4) | Ln(△Patents + 1) Model (5) | Ln(△Patents + 1) Model (6) | Ln(△Patents + 1) Model (7) | Ln(△Patents + 1) Model (8) |
| RD_intensity | 10.264** | 9.383** | 5.746* | 12.878*** | 12.643*** | 8.983** | 6.697* | 6.833* |
| | (2.47) | (2.35) | (1.84) | (3.24) | (3.26) | (2.26) | (1.82) | (1.76) |
| $RD\_intensity_{t-1}$ | 3.311 | 3.356 | 3.467 | 3.030 | 3.536 | 2.647 | 4.110 | 3.376 |
| | (1.15) | (1.17) | (1.24) | (1.14) | (1.34) | (1.02) | (1.04) | (0.89) |
| $RD\_intensity_{t-2}$ | 4.613* | 4.584* | 4.821* | 1.247 | 1.752 | 1.194 | 5.512 | 0.869 |
| | (1.81) | (1.80) | (1.95) | (0.53) | (0.75) | (0.52) | (1.65) | (0.23) |
| Overseas_Sales | 0.104* | | | 0.738* | | | 0.734* | |
| | (1.72) | | | (1.80) | | | (1.87) | |
| Domes_Sales | 0.246* | | | 0.357* | | | 0.384* | 0.984** |
| | (1.82) | | | (1.81) | | | (1.77) | (2.08) |
| Export_Rate | | 0.111* | | | 0.782*** | | | |
| | | (1.75) | | | (2.66) | | | |
| Overseas_Agency | | | 0.596*** | | | 0.533*** | | |
| | | | (5.50) | | | (3.50) | | |
| Patents_past_total | 0.006*** | 0.006*** | 0.006*** | 0.030*** | 0.030*** | 0.029*** | 0.005*** | 0.024*** |
| | (6.93) | (6.97) | (6.50) | (10.96) | (10.99) | (10.50) | (5.36) | (6.24) |
| Ceo_Gender | 0.029 | 0.014 | −0.041 | 0.275 | 0.222 | 0.273 | −0.162 | 0.308 |
| | (0.13) | (0.06) | (−0.19) | (1.20) | (0.99) | (1.23) | (−0.57) | (0.90) |
| Ceo_Age | −0.008 | −0.008 | −0.005 | 0.011 | 0.014 | 0.013 | 0.004 | −0.020 |
| | (−0.87) | (−0.87) | (−0.56) | (1.12) | (1.37) | (1.34) | (0.28) | (−1.55) |
| Ceo_Education | 0.277** | 0.283** | 0.353*** | 0.048 | 0.021 | 0.078 | 0.325** | 0.292 |
| | (2.28) | (2.34) | (2.98) | (0.31) | (0.14) | (0.52) | (2.12) | (1.48) |
| Ceo_Experience | −0.308* | −0.310* | −0.434** | 0.107 | 0.098 | 0.075 | −0.468** | −0.051 |
| | (−1.76) | (−1.77) | (−2.53) | (0.53) | (0.49) | (0.38) | (−2.12) | (−0.19) |
| Dual | 0.123 | 0.127 | 0.151 | −0.018 | −0.036 | 0.024 | 0.083 | 0.228 |
| | (1.12) | (1.16) | (1.42) | (−0.14) | (−0.27) | (0.18) | (0.58) | (1.38) |
| First_Stake | 0.518 | 0.484 | 0.472 | −0.090 | −0.060 | 0.137 | 1.209** | 0.029 |
| | (1.24) | (1.16) | (1.17) | (−0.19) | (−0.13) | (0.29) | (2.18) | (0.05) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Property | 0.961*** | 0.970*** | 0.974*** | −0.522* | −0.496* | −0.308 | 0.961** | 0.840* |
| | (3.19) | (3.22) | (3.33) | (−1.84) | (−1.76) | (−1.08) | (2.46) | (1.85) |
| VC | 0.194* | 0.199* | 0.159 | 0.050 | 0.058 | 0.070 | 0.200 | 0.076 |
| | (1.81) | (1.86) | (1.53) | (0.38) | (0.45) | (0.55) | (1.43) | (0.48) |
| Tobin's Q | 0.247* | 0.243* | 0.190 | 0.128 | 0.164 | 0.140 | −0.163 | 0.250 |
| | (1.84) | (1.81) | (1.46) | (0.93) | (1.23) | (1.07) | (−0.89) | (1.34) |
| Lev | 0.130 | 0.013 | −0.055 | 0.075 | −0.068 | −0.017 | 0.017 | 0.526 |
| | (0.27) | (0.03) | (−0.13) | (0.13) | (−0.13) | (−0.03) | (0.03) | (0.76) |
| Size | 6.012*** | 6.254*** | 5.848*** | 2.687 | 3.562 | 1.978 | 5.323** | 4.084 |
| | (2.84) | (2.97) | (2.87) | (1.03) | (1.37) | (0.77) | (2.01) | (1.24) |
| Constant | −12.170*** | −12.743*** | −12.023*** | −5.406 | −7.518 | −4.709 | −10.948* | −7.340 |
| | (−2.61) | (−2.75) | (−2.69) | (−0.94) | (−1.32) | (−0.84) | (−1.87) | (−1.01) |
| Industry | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| F-statistics | 7.15*** | 7.50*** | 9.45*** | 10.95*** | 11.67*** | 12.10*** | 3.82*** | 5.08*** |
| Prob > F | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Adj. $R^2$ | 0.1983 | 0.1994 | 0.2446 | 0.5022 | 0.5108 | 0.5205 | 0.1586 | 0.2827 |
| $N$ | 540 | 540 | 540 | 285 | 285 | 285 | 325 | 215 |

We use the OLS model.

T-statistics in parentheses are robust.

* Statistical significance at the 10% level for two-tailed tests.

** Statistical significance at the 5% level for two-tailed tests.

*** Statistical significance at the 1% level for two-tailed tests.

are domestic. The other group consists of ChiNext companies that have overseas revenues. The results are displayed in Models (3) and (4). △Overseas_Sales and △Domes_Sales are significantly positively related to △RD_intensity in Model (4). The regression coefficients are 0.023 and 0.013, respectively, which are significant at the 1% and 5% levels, respectively. Thus, an internationalization strategy has a significant incentive effect on R&D input for internationalized ChiNext companies. Overseas income, which measures a company's degree of internationalization, contributes more to changes in R&D investments than domestic income ($0.023 > 0.013$).

△Export_Rate is significantly positively related to △RD_intensity in Model (5). The regression coefficient is 0.001, which is significant at the 10% level. This indicates that a higher △Export_Rate, which measures the degree of internationalization, strengthens RD_intensity. The empirical evidence reported in Table 8 thus supports Hypothesis 1. An internationalization strategy has an incentive effect on R&D. In addition, the control variables in the model are consistent with the previous regression results.

Based on previous studies (Lileeva and Trefler, 2010; Bustos, 2011; Bratti and Felice, 2012), we use TSLS to test the effects of internationalization on independent innovation while considering the endogeneity of internationalization. The corresponding results are shown in Table 9.

As shown in Table 9, an internationalization strategy still has an incentive effect on R&D input after controlling for endogeneity. Companies with higher degrees of internationalization have higher R&D inputs. The empirical evidence reported in Table 9 provides additional support for Hypothesis 1.

To completely investigate the influence of an internationalization strategy on entrepreneurial companies' independent innovation, an empirical analysis of the influences of internationalization on the efficiency of patent output is displayed in the remaining part. In light of the related literature (Pakes and Griliches, 1980; Hausman et al., 1984), we adopt the Poisson model to explore the relationship between internationalization, R&D input and patent output. The results are shown in Table 10.

According to Models (1) to (5) in Table 10, when other variables such as $RD\_intensity_{t-1}$ and $RD\_intensity_{t-2}$ are controlled, RD_intensity, Patents_past_total and △Patents are significantly positively related. The corresponding regression coefficients are significant at the 1% level. This shows that companies with higher R&D inputs and more knowledge stock have more patent outputs.

In Models (1), (3), (4) and (5), the proxy variables of internationalization strategy, such as Overseas_Sales, Export_Rate and Overseas_Agency, are significantly positively related to △Patents. The corresponding regression coefficients are 0.280, 3.561, 0.288 and 0.722, respectively, which are all significant at the 1% level. Thus, internationalization can significantly increase entrepreneurial companies' patent outputs. Moreover, Overseas_Sales has greater effects on patent output than Domes_Sales in Model (3) ($3.561 > 0.331$). Therefore, an internationalization strategy can improve the efficiency of patent output. The empirical evidence reported in Table 10 thus supports Hypothesis 2.

