

# Corporate innovation in China and its implications

Jingjing Yang\*

China's current economic transition policies focus on shifting from export-driven manufacturing towards high-end, high-tech research and development (R&D), and domestic consumption. Since the early 2000s the government has issued a series of policies and guidelines to encourage innovation. Both in-house R&D investment and the number of patent grants/applications have seen considerable growth in recent years. More specifically, industry-funded R&D was responsible for more than three quarters of total in-house R&D investment. Despite the rapid growth in R&D expenditure and the number of patents, China's corporate innovation still faces many obstacles and challenges. To further stimulate corporate innovation, the government may need to create an environment of fair competition for domestic enterprises, encourage the growth of institutional investors and their active participation in corporate governance, and improve the efficiency of financial systems. The experience of China in promoting innovation provides policy approaches and implications from which other emerging economies can learn.

## Introduction

The economy of the People's Republic of China (hereafter, China) has been growing at an average of almost 10 per cent since it embraced economic reform in the late 1970s. With a population of 1.3 billion, China is now the world's second largest economy by nominal GDP<sup>1</sup> and the world's largest exporter of goods.<sup>2</sup> It is increasingly playing an important and influential role in international development and the global economy. Although

China's economy is booming, it faces major challenges in terms of high inequality, environmental sustainability, external imbalances, and limited indigenous innovation. Among these challenges, many believe limited indigenous innovation to be the key impediment to sustainable economic growth in China.

To ensure long-term sustainable economic growth and stimulate national competitiveness, the government has put great effort into promoting research and development (R&D) activities during the past decade. During 2007 to 2015, in-country R&D spending increased

\* Jingjing Yang, Professor of Finance, School of Finance, Guangdong University of Foreign Studies and Southern China Institute of Fortune Management Research, Guangzhou, China (Corresponding Author, E-mail: [jyang@gdufs.edu.cn](mailto:jyang@gdufs.edu.cn)). This study is supported by the National Natural Science Foundation of China (Project No. 71563020). The author warmly thanks the anonymous referees for their careful reading and valuable comments. All errors remain my own.

1 'GDP ranking' by World Bank, <https://datacatalog.worldbank.org/dataset/gdp-ranking>

2 'World Integrated Trade Solution' by World Bank, [https://wits.worldbank.org/CountryProfile/en/Country/WLD/Year/LTST/TradeFlow/Import/Partner/by-country/Show/MPRT-TRD-VL;MPRT-PRTR-SHR;/Sort/Import%20\(US\\$%20Thousand\)](https://wits.worldbank.org/CountryProfile/en/Country/WLD/Year/LTST/TradeFlow/Import/Partner/by-country/Show/MPRT-TRD-VL;MPRT-PRTR-SHR;/Sort/Import%20(US$%20Thousand))

by 120 per cent in China but by only 34 per cent in the USA.<sup>3</sup> Furthermore, corporate R&D accounts for a substantial part of the country's total R&D input. According to a report by the National Bureau of Statistics of China, the country's total R&D input was 1.75 trillion Chinese Yuan (approximately US\$270 billion) in 2017, and industry-funded R&D was responsible for more than three quarters of this spending.<sup>4</sup> Many leading Chinese enterprises have also been ranked as the top 500 companies based on their R&D expenditure. For example, the R&D expenditure of Huawei, a leading Chinese technology company, was ranked in the top 20 in 2015 according to a report by the European Commission.<sup>5</sup>

The large R&D investment has resulted in a significant increase in innovation output. In 2013, China topped the rankings for both the source (filings by China) and the destination (filed in China) for the four types of intellectual property, namely patents, utility models, trademarks, and industrial design.<sup>6</sup> According to a report by the World Intellectual Property Organisation, China's State Intellectual Property Office received about 1.3 million patent applications in 2016. Moreover, the number of China's patent applications was greater than the combined total of patent applications filed in 2016 in the USA, Japan, the Republic of Korea, and the European Patent Office.<sup>7</sup>

However, despite the large increase in the quantity of innovation output in China in recent years, the quality of innovation output has not risen proportionately. Abrami et al. (2014) argue that China is largely a land of rule-bound rote learners and also a place where R&D is diligently pursued with few breakthroughs. Using patents as a proxy for innovation output, Prud'homme and Zhang (2017) report that the number of utility model patent applications and

grants is higher than that of invention patent applications and grants over the period 2009–16. Compared with invention patents, utility model patents do not require substantive examination prior to grant and embody few technological components (Xie and Zhang 2015; Prud'homme and Zhang 2017). Moreover, the average maintenance time of patents filed in China is shorter than that in the USA, the UK, Germany, and the Republic of Korea (Prud'homme and Zhang 2017). Patents with longer maintenance time are usually more valuable as patentees will pay fees needed to maintain valuable patents (Pakes 1986). Therefore, China may need more accumulation of knowledge and technology to improve the quality of indigenous innovation.