In Table 11, the ordinary least squares (OLS) model is adopted to replace the Poisson model for further robustness testing. Models (1), (3), (4) and (5) show that when other variables such as $RD\_intensity_{t-1}$ and $RD\_intensity_{t-2}$ are controlled, proxy variables of internationalization strategy such as Overseas_Sales, Export_Rate and Overseas_Agency are significantly positively related to △Patents. The corresponding regression coefficients are 0.234, 0.702, 0.437 and 0.679, respectively, which are significant. This shows that internationalization can significantly increase the number of entrepreneurial companies' patent outputs. In Model (3), Overseas_Sales has a greater effect on patent output ($0.702 > 0.029$) than Domes_Sales. This result is essentially the same as that in Table 10, further demonstrating that our results are robust. The internationalization strategies of companies have obvious efficiency improvement effects on patent output. The higher the degree of internationalization, the higher companies' patent outputs. This further supports Hypothesis 2.

To make the results more robust, the differences between export and non-export companies in R&D inputs and patent outputs are compared. The results are shown in Table 12.

Table 12 shows that export companies have higher R&D intensities and more patent outputs than non-export companies regardless of the mean and median. An internationalization strategy has an incentive effect on R&D and R&D output. Thus, Hypotheses 1 and 2 are supported.

## 5. Influence of internationalization on strategic emerging industries: An expanding analysis

*Decision of the State Council on Accelerating the Fostering and Development of Strategic Emerging Industries* (2010, No. 32), promulgated by the State Council in October 2010, determines the focus on the development of energy saving, new generation of IT and seven other strategic emerging industries, requiring the relevant departments to promptly formulate plans and implement specific supporting measures. Moreover, *Guiding Opinions on Promoting the Internationalization of Strategic Emerging Industries* (2011, No. 310), jointly promulgated by the Ministry of Commerce, the National Development and Reform Committee and nine other ministries and commissions in September 2011, explicitly state that global innovation resources are to be used to enhance the ability of industrial innovation. To this end, the ChiNext market attaches more importance to the development of strategic emerging industries. We believe that the ChiNext market is perfect for researching the impacts of internationalization strategy on R&D in strategic emerging industries, as a large sum of high-quality companies in strategic emerging industries are listed in the ChiNext market.

Conforming with the *Strategic Emerging Industry Classification (2012) (Trial)* compiled by the National Statistics Bureau in December 2012, the samples are subdivided into strategic emerging industries to further explore the effects of internationalization strategy on R&D in strategic emerging industries.

More specifically, in correspondence with the main business and prime products disclosed in the prospectuses, 540 observations defined in strategic emerging industries include 27 observations in the energy saving and environmental protection industry, 158 observations in the new generation of IT industry, 89 observations in the pharmaceutical industry, 136 observations in the high-end equipment manufacturing industry, 48 observations in the new energy industry, 68 observations in the new materials industry and 14 observations in the new energy vehicles industry. Table 13 reports the results.

In Table 13, a comparison of Models (1) and (2) shows a significant positive relationship between Overseas_Sales and RD_intensity in strategic emerging industries. The regression coefficient is 0.023, which is significant at the 1% level. However, in non-strategic industries, there is no significant relationship between overseas sales and R&D input. This shows that the internationalization strategies in strategic emerging industries positively promote R&D. Companies with higher degrees of internationalization have higher R&D inputs.

A comparison of Models (3) and (4) shows that Export_Rate, which measures internationalization, is significantly positively related to RD_intensity. The regression coefficient is 0.004, which is significant at the 5% level. However, no significant relation is found between overseas sales and R&D input in non-strategic industries. This shows that the internationalization strategies in strategic emerging industries have incentive effects on R&D. Companies with higher proportions of overseas sales have higher R&D inputs.

In Models (5) and (6), Overseas_Agency has significant positive impacts on RD_intensity in either strategic or non-strategic industries. The regression coefficients are 0.005 and 0.013, respectively, which are significant at the 1% level. Thus, the establishment of overseas institutions positively promotes R&D for companies in both strategic and non-strategic industries. In addition, a comparison of Models (7) and (8) shows that the different natures of strategic emerging industries cause overseas sales to have different influences on RD_intensity from those of other internationalization companies. In strategic emerging industries, both the regression coefficients and significance levels are higher than those of non-strategic companies (coefficient $0.017 > 0.011$, $T$ value $2.57 > 1.3$). This further shows that an internationalization strategy has more pronounced incentive effects on R&D inputs in strategic emerging industries. An internationalization strategy has a more positive role in promoting the R&D of companies in strategic emerging industries.

To enhance the robustness of the results, as shown in Table 8, the Change model is used to further examine the impacts of internationalization on R&D in strategic emerging industries. The results are shown in Table 14.

A comparison of Models (1) and (2) in Table 14 shows that △Overseas_Sales and △Domes_Sales are significantly positively related to △RD_intensity. The regression coefficients are 0.030 and 0.022, respectively, which are significant at the 1% level. In non-strategic industries, changes in overseas and domestic sales have no significant impacts on changes in R&D inputs. This shows that the internationalization strategy mainly exerts positive impacts on R&D in companies in strategic emerging industries. More changes in overseas and domestic sales cause greater changes in R&D input. In addition, compared with domestic revenues,

changes in overseas revenues, which measure companies' internationalization, cause greater changes in R&D inputs (0.030 > 0.022). This further proves that in strategic emerging industries an internationalization strategy has an incentive effect on R&D input, and that changes in the degree of internationalization lead to changes in R&D input in the same direction.

In Models (3) and (4), the △Export_Rate of strategic industrial companies is positively related to the change in R&D input. The regression coefficient is 0.005, which is significant at the 5% level. In non-strategic industrial companies, changes in the proportion of overseas sales have no significant impacts on R&D input. This shows that in strategic industrial companies, greater changes in the proportion of overseas sales, which measure the degree of internationalization, cause greater changes in R&D input. Therefore, implementing internationalization strategies in strategic industrial companies have an incentive effect on R&D.

Compared with Models (5) and (6), changes in overseas sales have significant effects on strategic industrial companies' R&D. The regression coefficient of △Overseas_Sales is 0.022, which is significant at the 5% level. No significant impact is found in non-strategic industries. In addition, comparing Models (5) and (7) shows that an internationalization strategy has a more significant influence on R&D input in strategic emerging industries than in non-strategic emerging industries.

To comprehensively study the impact of an internationalization strategy on the independent innovation of strategic emerging industries, we further examine the impact of internationalization on patent output in strategic emerging industries. The results are shown in Tables 15 and 16.

Models (1) to (6) in Table 15 show that after controlling other variables such as $RD\_intensity_{t-1}$ and $RD\_intensity_{t-2}$, proxy variables of internationalization strategy such as Overseas_Sales, Export_rate and Overseas_Agency are significantly positively related to △Patents in both strategic emerging and non-strategic industries. The regression coefficients are 0.756, 0.182, 0.506 and 0.212, 0.521 and 1.062, respectively. This proves that internationalization can significantly improve entrepreneurial companies' patent outputs in both strategic and non-strategic emerging industries.

Comparing Models (1) and (4) shows that in strategic emerging industries, Overseas_Sales has a greater impact on patent output than domestic sales (0.756 > 0.260). In non-strategic industrial companies, Dome_Sales has a greater impact than Overseas_Sales on patent output (0.571 > 0.212). The results of Model (7) show that in strategic industrial companies, Overseas_Sales has a greater impact than Domes_Sales on patent output (1.037 > 0.101). The results illustrate that in strategic emerging industries, companies with higher degrees of internationalization have higher patent outputs. Thus, an internationalization strategy can enhance companies' patent outputs in strategic emerging industries.

In Table 16, the OLS model substitutes the Poisson model for further robustness testing. The regression results are substantially the same as those in Table 15, which further demonstrates that our results are robust. In summary, an internationalization strategy has more pronounced effects on the independent innovation input and efficiency of strategic emerging industries.