This study reviews the literature related to corporate innovation in China and aims to provide an integrated picture of the factors affecting corporate innovation, including R&D intensity and innovation output (that is, patent applications and grants). The remaining part of this study is organised as follows. The next section discusses laws and law enforcement with respect to corporate innovation in China. The third section discusses public policies and the model of the entrepreneurial state. The fourth section discusses the relationship between financial constraints and corporate innovation. The fifth and sixth sections present analyses of the effects of external and internal governance on corporate innovation, respectively. The last section concludes and provides some policy implications.

---

## Law and corporate innovation

There is hardly any debate on the key proposition that effective legal and financial

3 'The 2015 Global Innovation 1000: Innovation's new world order (study report)' by PwC, <http://www.strategyand.pwc.com/reports/2015-global-innovation-1000-media-report>

4 '2017 Research and development expenditure (% of GDP)' by National Bureau of Statistics of People's Republic of China, [http://www.stats.gov.cn/tjsj/zxfb/201802/t20180213\\_1583420.html](http://www.stats.gov.cn/tjsj/zxfb/201802/t20180213_1583420.html) (in Chinese)

5 'The 2015 EU Industrial R&D Investment Scoreboard' by the European Commission, <http://iri.jrc.ec.europa.eu/scoreboard15.html>

6 'Global Patent Filings See Fastest Growth in 18 Years' by World Intellectual Property Organisation, [http://www.wipo.int/pressroom/en/articles/2013/article\\_0028.html](http://www.wipo.int/pressroom/en/articles/2013/article_0028.html)

7 'China Tops Patent, Trademark, Design Filings in 2016' by World Intellectual Property Organisation, [http://www.wipo.int/pressroom/en/articles/2017/article\\_0013.html](http://www.wipo.int/pressroom/en/articles/2017/article_0013.html)

institutions are essential factors in economic growth (for example, La Porta et al. 1998; Rajan and Zingales 1998). It is noteworthy that China's legal and financial systems are underdeveloped (Allen, Qian, and Qian 2005). Yang et al. (2011) further argue that poor law enforcement is another major problem of China's legal system. The ineffective legal and financial systems have significantly impeded China's corporate innovation since its economic reform.

Firms are reluctant to invest in R&D without proper intellectual property right (IPR) protection (for example, Sakakibara and Branstetter 2001). Weak IPR protection increases the probability and magnitude of appropriation of intellectual property, and hence, reduces the incentive to innovate. Most of the IPR laws in China came into existence after China joined the World Trade Organisation in 2001. China's IPR laws and the international treaties it has joined have put China on a par with the more developed economies (Ang et al. 2014).

However, IPR infringement in China is more a problem of lack of enforcement of laws than the absence of laws (Massey 2006; Ang et al. 2014). China's weak enforcement of IPR laws has been a major source of debate and controversy with many other countries (Awokuse and Yin 2010). There are also differences in the levels of local enforcement of IPR laws in China. Ang et al. (2014) found that firms in provinces with better enforcement of IPR laws invest more in R&D and generate more innovation patents. Lin et al. (2010) also report that IPR protection is positively and significantly related to corporate R&D intensity in China.

Using China as the object of study, Chu et al. (2014) investigated the optimal strength of IPR protection. The authors found that a country may implement weak IPR protection to facilitate imitation at an early stage of economic development for the sake of social welfare, but implement strong IPR protection to encourage domestic innovation at a later stage of development (Chu et al. 2014). The authors conclude that the optimal strength of IPR protection increases as a developing country

moves towards the global technology frontier. This stage-dependent IPR protection is consistent with the evolution of the IPR system in China (Chu et al. 2014). In recent years, China has begun to enhance its IPR protection by amending the IPR laws and strengthening law enforcement. For example, the Third Amendment to China's Patent Law, which increased statutory damages and administrative fines, was approved in December 2008 and came into effect in October 2009. According to the report of the Supreme People's Court of China, the number of IPR-related cases doubled during the 2013–17 period. Moreover, there has been a sharp rise in the number of concluded IPR-related cases even though the number of judges has not been significantly increased during the same period. As of the end of 2017, the Supreme People's Court had released 36 judicial interpretations of IPR laws, which has exerted a positive effect on the enforcement of IPR laws in China.<sup>8</sup>

As mentioned above, patent applications and patent grants have been increasing during the past decade. It is noteworthy that China relied heavily on German civil law during modernisation (La Porta et al. 2008). Different from common law countries emphasising the strategy of social control that seeks to support private market outcomes, civil law countries favour policies such as nationalisation and direct government control (or state-desired allocation) (La Porta et al. 2008). Furthermore, as an emerging economy, China's legal system is not as sound and functional as in developed economies. As such, the experience of China's government in stimulating domestic innovation could be relevant in emerging civil law countries.

---

### **Public policies and the entrepreneurial state**

---

Since the early 2000s China's leaders have been promoting innovation as the key to the

8 'The number of IPR-related cases exceeds 20,000 in 2017' by National Website of Intellectual Property of China, [http://www.iprchn.com/cipnews/news\\_content.aspx?newsId=105993](http://www.iprchn.com/cipnews/news_content.aspx?newsId=105993)

country's sustained economic growth. A series of policies and guidelines have been issued to promote innovation. The State Council of China issued the 'National Guideline on Medium and Long-term Plan for Science and Technology Development (2006–2020)' in January 2006,<sup>9</sup> aiming to transform the economy from 'made-in-China' to 'invented-in-China'. The guideline stated that forming an innovative country is the national strategic plan, and proposed to raise the R&D/GDP ratio to 2.5 per cent by 2020. This strategic plan is consistent with China's ongoing economic transition that focuses on shifting from export-driven manufacturing towards high-end, high-tech R&D, and domestic consumption.

To boost innovation and meet the goal of 2.5 per cent R&D/GDP ratio, the government has been providing tax deductions and financial support to domestic enterprises. Agencies of the central government have issued several circulars on R&D expenses eligible for super deduction. For instance, on 3 November 2015, the Ministry of Finance, the State Administration of Taxation, and the Ministry of Science and Technology jointly promulgated guidance (Circular 119) to expand the scope of the super deduction for R&D expenses incurred by enterprises domiciled in China. R&D expenses, including labour costs of external R&D personnel, testing expenses for trial products, and other expenses directly related to R&D activities have been eligible for the super deduction since then. Furthermore, regional governments have been offering R&D subsidies to local enterprises through direct government subsidy and other government-funded research projects during the past decade. In the 13th Five-Year Plan covering the years 2016–20, innovation is listed as one of the top guiding principles of the country's economic policy.<sup>10</sup> These

government policies and guidelines exert a positive effect on in-country R&D investment. As reported by the World Bank, China's R&D/GDP ratio increased from 1.371 per cent in 2005 to 2.066 per cent in 2016<sup>11</sup>; and industry-funded R&D accounted for the major part of total R&D spending.

In recent years, many policy-related studies have emphasised the state's role in supporting innovation. Duckett (1996, 1998) proposed a model of the *entrepreneurial state*, which describes the state adaption to marketisation and state officials' activities in producing profits for their bureaus in China. In the model of the entrepreneurial state, state bureaus can be risk takers and invest capital in firms to gain market share and profits. Furthermore, through active intervention in economic affairs, a government can act like an entrepreneur (Yu 1997). Mazzucato (2013) argued that the modern state is an entrepreneurial state, as government creates or identifies opportunities for technology breakthrough. Mazzucato (2013) provided a series of examples to explain the entrepreneurial risk-taking activities of the US government and the impact of these activities on corporate innovation. For instance, the Defence Advance Research Project Agency made a substantial contribution to the development of internet and personal computers, which profoundly changed the economy and drove it forward. The author argued that high-tech companies, such as Apple and Google, have greatly benefited from these technological advancements and other state-funded research.

State entrepreneurialism has also played a pivotal role in shaping the socialist market economy of China. One major characteristic of China's state entrepreneurialism is the large number of state-owned enterprises (SOEs) spanning almost every industry sector.

9 'National medium- and long-term plan for scientific and technological development' by Ministry of Science and Technology of China, [http://www.most.gov.cn/mostinfo/xinxifenlei/gjkjgh/200811/t20081129\\_65774.htm](http://www.most.gov.cn/mostinfo/xinxifenlei/gjkjgh/200811/t20081129_65774.htm) (Ministry of Science and Technology of China official website).

10 'The 13th Five-year plan for economic and social development of the People's Republic of China', <http://en.ndrc.gov.cn/newsrelease/201612/P020161207645765233498.pdf>

11 'Research and development expenditure (% of GDP)' by World Bank, <https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?locations=CN>

According to data obtained from the Chinese Stock Market and Accounting Research Database, SOEs accounted for more than 30 per cent of all firms listed on Shanghai and Shenzhen stock exchanges at the end of 2017. Moreover, government agencies and SOEs affiliated to central/local governments have substantial holdings in many other non-state-controlled listed firms. State entrepreneurialism can support innovation in many ways. Lu and Lazonick (2001) argue that China's innovation system integrates national science and technology programs and public research institutes with the business activities of industrial enterprises. Many leading Chinese public research institutes, such as the Chinese Academy of Science, have been requested by the central government to deepen cooperation with private firms through establishing joint laboratories or technology transfer.<sup>12</sup> This unique national innovation system has successfully upgraded China's industrial competitiveness and promoted a series of multinational, high-tech companies. Sun (2015) investigated China's state entrepreneurialism through a case study of the high-speed rail (HSR) industry, which has experienced tremendous growth and become a national symbol of innovation in recent years.<sup>13</sup> The HSR industry has been dominated by a few large SOEs, which makes it relatively easy for the government to allocate resources and determine development strategies. The author identified three dimensions of China's state entrepreneurialism: alertness to opportunities, resource exploration and consolidation, and strategic learning. In the HSR industry case, the government paid more attention to the accumulation of technology and the creation of innovative capacity in the long-run, rather

than a short-sighted technology acquisition and imitation program (Sun 2015). As of the end of 2017, China's bullet train network had become the largest in the world<sup>14</sup> with the support of state entrepreneurialism.