## 6. Conclusions and implications

Guided by the "going-out" strategy, Chinese enterprises have accelerated their pace of internationalization in recent years. We study how an internationalization strategy affects the independent innovation of Chinese entrepreneurial companies from two dimensions: R&D input and patent output. The main findings are outlined as follows.

First, a large number of ChiNext companies have implemented internationalization strategies and have actively expanded into overseas markets to earn foreign revenues.

Second, an internationalization strategy has a significant incentive effect on R&D input. Companies with higher degrees of internationalization have higher R&D inputs. After controlling for endogeneity, the incentive effect still exists.

Third, an internationalization strategy has significantly improved the efficiency of patent outputs. Companies with higher degrees of internationalization have higher patent output efficiencies.

Fourth, an internationalization strategy has more pronounced effects on independent innovation in strategic emerging industries.

Improving independent innovation capability and building a long-term competitive advantage are not only vital to the survival and development of China's companies, but also important to China's long-term economic development. An internationalization strategy is conducive to enhancing Chinese companies' independent innovation, regardless of R&D input or patent output. Therefore, Chinese entrepreneurial companies should clearly understand that an internationalization strategy is an important way to enhance independent innovation capacity. They must adhere to the going-out strategy, actively expand overseas markets, integrate global resources through various approaches such as exports and overseas investment and establish foreign institutions to enhance their independent innovation capacities. However, aside from encouraging and guiding companies to open up to the world, the government should vigorously promote the internationalization of strategic emerging industries to achieve industrial transformation and improvement.

From the two dimensions of R&D input and patent output, we provide empirical evidence that Chinese entrepreneurial companies' internationalization strategies influence their independent innovation. This study has two limitations. First, the ChiNext companies' sales data are not reported clearly or completely with respect to detail or regional division, making it difficult to confirm overseas sales in certain regions. Thus, we fail to study the influences of internationalization on innovation under the distribution of export regions. Second, the sample period used covers 2009 to 2012. Future studies should choose longer sample periods.

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# Stock index adjustments, analyst coverage and institutional holdings: Evidence from China

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ABSTRACT

Using 231 pairs of matched firms from 2009 to 2012 in Chinese stock market, we find that the stock index adjustment significantly affects the analyst coverage, which in addition to the stock index leads to more analyst coverage, while deletion from the stock index has no significant effect, indicating that stock index adjustment can significantly change the information environments of firms that are added to the index. An index adjustment also affects institutional holdings in consideration of new information (e.g., changes in fundamentals and information environments). Changes in institutional holdings are partially due to changes in analyst coverage, and both index funds and other types can change their portfolios in response to changes in the target firms' informativeness.



## 1. Introduction

The "S&P game" is another name for the arbitrage that occurs in response to the addition of stocks in the S&P 500 index (Lee et al., 2008), which is conducted by both index fund managers and other traders. Usually, significantly positive (negative) abnormal returns around the index addition (deletion) are found (Harris and Gurel, 1986). A large increase occurs in correlating the trading volume of stocks added to the index with the volume of those that remained in the index, and the opposite is true as a result of the deletions (Greenwood and Sosner, 2007). Due to the arbitrage surrounding the times of index changes, investors in funds linked to the S&P 500 Index and the Russell 2000 Index lose between $1 and 2.1 billion a year for the two indices combined, and the losses can be greater if benchmarked assets are considered; the pre-reconstitution period

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is lengthened or involuntary deletions are taken into account (Chen et al., 2006). However, recent research finds that a buy–hold index portfolio outperformed the annually rebalanced index in the 1979–2004 period. Although the short-term momentum and poor long-term returns of new issues partially explain these returns, index deletions were found to provide significantly higher factor-adjusted returns than index additions (Cai and Houge, 2008). This suggests that changing holdings around index adjustment may not be a wise decision.

Although changes in institutional index fund holdings are responsible for the observed abnormal returns in response to S&P 500 changes (Shleifer, 1986; Harris and Gurel, 1986), there has been scant supporting empirical evidence (Pruitt and Wei, 1989; Chen et al., 2004; Green and Jame, 2011). Do changes in institutional holding only result from the portfolio management of index funds? Addition and deletion announcements also contain valuable and relevant new information that may further affect the portfolio management for both index funds and other institutional investors. Moreover, Beneish and Whaley (1996) and Shleifer (1986) suggest that analysts may also alter their attitudes regarding firms that are added to or deleted from the stock index, which is not supported by evidence. Do stock index adjustments also affect analysts' coverage and stock recommendations, further influencing changes in institutional holdings and ultimately leading to a more volatile market reaction to index adjustment? There are no clear answers, as little work has been done in this area.

We use 231 pairs of matched Chinese firms in the same industry, during the same year and the same quarter with similar assets over the 2009–2012 period, and find that stock index adjustments significantly affect analyst coverage, which in addition to the stock index, leads to more analyst coverage (proxied by the number of analysts and stock recommendations). In contrast, deletion from the stock index has no significant effect, indicating that stock index adjustments can significantly change the information environments of firms added to the index, as Beneish and Whaley (1996) and Shleifer (1986) suggest. Index adjustments also affect institutional holdings, as Pruitt and Wei (1989) note, even in cases of new information, such as changes in fundamentals and information environments. Moreover, changes in institutional holdings can be partially due to changes in analyst coverage, such that index and other funds change their portfolios in response to changes in the informativeness of the target firms.

Our paper contributes to the literature in the following ways. First, we provide more rigorous evidence for the effects of stock index adjustments on institutional holdings in relation to the validity of the related hypotheses. We use matched samples and a multi-regression to investigate the information content of stock index changes, such as changes in firms' profitability, growth potential or the information available for decisions—any of which may coincide with stock index adjustments and lead to changes in institutional holdings. Second, we examine the influence of index adjustments on firms' information environments and show how the former affects the latter's analyst coverage and stock recommendations, which then influence their market performance and investor holdings. Our finding provides some evidence for the information content hypothesis concerning stock index adjustment. Third, our work provides further evidence of the stock index adjustments, analyst coverage and institutional holdings in the Asian Pacific and other emerging markets. Finally, the conclusions of this paper will be useful for studies on the future of stock indices in China. In 2015, China's stock market experienced a dramatic uprush and collapse, and the stock index future is now heavily criticized by many scholars and investors. Our work on the logic and patterns of institutional investors' reactions to stock index adjustments can provide some evidence and useful clues about the regulation of stock indices in China's future.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature and Section 3 presents the stock index adjustments in China. Section 4 describes the research design and the empirical analysis is shown in Section 5. The final section concludes our paper and discusses future research.

## 2. Literature review

There are many studies on the market created in reaction to stock index adjustments, and several hypotheses are proposed. The downward-sloping demand curve hypothesis suggests that the demand of index fund managers reduces the stock's supply for non-indexing investors, permanently increasing the market clearing price (Shleifer, 1986; Chakrabarti et al., 2005). The liquidity hypothesis suggests that the addition or deletion of a stock from the index alters the stock's liquidity, which affects its price (Shleifer, 1986; Beneish and Whaley, 1996). Price pressure is attributable to index trading, because index fund managers must add or delete the stock from their portfolios to avoid unfavorable tracking errors by which they may be evaluated. Reflect-

ing a supply and demand imbalance, securities prices adjust to new levels in response to this buying and selling pressure exerted by the index-fund managers (Harris and Gurel, 1986; Elliott et al., 2006; Platikanova, 2008). The information content hypothesis proposes that addition and deletion announcements contain valuable and relevant information. Inclusion (exclusion) signals a real or perceived increase (decrease) in management quality, and the S&P's inclusion of a stock in an index may act as a certification of quality, leading to a price and possible volume increase due to trading by index managers (Beneish and Whaley, 1996; Denis et al., 2003; Cai, 2007; Gygax and Otchere, 2010). The investor awareness hypothesis suggests that investors cannot invest in a security of which they are unaware, and firms have a shadow cost for being unknown that decreases as the firms become better recognized. A stock's addition to an index alerts investors of its existence, increasing the number of analysts following it, its information dissemination and its liquidity and breadth of ownership. These factors lead to a reduction in the firms' shadow costs and the investors' required rate of return, which results in an increase in the firms' stock price and expected stock returns (Chen et al., 2004; Elliott et al., 2006).