China's government also promotes innovation through publicly funded research activities, small business start-up grants,<sup>15</sup> and tax credits to both SOEs and private firms. Overall, promoting innovation has become a leading state policy of China over the past two decades. The central government has not only issued a series of favourable policies but also directly engaged in entrepreneurial business activities to stimulate innovation. These endeavours have assisted a great number of Chinese companies in improving their global competitiveness.

---

### Financial constraints and corporate innovation

---

Many studies provide both theoretical and empirical evidence for the idea that financial constraints heavily impede corporate investment and growth (for example, King and Levine 1993; Hubbard 1998; Stein 2003). As a critical input of innovation, R&D is more susceptible to financial constraints than other types of investment. R&D investment usually lacks collateral value, has a long-term cycle, and is associated with severe information asymmetry (Aboody and Lev 2000; Brown et al. 2012). If a firm fails to raise sufficient funds to continue with experiments or tests, it has to suspend the project. The suspension may harm firm value as it prevents the resolution of the technical uncertainty and reduces firm competitiveness (Li 2011). Studies have

12 'Guidelines on deepening the reform of science and technology system and speeding up the construction of national innovation system' jointly issued by the Central Committee of the Communist Party and the State Council on 23 September 2012. [http://www.gov.cn/jrzq/2012-09/23/content\\_2231413.htm](http://www.gov.cn/jrzq/2012-09/23/content_2231413.htm) (in Chinese)

13 'China's high-speed rail on fast track in technology innovation and application' by China Daily, [http://www.chinadaily.com.cn/china/2016-12/29/content\\_27810428.htm](http://www.chinadaily.com.cn/china/2016-12/29/content_27810428.htm)

14 'China has built the world's largest bullet-train network' by The Economist, <https://www.economist.com/china/2017/01/13/china-has-built-the-worlds-largest-bullet-train-network>

15 Many Chinese provincial and municipal governments have set up venture capital fund corporations to nurture local industry growth and attract investment. 'China's Local Governments Are Getting Into Venture Capital Business' by Bloomberg, <https://www.bloomberg.com/news/articles/2016-10-20/china-heartland-province-deploying-81-billion-to-seed-startups>

found that financial constraints have a negative effect on R&D investment by firms in the USA (Li 2011) and Europe (Brown et al. 2012). Using a sample of firms across 32 countries, Brown (2013) found that better access to stock market financing leads to significantly higher R&D investment.

As China's market economy is evolving, there is increasing demand for more market-oriented resource allocation. However, capital market imperfections have been another major obstacle to economic growth in China. State-owned commercial banks, which dominate the banking sector, are not efficient since they are largely influenced by central government and accumulate substantial non-performing loans (Guariglia and Yang 2016; Tan 2016). The allocation of loans and lending rates has also been biased towards SOEs (Cull et al. 2009; Lu et al. 2012; Cull et al. 2015). Moreover, the selection process for Initial Public Offerings (IPOs) is still merit-based (Li and Zhou 2015) and is under close government control (Johansson et al. 2017). Compared with non-SOEs, SOEs are more likely to be chosen for an IPO (Johansson et al. 2017). Accordingly, non-SOEs face more severe financial constraints than SOEs due to the discriminatory lending practices and merit-based IPO selection processes.

In the empirical literature, studies find that financial constraints lead to R&D underinvestment in China (Howell 2016; Lin et al. 2017). This finding is consistent with the findings for developed economies. Other studies report that the negative effect of financial constraints on R&D expenditure is stronger for non-SOEs than for SOEs (Xiao and Qu 2012; Zhang and Lu 2012). Therefore, to encourage corporate innovation, it is crucial for the government to reduce intervention in the capital market and increase private sector involvement in the banking industry. On 10 April 2018, Chinese President Xi Jinping announced further opening of the Chinese economy, including relaxing restrictions on foreign ownership of financial institutions (for example, commercial

banks and securities companies) and other reforms in the finance industry. These reforms may improve the efficiency of the financial sector and ease financial constraints.

---

### External governance and corporate innovation

---

Major external corporate governance mechanisms include the legal infrastructure, outside investors, industry competition, and the takeover market (Yang et al. 2011). The effect of IPR laws and public policies on corporate innovation was discussed in the second section. This section focuses on outside investors, industry competition, and the takeover market. Outside investors in Chinese-listed firms are mainly institutional investors, including mutual funds (security investment funds), insurance companies, security companies, pension funds, trusts, and Qualified Foreign Institutional Investors (QFII). Compared with other types of institutional investors, mutual funds have more concentrated investment and higher ownership in listed firms in China (Aggarwal et al. 2015). However, the stockholdings of mutual funds are still smaller than that of their counterparts in developed economies.<sup>16</sup> Therefore, there is an argument that mutual funds may not have the necessary capability to provide monitoring of listed firms in China.