All of these hypotheses imply changes in investor trading, particularly that of institutional investors such as index funds. Shleifer (1986) and Harris and Gurel (1986) suggest that changes in institutional index fund holdings are responsible for the observed abnormal returns in response to S&P 500 changes, but they do not provide evidence. Pruitt and Wei (1989), Chen et al. (2004) and Green and Jame (2011) examine the actual changes in institutional holdings following both additions to and deletions from the S&P 500. They reveal that changes in institutional holdings in response to additions or deletions from the S&P 500 are positively correlated. However, they do not consider the informational content of the stock index change, such as changes in firms' profitability and growth potential, or the information available for decisions—all of which may coincide with stock index adjustments and ultimately lead to changes in institutional holdings. A stock's addition to an index alerts investors of its existence, increasing the number of analysts following it and its information dissemination. Financial analysts are outsiders who generally have less access to firm-level, idiosyncratic information. As such, they can focus their efforts on obtaining and mapping industry- and market-level information into prices. Unlike institutions and insiders, analysts convey their private information through firm-specific earnings forecasts and stock recommendations (Piotroski and Roulstone, 2004). Mikhail et al. (2007) find that both large and small traders react to analyst reports (analysts' recommendations). However, few studies have been conducted examining index adjustments' effects on firms' information environments, which further affect their market performance and investor holdings.

## 3. Stock index and index adjustment in China

Unlike the U.S., Japan and other major security markets where most of the listed firms in a single country are traded in one stock exchange, in mainland China there are two stock exchanges—Shanghai Stock Exchange and Shenzhen Stock Exchange—that manage the trading of publicly listed firms in mainland China. Up to 31 December 2012, there have been 975 firms listed in the Shanghai Stock Exchange, with 921 (54) in the A-share (B-share) market. There have been 1537 firms listed in the A-share market in the Shenzhen Stock Exchange, including 481 firms on the Main Board, 701 on the Small and Medium Enterprise Market Board and 355 on the Growth Enterprises Market Board. Another distinguishing factor is that unlike the S&P 500 or Russell 2000 in the U.S., the Nikkei 225 in Japan and the Hang Seng Index in Hong Kong, there are two major stock indices for the Shanghai and Shenzhen Stock Exchanges in mainland China: namely, the Shanghai Composite Index (Code: 000001) (SHCI as the acronyms hereafter) and the Compositional Index of Shenzhen Stock Market (Code: 399001) (SZCI as the acronyms hereafter), respectively.

The SHCI is the most important stock index in China in terms of presenting changes in market volatility. It started on 15 July 1991, based on 100 points, and is disclosed to global investors via Thomson Reuters, Bloomberg and other channels. The SHCI is based on all of the listed firms in the Shanghai Stock Exchange, computed as the market value of sample firms and multiplied by its weight, which is the number of stocks issued by sample firms.[1] If a firm launches an IPO, it will be included in the index on the 11th day of its trading

[1] Given that the index also contains the B-shares, which are priced in terms of U.S. dollars, the market value is exchanged based on the appropriate exchange rate, usually the middle rate of RMB yuan against the U.S. dollar on the last trading day of each week by China Foreign Exchange Trade Center.

on the market. If a firm delists, it will be excluded from the index on the exclusion day. It is often common knowledge on the market several months in advance that a firm is going IPO, so there are already many analysts covering the IPO firms. For the delisted firms, listed firms in China delist if they suffer losses for three continuous years. Before the financial report is provided for the last year when the firm may delist, the market might already know something, but may be unsure whether the firm will delist. Thus, there are a few days for the market, institutional investors, analysts and other investors to discover whether a particular stock is being added to or deleted from the Shanghai Composite Index.

The SZCI is based on 40 typical listed firms and started on 23 January 1995 with a base of 1000 points. The SZCI is computed as the market value of sample firms multiplied by its weight, which is the circular number of stocks issued by sample firms, not the total number of stocks. To maintain objectivity and fairness, the SZCI is adjusted considering the norm of the component stocks. On each January, May and September, the SZCI may be adjusted. First, the Shenzhen Stock Exchange looks at all of the listed firms and filters out those that meet the following requirements: a listed time of more than 3 months, a market value based on circular stocks to the total market value of all firms that is in the top 90% and a trading-to-total-market value of all firms in the top 90%. Given the circular market and trading values, representative of the industry and growth, financial position and operating performance for the past three years and compliance with regulations in the past two years, the Shenzhen Stock Exchange weights each factor and then chooses up to 40 firms as being representative of the Shenzhen Stock Exchange. Thus, it has a small window during which the market, institutional investors, analysts and other investors can determine whether particular stocks will be added to or deleted from the SZCI.

There is another important stock index, the Hushen 300 index (Code: 000300) (SH300 as the acronyms hereafter), that contains 300 listed firms in either the Shanghai Stock Exchange or the Shenzhen Stock Exchange. It covers firms with 70% market value to the total value of all listed firms in both exchanges. This index is a single-stock index that represents the market, and it is recognized by both the Shanghai Stock Exchange and the Shenzhen Stock Exchange. The HS300 started on 31 December 2004 with a base of 1000 points, and is based on sample firms with daily trading volumes in the top 50% of all listed firms in China. Those with daily market values in the top 300 of the total samples are selected, and the weight of each sample stock is well balanced, with the industry distribution covering most industries. The HS300 is adjusted biannually, with enforcement in early January and July and two weeks of advanced disclosure of the adjustment list. Each time the HS300 is adjusted, the adjustment ratio (stocks adjusted to total number) is lower than 10%. Moreover, firms that have suffered a loss during the most recent year are not added to the HS300 unless they significantly affect the representativeness of the index. The only index future in China's security market is the HS300 future, which is based on the HS300. Thus, the HS300 is more influential than the SHCI and the SZCI, especially for institutional investors.

## 4. Research design

### *4.1. Data and samples*

The SHCI is based on all listed firms, such that additions to the index provide no additional information. Thus, we collect all of the stock index adjustments for the HS300 since they began to the end of 2012 from the WIND database. Analyst coverage (number of analysts and stock recommendations) is available from the third quarter of 2009 to the first quarter of 2013, and the holdings of institutional investors are available from the third quarter of 2004 to the first quarter of 2013 in the WIND database.[2] Given that we need to calculate the changes in variables, our sample firms are from the fourth quarter of 2009 to the fourth quarter of 2012. To make the study more rigorous, we use matched samples. The matching is based on the same industry, the same year, the same quarter and similar size. After dropping the financial industry, our final sample is 462: 231 stock index adjustment firms and 231 matched firms from 2009 to 2012, including 112 firms added to the HS300 with 112 matched firms and 119 firms dropped from the HS300 with 119 matched firms.

[2] As analyst coverage, institutional holdings and other financial information are disclosed on a quarterly basis, we collect our data based on quarterly financial statements.

### 4.2. Model and variables

We suggest that the stock index adjustment not only affects the portfolio management for index funds, but also affects other institutional investors by influencing their information environments, namely the analyst coverage, which affects institutional decision making.

To examine whether stock index adjustments affect information environments, namely, analyst coverage, our model is based on O'Brien and Nhushan (1990) with additional controlling factors:

$$\Delta NumAnalyst = \alpha_0 + \alpha_1 Indexing + \alpha_2 \Delta NumInst + \alpha_3 \Delta ROE + \alpha_4 \Delta GROW + \alpha_5 \Delta LEV + \alpha_6 \Delta SIZE + \alpha_7 Ret + \alpha_8 Quarter + \sum \alpha_i Inds_i + \sum \alpha_j Years_j + \varepsilon \quad (1)$$

Our analyst coverage measure includes two variables. NumAnalyst is the number of analysts in a particular firm, and NumRating is the total number of stock recommendations (Buy, Upgrade, Hold, Downgrade and Sell) issued by analysts in a particular firm. As we want to compare the analyst coverage before and after stock index adjustment, we use the changes in the two variables. ΔNumAnalyst is the change in the number of analysts in the next quarter compared to the event quarter when the target firm is added to or dropped from the stock market index. ΔNumRating is the change in the number of total stock recommendations in the next quarter compared to the event quarter. As a robustness test, we also use the change in the number of "Buy" (ΔNumBuy), positive (Buy and Upgrade) (ΔNumPositive) and negative (Sell and Downgrade) (ΔNumNegative) recommendations. For matched firms, all of the variables listed above represent changes in the same quarter as for target firms.

Indexing refers to the stock index adjustment, with 1 indicating that the target firm is added to the stock market index, −1 indicating that it is dropped and 0 being matched firms.