Bharath et al. (2013) suggest that institutional investors, such as mutual funds, can influence firms even when they hold only a small proportion of shares in the invested firms, given that these investors tend to be informed traders who could control management through 'threat of exit'. Other studies report that domestic mutual funds are able to boost firm performance (Yuan et al. 2008), reduce firms' fraudulent activities (Aggarwal et al. 2015), and reduce the level of earnings management (Chi et al. 2014). On the other hand, other types of institutional investors

16 On average, the percentage of shares held by mutual funds domiciled in China was around 4 per cent in 2011, as reported by Aggarwal et al. (2015).

(that is, insurance companies, pension funds, QFIIs) have little impact on firm performance and investment decisions, since they usually have potential business connections with listed firms or have diffused investment in the stock market (Aggarwal et al. 2011; Aggarwal et al. 2015; Chen et al. 2017).

The empirical evidence on the relationship between institutional investors and corporate innovation in China is scarce. One exception is the study of Choi et al. (2011), which employs the total stockholdings of institutional investors as a proxy for institutional ownership (but does not distinguish between types of institutions), and finds a positive effect of institutional ownership on the number of patent grants received by listed firms in China. In conjunction with the findings of other studies with similar arguments on the monitoring role of institutional investors, such an effect may be mainly driven by mutual funds. Moreover, the holdings of domestic mutual funds in listed firms have been increasing rapidly, which may provide mutual funds with more incentives and capabilities to encourage listed firms to innovate.

The influence of product market competition on corporate innovation has been one of the most controversial topics in the economics literature since Joseph A. Schumpeter proposed that competitive markets could not effectively promote innovation. Schumpeter (1934, 1942) suggested that monopoly provides a more stable platform for engaging in R&D and that perfect competition is not necessarily the most efficient market structure to promote innovation. However, many studies provide contradictory evidence showing that product market competition may to some extent increase innovation incentives (for example, Fellner 1951; Aghion et al. 2005; Bos et al. 2013).<sup>17</sup> The empirical evidence on the relationship between market competition and corporate innovation in China is quite limited. By interviewing the management and owners

of domestic small- and medium-sized enterprises (SMEs), Zhu et al. (2012) found that unfair competition is one of the key institution-based barriers constraining the innovation of SMEs in China. The authors document that large firms have monopoly power because of preferential treatment by the government and broader access to resources. Future research can contribute by providing empirical evidence on the relationship between industry competition and corporate innovation in China.

A dynamic takeover market is considered to be essential for the efficient allocation of resources (Bai et al. 2004; Yang et al. 2011). Recent empirical studies find that promoting innovation is one of the driving factors of mergers and acquisitions (M&As) (for example, Sevilir and Tian 2012; Bena and Kai 2014). The synergies obtained from combining innovation capabilities through M&As have a positive effect on the innovation output of acquirers (Betton et al. 2008; Bena and Kai 2014). In recent years, many Chinese technology firms (for example, Lenovo, Huawei, and Tencent) have obtained a large number of patents through cross-border M&As, which are guided by the ‘going-out strategy’ of the government. China was the top outbound acquirer of foreign companies in 2016. One of the major objectives of Chinese acquirers engaging in cross-border M&As is to obtain high-end, world-class technology.<sup>18</sup> These outbound M&As are also in line with the objective of the central government in aiming to bolster domestic innovation.

There are some negative effects of the rising trend in overseas investment. China’s foreign-exchange reserves declined sharply in 2016, mainly due to the rapid growth of overseas investment. In February 2018, to slow a surge in capital flight and mitigate financial risk, the State Development and Planning Commission of China and three other central agencies began to curb domestic enterprises’

17 Aghion et al. (2005) and Bos et al. (2013) report a non-linear relationship between market competition and innovation.  
18 ‘China Hits Record High M&A Investments In Western Firms’ by Forbes, <https://www.forbes.com/sites/wadeshepard/2016/09/10/from-made-in-china-to-owned-by-china-chinese-enterprises-buying-up-western-companies-at-record-pace/#5dc63d2c5d87>

overseas investments in properties, hotels, cinemas, entertainment, sports clubs, and equity investment funds.<sup>19</sup> However, outbound investments in high-tech industries and other sectors that can create more employment in China are still on the encouraged list. To date, there is little research about the relationship between M&As (including domestic and cross-border M&As) and corporate innovation.

---

### Internal governance and corporate innovation

---

This section reviews the literature about the effect of internal governance mechanisms on corporate innovation. The internal governance discussed includes incentive-based compensation and ownership type. Corporate innovation largely depends on R&D intensity. However, R&D spending is an inherently high-risk investment (Baird and Thomas 1985; Graves and Langowitz 1993), with a long-term horizon and a high degree of uncertainty (Ryan and Wiggins 2002). Firms with high R&D intensity sacrifice short-term financial performance for long-term performance gains (Lavery 1996). Therefore, it is necessary to align manager-shareholder interests to encourage R&D spending. It is noteworthy that incentive-based compensation can either align shareholder-manager interests or lead to management entrenchment and opportunistic behaviour (Morck et al. 1988).

Many studies have investigated the effect of incentive-based compensation on R&D intensity in both developed and emerging economies. The evidence from most studies supports the convergence-of-interests hypothesis, which predicts that long-term incentives lead to high R&D intensity in developed economies (for example, Lerner and Wulf 2007).

Others argue that only stock options are positively associated with R&D intensity, whereas restricted shares expose managers to downside risk and cannot motivate managers to invest in R&D activities (for example, Ryan and Wiggins 2002).

Dong and Gou (2010) argue that the less developed stock incentive plans of listed firms is one of the major factors impeding R&D investment in China. As reported by Chen et al. (2017), only less than 5 per cent of listed firms in China adopted incentive-based compensation schemes during 2004 to 2012.<sup>20</sup> Lin et al. (2011) found that both CEO holdings and the presence of incentive-based compensation schemes are positively associated with R&D intensity in China. They further report that sales-based performance measures in the incentive scheme are more conducive to R&D investment than profit-based performance measures. Accordingly, listed firms may need to select carefully the performance measure when employing incentive-based compensation schemes to mitigate managerial discretion and expand R&D investments.

Ownership type is another major determinant of corporate innovation in China. SOEs dominated the A-share stock market during the early stages of the Shanghai and Shenzhen Stock Exchanges. There are still many listed firms ultimately controlled by governments and their agencies. SOEs or listed firms with a high proportion of shares held by governments usually have a more monopolistic position in their respective industries. Consequently, SOEs may be less motivated to improve their competitiveness through conducting R&D activities (Dong and Gou 2010). Furthermore, top managers of SOEs are appointed under the heavy influence of governments and their career changes are determined by parent SOEs or controlling government agencies (Huang et al. 2011). Accordingly, top managers of SOEs are more

19 'Opinions on further guiding and regulating the direction of overseas investment' issued by the State Development and Planning Commission, the Ministry of Commerce, The People's Bank of China, and the Ministry of Foreign Affairs, [http://www.gov.cn/zhengce/content/2017-08/18/content\\_5218665.htm](http://www.gov.cn/zhengce/content/2017-08/18/content_5218665.htm)

20 The number of firms adopting equity-based compensation has been increasing in recent years. According to the data obtained from the CSMAR database, there were more than 400 A-share listed firms that employed incentive-based compensation schemes in 2017.

likely to pursue politically motivated goals for their own interests rather than the firms' long-term performance. Considering that R&D spending is associated with a long-term horizon and a high degree of uncertainty (Ryan and Wiggins 2002), managers of SOEs may hold a negative attitude towards high R&D expenditure.

However, the government has spent a great deal of effort on transforming the economy from export-driven manufacturing to high-end, high-tech R&D, and domestic consumption and emphasised the importance of innovation since the early 2000s. This shift in government focus may influence the attitudes of managers from SOEs towards R&D activities and consequently affect the R&D intensity of SOEs. Additionally, SOEs in general have better and easier access to financing and government subsidies than private firms do. This advantage may provide SOEs with more resources for engaging in R&D activities.

Some studies report that the negative relationship between financial constraints and corporate investments is less pronounced in SOEs than in private firms (for example, Zhang and Lu 2012). Accordingly, the relationship between ownership type and R&D intensity is relatively complicated.

Using a sample of A-share listed firms over the period 2010–12, Lin et al. (2017) found that the R&D expenditure of SOEs is significantly lower than that of non-SOEs. Therefore, although SOEs have less financial constraints and are more subject to government policy (for example, forming an innovative country), they still lack strong motivation to innovate. Apart from R&D intensity, Zhang et al. (2003) report that SOEs have lower R&D efficiency (estimated by stochastic frontier analysis) when compared with non-SOEs. R&D efficiency is another fundamental determinant of innovation output. If R&D resources are not used effectively, additional investment may be less capable of generating innovations. As such, it is crucial for the government to provide less protection or subsidies to SOEs and create a fairer competitive environment, so that SOEs can be more motivated to innovate.

## Conclusions and implications for future studies

Innovation is essential for sustainable economic growth and development and is now one of the key strategies of China's government. In recent years, the government has spent a great effort in promoting indigenous innovation to transform the economy from 'made-in-China' to 'invented-in-China'. A series of policies and guidelines have been issued by the central government and its agencies to support and stimulate innovation activities, such as reducing the tax burden, requiring SOEs to increase R&D spending, and implementing strong IPR protection. The government has also directly engaged in entrepreneurial business activities, for example, facilitating cooperation between public research institutes and industrial firms and assisting domestic firms in outward technology exploration. Thanks to these efforts, the government has successfully nurtured a number of high-tech companies with sustainable competitive advantage.