NumInst is the number of institutional investors in the target firm in the event quarter, and ΔNumInst is the change in the number of institutional investors in the target firm in the event quarter compared to the previous quarter (Pruitt and Wei, 1989). For the matched firms, all of the above variables are the changes in the same quarters as the target firms.

ΔROE is the change in return on equity (ROE) in the event quarter compared to the previous quarter. ΔGROW is the change in revenue growth in the event quarter compared to the previous quarter. ΔLEV is the change in leverage (total debt ratio) in the event quarter compared to the previous quarter. ΔSIZE is the change in scale (nature log form of total assets) in the event quarter compared to the previous quarter and Ret is the raw market return during the event quarter. For matched firms, all of the above variables measure the change in the same quarter as the target firms.

Inds are the industry dummy variables, namely 11 dummy variables for 12 industry categories used by the China Securities Regulatory Commission (CSRC) after dropping the financial industry. Years are the year dummy variables, namely 3 dummy variables for 4 years. Quarter is a dummy variable where 1 indicates the quarter 1, and 0 otherwise because the Hushen 300 only adjusts twice a year in January and July.

To investigate the influence of analyst coverage on the effects that stock index adjustments have on institutional holdings, we use the Baron and David (1986) method, which is popular in the management literature. Our models are set as follows:

$$\Delta Insthold = \beta_0 + \beta_1 Indexing + \beta_2 \Delta ROE + \beta_3 \Delta GROW + \beta_4 \Delta LEV + \beta_5 \Delta SIZE + \beta_6 Quarter + \sum \beta_i Inds_i + \sum \beta_j Years_j + \varepsilon \quad (2)$$

$$\Delta Insthold = \gamma_0 + \gamma_1 Indexing + \gamma_2 \Delta NumAnalyst + \gamma_3 \Delta ROE + \gamma_4 \Delta GROW + \gamma_5 \Delta LEV + \gamma_6 \Delta SIZE + \gamma_7 Quarter + \sum \gamma_i Inds_i + \sum \gamma_j Years_j + \varepsilon \quad (3)$$

Insthold is the institutional investor holding (in the percentage of the invested firm's total stock) in the event quarter, and ΔInsthold is the change in institutional holding during the subsequent quarter of the event quarter in which the target firm is added to or dropped from the stock market index, compared to the event quarter (Green and Jame, 2011). For matched firms, all of the above variables are the change in the same quarter as the target firms.

Indexing, ΔNumAnalyst, ΔROE, ΔGROW, ΔLEV, ΔSIZE, Inds and Years are the same as above.

According to Baron and David (1986), if $\alpha_1 > 0$, $\beta_1 > 0$, $\gamma_1 > 0$, $\gamma_2 > 0$ and $\gamma_1 < \beta_1$, then the analyst coverage plays a partial mediation role in the influence that stock index adjustments have on institutional holdings. If $\gamma_1 > 0$ is not significant while $\alpha_1 > 0$, $\beta_1 > 0$ and $\gamma_2 > 0$ are significant, then the analyst coverage has a whole mediation effect, suggesting that the stock index adjustment affects the institutional holding total via the analyst coverage. Otherwise, the analyst coverage has no mediation effect.

## 5. Empirical analysis

### 5.1. Descriptive statistics

Table 1 shows the mean comparisons for the interested variables among different groups. Panel A shows the comparisons between firms added to the stock index and matched firms. The change in institutional holdings

Table 1
Mean comparisons.

| | Match_Add (112) | Add (112) | Difference | *t* |
|---|---|---|---|---|
| *Panel A Comparisons between Add and Match* | | | | |
| ΔInsthold | 2.930 | 6.002 | −3.072 | −2.71*** |
| ΔNuminst | −33.036 | −44.776 | 11.741 | 2.93*** |
| ΔNumAnalyst | −1.152 | −0.303 | −0.848 | −1.88* |
| ΔNumRating | −1.116 | −0.169 | −0.946 | −2.37** |
| ΔNumBuy | −0.321 | −0.071 | −0.250 | −0.90 |
| ΔNumPositive | −0.830 | −0.063 | −0.767 | −1.92* |
| ΔNumNegative | 0 | 0.009 | −0.009 | −0.22 |
| ΔROE | −5.221 | −5.562 | 0.3401 | 0.28 |
| ΔGROW | 2.720 | −12.051 | 14.772 | 2.48** |
| ΔLEV | 0.611 | 0.385 | 0.226 | 0.51 |
| ΔSIZE | 0.042 | 0.043 | −0.001 | −0.10 |
| Ret | −0.443 | −2.616 | 2.173 | 0.97 |
| | Drop (119) | Match_Drop (119) | Difference | *t* |
| *Panel B Comparisons between Drop and Match* | | | | |
| ΔIsthold | 1.845 | 3.639 | −1.794 | −2.62** |
| ΔNuminst | −24.260 | −32.554 | 8.294 | 2.79*** |
| ΔNumAnalyst | −0.504 | −0.655 | 0.151 | 0.41 |
| ΔNumRating | −0.369 | −0.873 | 0.504 | 1.46 |
| ΔNumBuy | 0.075 | −0.428 | 0.504 | 2.48** |
| ΔNumPositive | −0.092 | −0.798 | 0.705 | 2.08** |
| ΔNumNegative | 0.008 | −0.008 | 0.016 | 0.53 |
| ΔROE | −2.430 | −3.334 | 0.904 | 0.75 |
| ΔGROW | 3.388 | −11.284 | 14.673 | 2.06** |
| ΔLEV | 0.549 | 0.094 | 0.455 | 0.77 |
| ΔSIZE | 0.035 | 0.065 | −0.029 | −0.82 |
| Ret | 2.925 | 2.460 | 0.464 | 0.20 |

ΔInsthold is the change in institutional investors' holding during the next quarter compared to the event quarter when the target firm is added to or dropped from the stock market index. Add indicates that the target firm is added to the market index, Drop means it is deleted from the market index, and Match refers to the matched firms. ΔNumInst is the change in the number of institutional investors on the target firm in the event quarter compared to the previous quarter. ΔNumAnalyst is the change in the number of analysts in a particular firm in the next quarter to the event quarter. ΔNumRating is the change in the number of total stock recommendations in a particular firm in the next quarter compared to the event quarter. ΔNumBuy is the change in the number of "Buy" recommendations in a particular firm in the next quarter compared to the event quarter. ΔNumPositive is the change in the number of "Buy" and "Increase" recommendations in a particular firm in the next quarter compared to the event quarter. ΔNumNegative is the change in the number of "Sell" and "Decrease" recommendations in a particular firm in the next quarter compared to the event quarter. ΔROE is the change in ROE in the event quarter compared to the previous quarter. ΔGROW is the change in revenue growth in the event quarter compared to the previous quarter. ΔLEV is the change in leverage (total debt ratio) in the event quarter compared to the previous quarter. ΔSIZE is the change in scale (nature log form of total assets) in the event quarter compared to the previous quarter. Ret is the raw market return during the event quarter. For matched firms, all of the above variables are the change in the same quarter as the target firms.

for firms added to the stock index in the next quarter, compared to the event quarter, is 2.930%, indicating that institutional investors increase their holdings in those firms by 6.002%. Meanwhile, the change in institutional holdings for matched firms is 2.930%, and the difference is significant at the 0.01 level, indicating that firms added to the index attract more institutional holdings. However, the change in the number of institutional investors shows the opposite direction, in that the number of institutional investors decreases more for firms added to the index than those for matched firms. This may be because more shares are concentrated for fewer institutional investors.

Both of the changes in the analyst coverage variables, ΔNumAnalyst and ΔNumRating, show the same situation in which more analysts cover firms added to the stock index, and more stock recommendations are given to those firms compared to the matched firms. This indicates that firms added to the index are more likely to be covered by analysts. Further dividing stock recommendations, we find that the changes in the number of positive recommendations—namely "Buy" and "Update"—are higher for added firms than those for matched firms, whereas only the "Buy" recommendation does not significantly differ from that of matched firms. The changes in the number of negative recommendations—namely "Sell" and "Downgrade"—also do not significantly differ from those two groups. The fundamental aspects of the two groups do not differ from each other significantly except for the change in growth.