Moreover, the rapid growth of the economy has provided domestic enterprises with more resources to innovate. In-house R&D investment has been soaring during the past two decades. The surge in R&D spending has led to significant growth in both patent applications and patent grants. However, corporate innovation still faces many obstacles in China, including unfair market competition, financial constraints for non-SOEs, less involvement of institutional investors in corporate governance, and less developed internal governance mechanisms. To bolster corporate innovation, the government may need to create an environment of fair competition for the private sector and increase the efficiency of capital markets.

The number of patent grants/applications that embody more technologically advanced components account for a small proportion of total patent grant/applications in China. This suggests that the quality of innovation output needs to be improved and highlights the

importance of the accumulation of knowledge and technology for innovation. Most existing studies have focused on corporate R&D expenditure or the number of patent grants/applications and have paid less attention to the

efficiency of innovation activities, which is essential to the success of innovation. Future studies can contribute by investigating the effects of governance mechanisms and other firm characteristics on innovation efficiency.

## References

- Aboduy, D. and Lev, B., 2000. 'Information asymmetry, R&D, and insider gains', *The Journal of Finance*, 55(6):2747–66.
- Abrami, R.M., Kirby, W.C. and McFarlan, F.W., 2014. 'Why China can't innovate', *Harvard Business Review*, 92:107–11.
- Aggarwal, R., Erel, I., Ferreira, M. and Matos, P., 2011. 'Does governance travel around the world? Evidence from institutional investors', *Journal of Financial Economics*, 100(1):154–81.
- Aggarwal, R., Hu, M. and Yang, J., 2015. 'Fraud, market reaction, and the role of institutional investors in Chinese listed firms', *Journal of Portfolio Management*, 41(5):92–109.
- Aghion, P., Bloom, N., Blundell, R., Griffith, R. and Howitt, P., 2005. 'Competition and innovation: an inverted-U relationship', *The Quarterly Journal of Economics*, 120(2):701–28.
- Allen, F., Qian, J. and Qian, M., 2005. 'Law, finance, and economic growth in China', *Journal of Financial Economics*, 77:57–116.
- Ang, J.S., Wu, C. and Cheng, Y., 2014. 'Does enforcement of intellectual property rights matter in China? Evidence from financing and investment choices in the high-tech industry', *Review of Economics and Statistics*, 96(2):332–48.
- Awokuse, T.O. and Yin, H., 2010. 'Does stronger intellectual property rights protection induce more bilateral trade? Evidence from China's imports', *World Development*, 38(8):1094–104.
- Bai, C., Liu, Q., Lu, J., Song, F. and Zhang, J., 2004. 'Corporate governance and market valuation in China', *Journal of Comparative Economic*, 32:599–616.
- Baird, I. and Thomas, H., 1985. 'Toward a contingency model of strategic risk taking', *Academy of Management Review*, 10:230–43.
- Bena, J. and Kai, L., 2014. 'Corporate innovations and mergers and acquisitions', *Journal of Finance*, 69(5):1923–60.
- Betton, S., Eckbo, B.E. and Thorburn, K.S., 2008. *Handbook of Corporate Finance: Empirical Corporate Finance*, Elsevier, North-Holland.
- Bharath, S., Jayaraman, S. and Nagar, V., 2013. 'Exit as governance: an empirical analysis', *Journal of Finance*, 68(6):2515–47.
- Bos, J.W.B., Kolari, J.W. and Lamoen, R.C.R.V., 2013. 'Competition and innovation: evidence from financial services', *Journal of Banking and Finance*, 37(5):1590–601.
- Brown, J.R., 2013. 'Law, stock markets, and innovation', *Journal of Finance*, 68(4):1517–49.
- Brown, J.R., Martinsson, G. and Petersen, B.C., 2012. 'Do financing constraints matter for R&D?', *European Economic Review*, 56(8):1512–29.
- Chen, N., Sung, H. and Yang, J., 2017. 'Ownership structure, corporate governance and investment efficiency of Chinese listed firms', *Pacific Accounting Review*, 29(3):266–82.
- Chi, J., Yang, J. and Young, M., 2014. 'Mutual funds' holdings and listed firms' earnings management: evidence from China', *Journal of International Financial Management*, 28(3):62–78.
- Choi, S.B., Lee, S.H. and Williams, C., 2011. 'Ownership and firm innovation in a transition economy: evidence from China', *Research Policy*, 40(3):441–52.
- Chu, A.C., Cozzi, G. and Galli, S., 2014. 'Stage-dependent intellectual property rights', *Journal of Development Economics*, 106(1):239–49.
- Cull, R., Xu, L.C. and Zhu, T., 2009. 'Formal finance and trade credit during China's transition', *Journal of Financial Intermediation*, 18(2):173–92.
- Cull, R., Li, W., Sun, B. and Xu, L.C., 2015. 'Government connections and financial constraints: evidence from a large representative sample of Chinese firms', *Journal of Corporate Finance*, 32(1129):271–94.
- Dong, J. and Gou, Y.N., 2010. 'Corporate governance structure, managerial discretion, and the R&D investment in China', *International Review of Economics and Finance*, 19(2):180–8.
- Duckett, J., 1996. 'The emergence of the entrepreneurial state in contemporary China', *The Pacific Review*, 9(2):180–98.
- 1998. *The Entrepreneurial State in China: Real Estate and Commerce Departments in Reform Era Tianjin*, Routledge, London.
- Fellner, W.J., 1951. 'The influence of market structure on technological progress', *Quarterly Journal of Economics*, 65(4):556–77.