Panel B shows the comparison between firms dropped from the stock index and matched firms. The change in institutional holdings for firms dropped from the stock index in the next quarter compared to the event

Table 2
Stock index adjustment and analyst coverage.

| Variable | Expsign | All | Add&Match_Add | Drop&Match_Drop | Add&Drop |
|---|---|---|---|---|---|
| Indexing | + | 0.425** | 1.057** | 0.044 | 0.276 |
| | | (2.03) | (2.50) | (0.12) | (1.20) |
| ΔNumInst | ? | 0.013** | 0.008 | 0.016 | 0.006 |
| | | (2.26) | (1.15) | (1.52) | (0.65) |
| ΔROE | + | 0.036* | 0.006 | 0.045 | 0.046 |
| | | (1.67) | (0.20) | (1.33) | (1.42) |
| ΔGROW | + | 0.001 | 0.000 | 0.003 | 0.001 |
| | | (0.44) | (0.08) | (0.70) | (0.13) |
| ΔLEV | ? | 0.015 | 0.103 | −0.001 | −0.024 |
| | | (0.27) | (1.46) | (−0.02) | (−0.21) |
| ΔSIZE | ? | 0.102 | −8.873*** | 0.910 | 0.570 |
| | | (0.11) | (−2.65) | (0.90) | (0.10) |
| Ret | ? | 0.028*** | 0.035*** | 0.019 | 0.024** |
| | | (3.08) | (3.03) | (1.43) | (2.01) |
| Quarter | | Control | Control | Control | Control |
| Inds | | Control | Control | Control | Control |
| Years | | Control | Control | Control | Control |
| N | | 462 | 224 | 238 | 231 |
| R-sq | | 0.169 | 0.271 | 0.166 | 0.255 |

ΔNumAnalyst, the dependent variable, is the change in the number of analysts in a particular firm in the next quarter compared to the event quarter when the target firm is added to or dropped from the stock market index. All means all of the sample firms, Add indicates that the target firm is added to the market index, Drop means it is deleted from the market index, and Match refers to the matched firms. Indexing is the adjustment of the stock market index, where 1 indicates that the target firm is added to the stock market index, −1 indicates that it is dropped from the market index, and 0 represents the matched firms. ΔNumInst is the change in the number of institutional investors in the target firm during the event quarter compared to the previous quarter. ΔROE is the change in ROE in the event quarter compared to the previous quarter. ΔGROW is the change in revenue growth in the event quarter compared to the previous quarter. ΔLEV is the change in leverage (total debt ratio) in the event quarter compared to the previous quarter. ΔSIZE is the change in scale (nature log form of total assets) in the event quarter compared to the previous quarter. Ret is the raw market return during the event quarter. For matched firms, all of the above variables refer to the change in the same quarter as the target firms. Inds are the industry dummy variables, namely 11 dummy variables for 12 industry categories used by the China Securities Regulatory Commission (CSRC) after dropping the financial industry. Years are the year dummy variables; namely 3 dummy variables for 4 years. In parentheses are the White-t statistics considering heteroscedasticity.

*** Indicate significance at the 0.01 levels.

** Indicate significance at the 0.05 levels.

* Indicate significance at the 0.10 levels.

quarter is 1.845% while the change in institutional holdings for matched firms is 3.639%. The difference is significant at the 0.05 level, indicating that firms dropped from the index attract more institutional holdings. However, the change in the number of institutional investors shows the opposite direction. The analyst coverage (number of analysts and stock recommendations) does not significantly differ between firms dropped from the stock index and matched firms. Only the "Buy" recommendation and positive recommendation ("Buy" and "Update") are higher for matched firms than for those dropped from the stock index.

### 5.2. Stock index adjustment and analyst coverage

Table 2 shows the effects of stock index adjustments on analyst coverage, particularly the number of analysts covered. The first column shows the results for all of the sample firms (firms added to and dropped from the index, and matched firms). The coefficient for indexing, namely, the proxy for stock index adjustment, is

Table 3
Stock index adjustment and analyst's stock recommendation.

| Variable | ΔNumRating | | | ΔNumBuy | ΔNumPositive | ΔNumNegative |
|---|---|---|---|---|---|---|
| | All | Add&Match_Add | Drop&Match_Drop | | | |
| Indexing | 0.398** | 1.106*** | −0.256 | 0.062 | 0.376** | 0.014 |
| | (2.02) | (2.77) | (−0.81) | (0.50) | (2.00) | (0.71) |
| ΔNumInst | 0.015*** | 0.010 | 0.021** | 0.003 | 0.016*** | 0.001** |
| | (2.76) | (1.40) | (2.21) | (0.63) | (2.95) | (2.13) |
| ΔROE | 0.040** | 0.007 | 0.061* | 0.009 | 0.042* | 0.001 |
| | (1.99) | (0.21) | (1.91) | (0.80) | (1.86) | (0.43) |
| ΔGROW | 0.002 | −0.001 | 0.005 | 0.003** | 0.004 | −0.000 |
| | (1.05) | (−0.20) | (1.23) | (2.40) | (1.49) | (−1.27) |
| ΔLEV | −0.030 | 0.057 | −0.058 | −0.007 | −0.017 | −0.001 |
| | (−0.59) | (0.81) | (−0.86) | (−0.18) | (−0.34) | (−0.29) |
| ΔSIZE | 0.893 | −5.397* | 1.316 | 0.153 | 0.479 | −0.005 |
| | (1.07) | (−1.74) | (1.28) | (0.26) | (0.59) | (−0.11) |
| Ret | 0.023*** | 0.017 | 0.026** | 0.016*** | 0.029*** | 0.000 |
| | (2.65) | (1.30) | (2.25) | (2.68) | (3.53) | (0.30) |
| Quarter | Control | Control | Control | Control | Control | Control |
| Inds | Control | Control | Control | Control | Control | Control |
| Years | Control | Control | Control | Control | Control | Control |
| *N* | 462 | 224 | 238 | 462 | 462 | 462 |
| *R*-sq | 0.128 | 0.165 | 0.197 | 0.078 | 0.137 | 0.063 |

ΔNumAnalyst, the dependent variable, is the change in the number of analysts in a particular firm during the next quarter compared to the event quarter when the target firm is added to or dropped from the stock market index. All means all of the sample firms, Add indicates that the target firm is added to the market index, Drop means it is deleted from the market index, and Match refers to the matched firms. Indexing is the adjustment of the stock market index, 1 indicates that the target firm is added to the stock market index, −1 indicates that it is dropped from the market index, and 0 is for matched firms. ΔNumInst is the change in the number of institutional investors in the target firm during the event quarter compared to the previous quarter. ΔNumRating is the change in the number of total stock recommendations in a particular firm in the next quarter compared to the event quarter. ΔNumBuy is the change in the number of "Buy" recommendations in a particular firm in the next quarter compared to the event quarter. ΔNumPositive is the change in the number of "Buy" and "Upgrade" recommendations in a particular firm in the next quarter compared to the event quarter. ΔNumNegative is the change in the number of "Sell" and "Downgrade" recommendations in a particular firm in the next quarter compared to the event quarter. ΔROE is the change in ROE in the event quarter compared to the previous quarter. ΔGROW is the change in revenue growth in the event quarter compared to the previous quarter. ΔLEV is the change in leverage (total debt ratio) in the event quarter compared to the previous quarter. ΔSIZE is the change in scale (nature log form of total assets) in the event quarter compared to the previous quarter. Ret is the raw market return during the event quarter. For matched firms, all of the above variables are the changes in the same quarter as the target firms. Inds are the industry dummy variables, namely, 11 dummy variables for 12 industry categories used by the China Securities Regulatory Commission (CSRC) after dropping the financial industry. Years are the year dummy variables, namely, 3 dummy variables for 4 years. In the parentheses are the White-t statistics considering heteroscedasticity.

*** Indicate significance at the 0.01 levels.

** Indicate significance at the 0.05 levels.

* Indicate significance at the 0.10 levels.

Table 4
Stock index adjustment, analyst coverage and institutional investors' holding.

| | Exposing | ΔInsthold | ΔInsthold |
|---|---|---|---|
| Indexing | + | 1.680*** | 1.630*** |
| | | (3.06) | (2.99) |
| ΔNumAnalyst | + | | 0.221* |
| | | | (1.92) |
| ΔROE | + | −0.063 | −0.071 |
| | | (−1.43) | (−1.52) |
| ΔGROW | + | −0.001 | −0.001 |
| | | (−0.14) | (−0.14) |
| ΔLEV | ? | −0.086 | −0.091 |
| | | (−0.63) | (−0.65) |
| ΔSIZE | ? | 3.315 | 3.203 |
| | | (1.53) | (1.39) |
| Quarter | | Control | Control |
| Inds | | Control | Control |
| Years | | Control | Control |
| *N* | | 462 | 462 |
| *R*-sq | | 0.102 | 0.110 |

ΔInsthold, the dependent variable, is the change in institutional investors' holding in the next quarter compared to the event quarter when the target firm is added to or dropped from the stock market index. Indexing is the adjustment of the stock market index, 1 indicates that the target firm is added to the stock market index, −1 indicates that it is dropped from the market index, and 0 is for matched firms. Add means the target firm is added to the market index, Drop means it is deleted from the market index, and Match refers to the matched firms. ΔNumAnalyst is the change in the number of analysts in a particular firm in the next quarter compared to the event quarter. ΔROE is the change in ROE in the event quarter compared to the previous quarter. ΔGROW is the change in revenue growth in the event quarter compared to the previous quarter. ΔLEV is the change in leverage (total debt ratio) in the event quarter compared to the previous quarter. ΔSIZE is the change in scale (nature log form of total assets) in the event quarter compared to the previous quarter. For matched firms, all of the above variables are the changes in the same quarter as the target firms. Inds are the industry dummy variables, namely, 11 dummy variables for 12 industry categories used by the China Securities Regulatory Commission (CSRC) after dropping the financial industry. Years are the year dummy variables, namely, 3 dummy variables for 4 years. In the parentheses are the White-t statistics considering heteroscedasticity.

** Indicate significance at the 0.05 levels.

*** Indicate significance at the 0.01 levels.

* Indicate significance at the 0.10 levels.

significantly positive, suggesting that the stock index adjustment is positively related to analyst coverage (proxied by the number of analysts). The addition to the stock index alters analysts' attention and attracts their coverage, consistent with Beneish and Whaley (1996) and Shleifer (1986).

Given that research notes an asymmetric reaction of the market to index adjustment, suggesting that the market is less concerned with index deletions, we separate our samples into three groups. The second column reports on the firms added to the index and their matched samples, and the results are consistent with the total samples, indicating that additions to the stock index attract more analyst coverage. The third column uses the firms dropped from the index and their matched samples, but the coefficient for indexing is not significant, indicating that an asymmetric relation between stock index adjustment and analyst coverage also exists between addition to and deletion from the index. The last column uses the firms added to and those dropped from the index. The coefficient for indexing is not significant.

Table 2 shows that the analyst coverage proxied by the number of analysts is also asymmetrically related to stock index adjustments. In other words, addition to the stock index attracts more analysts, whereas being dropped from the index does not significantly affect the analyst coverage.

Table 5
Robust tests.

| | Add&Match_Add | | Drop&Match_Drop | | ΔNumRating | ΔNumBuy | ΔNumPositive | ΔNumNegative |
|---|---|---|---|---|---|---|---|---|
| Indexing | 3.053*** | 2.854** | 1.583** | 1.743** | 1.631*** | 1.685*** | 1.653*** | 1.682*** |
| | (2.73) | (2.46) | (2.31) | (2.46) | (2.97) | (3.08) | (3.02) | (3.06) |
| ΔNumAnalyst | | 0.211* | | 0.341** | 0.247* | 0.388* | 0.182 | −0.396 |
| | | (1.75) | | (1.98) | (1.93) | (1.71) | (1.40) | (−0.38) |
| ΔROE | −0.139* | −0.141* | −0.042 | −0.062 | −0.073 | −0.066 | −0.071 | −0.063 |
| | (−1.90) | (−1.90) | (−0.84) | (−1.06) | (−1.56) | (−1.45) | (−1.51) | (−1.42) |
| ΔGROW | 0.006 | 0.007 | −0.006 | −0.008 | −0.002 | −0.002 | −0.002 | −0.001 |
| | (0.33) | (0.34) | (−1.07) | (−1.18) | (−0.18) | (−0.24) | (−0.19) | (−0.15) |
| ΔLEV | −0.176 | −0.192 | −0.064 | −0.044 | −0.081 | −0.083 | −0.085 | −0.086 |
| | (−0.94) | (−1.03) | (−0.60) | (−0.41) | (−0.58) | (−0.61) | (−0.62) | (−0.63) |
| ΔSIZE | 24.441*** | 25.815*** | 1.881 | 1.218 | 3.026 | 3.147 | 3.158 | 3.309 |
| | (2.65) | (2.66) | (1.24) | (0.77) | (1.31) | (1.37) | (1.39) | (1.52) |
| Quarter | Control | Control | Control | Control | Control | Control | Control | Control |
| Inds | Control | Control | Control | Control | Control | Control | Control | Control |
| Years | Control | Control | Control | Control | Control | Control | Control | Control |
| *N* | 224 | 224 | 238 | 238 | 462 | 462 | 462 | 462 |
| *R*-sq | 0.140 | 0.144 | 0.163 | 0.187 | 0.111 | 0.112 | 0.107 | 0.103 |

ΔInsthold, the dependent variable, is the change in institutional investors' holding in the next quarter when the target firm is added to or dropped from the stock market index (the event quarter) compared to the previous quarter. Indexing is the adjustment of the stock market index, 1 indicates that the target firm is added to the stock market index, −1 indicates that it is dropped from the market index, and 0 is for matched firms. Add indicates that the target firm is added to the market index, Drop means it is deleted from the market index, and Match refers to the matched firms. ΔNumAnalyst is the change in the number of analysts of a particular firm in the next quarter compared to the event quarter. ΔNumRating is the change in the number of total stock recommendation in a particular firm in the next quarter compared to the event quarter. ΔNumBuy is the change in the number of "Buy" recommendations in a particular firm in the next quarter compared to the event quarter. ΔNumPositive is the change in the number of "Buy" and "Upgrade" recommendations in a particular firm in the next quarter compared to the event quarter. ΔNumNegative is the change in the number of "Sell" and "Downgrade" recommendations in a particular firm in the next quarter compared to the event quarter. ΔROE is the change in ROE in the event quarter compared to the previous quarter. ΔGROW is the change in revenue growth in the event quarter compared to the previous quarter. ΔLEV is the change in leverage (total debt ratio) in the event quarter compared to the previous quarter. ΔSIZE is the change in scale (nature log form of total assets) in the event quarter compared to the previous quarter. For matched firms, all of the above variables are the changes in the same quarter as target firms. Inds are the industry dummy variables, namely, 11 dummy variables for 12 industry categories used by the China Securities Regulatory Commission (CSRC) after dropping the financial industry. Years are year dummy variables, namely, 3 dummy variables for 4 years. In the parentheses are the White-t statistics considering heteroscedasticity.

*** Indicate significance at the 0.01 levels.

** Indicate significance at the 0.05 levels.

* Indicate significance at the 0.10 levels.

Table 3 shows the effects of stock index adjustments on analysts' stock recommendations. The first column is for the total number of stock recommendations. The coefficient for indexing is significantly positive, which means that the stock index adjustment leads to changes in stock recommendation issued by the analyst. Columns 2 and 3 regress for additional samples and deletion of samples, respectively. Added sample firms tend to have more stock recommendations issued by analysts in the next quarter than the matched firms, whereas deleted firms exhibit no significant difference compared to matched firms. The above results are consistent with Table 2; that is, that addition to the stock index leads to higher analyst coverage while deletion has little effect. The last three columns further separate the stock recommendations, but only the total "Buy" and "Upgrade" recommendations (ΔNumPositive) are significantly changed if the stock index is adjusted—details that are only evident for firms added to the index.[3]

In all, Tables 2 and 3 show that stock index adjustments lead to changes in analyst coverage for the target firms, with addition making the firm more attractive to analysts and prompting more stock recommendations (especially positive, e.g., "Buy" and "Upgrade") and deletion resulting in little change.

[3] We run the regressions for the change in the number of positive stock recommendations for Add&Match versus Drop&Match, and the coefficient for indexing is only significant for the former.

### 5.3. Stock index adjustment and institutional investor holdings

Table 4 examines the effects of stock index adjustments on institutional holdings and how analyst coverage influences this relationship. The first column presents the direct effects of stock index adjustments on institutional holdings. It shows a significant positive coefficient for indexing, namely the stock index adjustment measure, which means that a change in the stock index's status significantly affects the holding by institutional investors, consistent with Pruitt and Wei (1989), Chen et al. (2004) and Green and Jame (2011).

When the influence of analyst coverage is added (ΔNumAnalyst) in column 2, the coefficient of ΔNumAnalyst is significantly positive, suggesting that the change in analyst coverage leads to a change in institutional investors when the firm is added to or dropped from the stock index. This is consistent with the assertion of Mikhail et al. (2007) that institutional investors listen to analysts. The coefficient for indexing is still significantly positive; however, its magnitude drops from 1.706 to 1.648. In all, the results suggest that the change in analyst coverage has a partial mediation effect on the influence of stock index adjustment on institutional investors. In other words, the change in institutional holdings of firms added to or dropped from the stock index results not only from tracking the index portfolio strategies of index funds, but also partially from the changed information environments, which affect the portfolio management of institutional investors. Comparing the R-square value in the two regressions, it is about an 8% increase if considering the effect of analyst coverage, confirming the influence of analyst coverage on the changes in institutional holdings that surround the stock index adjustments.

Table 5 shows the results of more robustness tests. The first two columns compare the firms added to the stock index and their matched samples. Consistent with the results for all of the samples, the coefficients for indexing are significantly positive in both columns. However, the magnitude drops if the influence of analyst coverage is added, as it is also positively related to the changes in institutional holdings. This means that compared to matched sample firms, firms added to the stock index attract more analyst coverage, resulting in higher institutional holdings and increased holdings gained by tracking the index portfolio strategies of the index funds. Analyst coverage does influence the portfolio management of institutional investors.

This phenomenon is also seen in firms dropped from the stock index, the coefficients for indexing in the second two columns and the changes in the analyst coverage—all of which are significant. However, because deletion from the stock index does not significantly change the information environment (proxied by number of analysts[4] and stock recommendations[5]), the stock index adjustment only affects the portfolio management for index funds, and not other institutional investors, by influencing their information environments.

The last four columns show the results for stock recommendations. The coefficients for indexing are all significantly positive, which means that a change in the stock index's status really affects firms' institutional holdings. If analyst coverage is significant under the regressions for ΔNumRating, then addition to the stock index leads to higher institutional holdings not only due to the index portfolio strategies of index funds, but also due to more stock recommendations.

In all, Tables 4 and 5 suggest that changes in the institutional holdings of firms added to the stock index partially result from tracking the index portfolio strategies of index funds, and partially from changes in analyst coverage, which affects the portfolio management of institutional investors.

### 5.4. Robustness tests[6]

#### 5.4.1. Another stock index

We also collect all stock index adjustments for the SHCI and SZCI, from when they began to the end of 2012 from the WIND database. After dropping the financial industry, our final sample is 98: specifically 49 stock index adjustment firms and 49 matched firms. The regression results are better than the previous match-

[4] Shown in the third column of Table 2.

[5] Shown in the third column of Table 3.

[6] We also consider the stock repurchase influence on our conclusion. However, there is no stock repurchase for our sample firms during the sample period, so it has no repurchase influence.

ing when we use 49 pairs of matched firms from 2009 to 2012. The stock index adjustments significantly affect the analyst coverage; specifically, addition to the stock index generates more analyst coverage (proxied by the number of analysts and stock recommendations) while deletion has no significant effect. Moreover, the changed institutional holdings are partially the result of the changes in analyst coverage, suggesting that index and other funds change their portfolios based on the changed informativeness of the target firms.

*5.4.2. Mergers and acquisitions (M&A)*

M&A events may significantly change the holdings of institutional investors, coinciding with stock index adjustments to render our conclusion biased. To avoid the M&A influence, we check our data for the M&A activities during the sample year instead of only concentrating on the sample quarter to allow for the long M&A process. Of the sample firms added to the stock index (Add), 0 have M&A in the sample year, compared to 0 for matched firms (Match_Add). This result is 2.5% for firms dropped from the index (Drop) and 3.4% for their matched samples (Match_Drop). We include a dummy variable, M&A, in the regression to check the influence of stock index adjustments on analyst coverage and institutional holdings. The results are basically the same as above; that is, the coefficient for M&A is not significant. Thus, our previous conclusions are not biased on the M&A activities.

*5.4.3. Punished by the regulation authority*

Some firms may be punished by the regulation authority, China Securities Regulatory Commission (CSRC), for financial fraud, information disclosure, insider trading or other illegal activities. This then reflects their corporate governance and the stewardship of management that affects the valuation of institutional investors. The punishment may also coincide with a stock index adjustment. Thus, to allow for this effect, we also check our data for punishment during the sample year (not only concentrated on the sample quarter to allow for the long process of punishment). Of the sample firms, 2.7% of those added to the stock index (Add) are punished by the CSRC in the sample year, compared to 0.9% for the matched firms (Match_Add). The result is 0.8% for firms dropped from the index (Drop) and 1.7 for their matched samples (Match_Drop). We include a dummy variable, Punish, in the regression to check the influence of the stock index adjustments on analyst coverage and institutional holdings. The results are basically the same as above that is the coefficient for Punish is not significant. Thus, our previous conclusions are not biased for punishment by the regulation authority.

*5.4.4. Self-selection of stock index adjustment*

The stocks that are added to a stock index are selected based on many benchmarks, such as firm size and liquidity. Such stocks may be larger and perform better than those outside of the stock index; thus, they are more likely to be followed by analysts.[7] The relation between a stock index and the analysts following it may create a sample selection problem. We use the Heckman two-step method to address this issue, and the models are set as follows.

$$Indexing = \theta_0 + \theta_1 PreGrow + \theta_2 PreROE + \theta_3 Trade + \theta_4 MV + \theta_5 Punish + \sum \theta_i Inds_i + \varepsilon \quad (4)$$

Model (4) is the first step (probit model) in determining whether a firm should be added or dropped from the stock index. Usually, an adjustment to the stock index considers past operating performance, past operating compliance, the industry and growth and the trade volume and market value of the circular stock. Thus, we include the following factors in the first model regression: PreGrow, the sales growth rate for the past year; PreROE, the ROE for the past year; Trade, the trade volume in log form; MV, the market value of the circular stock in log form; and Punish, a dummy variable equal to 1 if the sample firm was punished by the CSRC in the sample year, and 0 otherwise. Inds are the industry dummy variables; namely, 11 dummy variables for 12 industry categories are used by the China Securities Regulatory Commission (CSRC) after dropping the financial industry.

[7] Thanks to the anonymous referee for pointing out the endogeneity problem.

$$\Delta NumAnalyst = \vartheta_0 + \vartheta_1 IMR + \vartheta_2 Indexing + \vartheta_3 \Delta NumInst + \vartheta_4 \Delta ROE + \vartheta_5 \Delta GROW + \vartheta_6 \Delta LEV + \vartheta_7 \Delta SIZE + \vartheta_8 Ret + \sum \vartheta_i Inds_i + \sum \vartheta_j Years_j + \varepsilon \quad (5)$$

Model (5) is the second step of the Heckman tests, where IMR is the inverse Mills ratio. The variables are defined as in model (1).

The regression result shows that the coefficient of IMR is not significant, which means the sample selection issue is not significant. In contrast, the coefficient of Indexing remains significantly positive, indicating that a stock index adjustment does affect the analysts following it for a specific stock. Our conclusion is that the sample selection problem does not have a significant effect.

## 6. Conclusions

Even though there are several hypotheses in the literature explaining market reactions to stock index adjustments, scant rigorous empirical evidence has been provided (Pruitt and Wei, 1989; Chen et al., 2004; Green and Jame, 2011). Little has been done in terms of the influence of index adjustments on firms' information environments, which further affects market performance and investor holdings. Using 231 pairs of sample firms in China, we give direct evidence of the price pressure and investor awareness hypotheses on the stock index adjustment effect. Our results suggest that changes in institutional holdings for firms added to the stock index partially result from tracking the index portfolio strategies of index funds, and partially stem from the changed analyst coverage, which affects the portfolio management of institutional investors. Deletion from an index does not reflect this phenomenon.

An important weakness of this study is that our sample period is only from 2009 to 2012, which may be too short in that it does not cover a bear and a bull market period. The results may appear to be due to a bear market sentiment that affects the investors' behavior, and thus using a longer period may improve the results and our conclusions.

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