- Graves, S.B. and Langowitz, N.S., 1993. 'Innovative productivity and returns to scale in the pharmaceutical industry', *Strategic Management Journal*, 14(8):593–605.
- Guariglia, A. and Yang, J., 2016. 'A balancing act: managing financial constraints and agency costs to minimize investment inefficiency in the Chinese market', *Journal of Corporate Finance*, 36: 111–30.
- Howell, A., 2016. 'Firm R&D, innovation and easing financial constraints in China: does corporate tax reform matter?', *Research Policy*, 45(10): 1996–2007.
- Huang, J.J., Shen, Y. and Sun, Q., 2011. 'Nonnegotiable shares, controlling shareholders, and dividend payments in China', *Journal of Corporate Finance*, 17(1):122–33.
- Hubbard, R.G., 1998. 'Capital market imperfections and investment', *Journal of Economic Literature*, 36(1):193–225.
- Johansson, A.C., Luo, D., Rickne, J. and Zheng, W., 2017. 'Government intervention in the capital allocation process: excess employment as an IPO selection rule in China', *China Economic Review*, 44:271–81.
- King, R. and Levine, R., 1993. 'Finance, entrepreneurship and growth: theory and evidence', *Journal of Monetary Economics*, 32:513–42.
- La Porta, R., Lopez-de-Silanes, F., Shleifer, A. and Vishny, R., 1998. 'Law and finance', *Journal of Political Economy*, 106:1113–55.
- La Porta, R., Lopez-de-Silanes, F. and Shleifer, A., 2008. 'The economic consequences of legal origins', *Journal of Economic Literature*, 46:285–332.
- Laverty, K.J., 1996. 'Economic 'short-termism': the debate, the unresolved issues, and the implications for management practice and research', *Academy of Management Review*, 21:825–60.
- Lerner, J. and Wulf, J., 2007. 'Innovation and incentives: evidence from corporate R&D', *Review of Economics and Statistics*, 89(4):634–44.
- Li, D., 2011. 'Financial constraints, R&D investment, and stock returns', *The Review of Financial Studies*, 24(9):2974–3007.
- Li, G. and Zhou, H., 2015. 'Political connections and access to IPO markets in China', *China Economic Review*, 33:76–93.
- Lin, C., Lin, P. and Song, F., 2010. 'Property rights protection and corporate R&D: evidence from China', *Journal of Development Economics*, 93(1):49–62.
- Lin, C., Lin, P., Song, F. and Li, C., 2011. 'Managerial incentives, CEO characteristics and corporate innovation in China's private sector', *Journal of Comparative Economics*, 39(2):176–90.
- Lin, Z.J., Liu, S. and Sun, F., 2017. 'The impact of financing constraints and agency costs on corporate R&D investment: evidence from China', *International Review of Finance*, 17(1):3–42.
- Lu, Q. and Lazonick, W., 2001. 'The organization of innovation in a transitional economy: business and government in Chinese electronic publishing', *Research Policy*, 30(1):55–77.
- Lu, Z., Zhu, J. and Zhang, W., 2012. 'Bank discrimination, holding bank ownership, and economic consequences: evidence from China', *Journal of Banking and Finance*, 36(2):341–54.
- Massey, J.A., 2006. 'The emperor is far away: China's enforcement of intellectual property rights protection, 1986–2006', *Chicago Journal of International Law*, 7(1):231–7.
- Mazzucato, M., 2013. *The Entrepreneurial State: Debunking Public Vs. Private Sector Myths*, Anthem Press, London and New York.
- Morck, R., Shleifer, A. and Vishny, R., 1988. 'Management ownership and market valuation: an empirical analysis', *Journal of Financial Economics*, 20:293–315.
- Pakes, A., 1986. 'Patents as options. Some estimates of the value of holding European patent stocks', *Econometrica*, 54:755–84.
- Prud'homme, D. and Zhang, T., 2017. *Evaluation of China's intellectual property regime for innovation*, Report for the World Bank, 39–66. Available at <https://ssrn.com/abstract=3104260>, accessed 30 April 2018.
- Rajan, R. and Zingales, L., 1998. 'Financial dependence and growth', *American Economic Review*, 88:559–86.
- Ryan, H.E. Jr. and Wiggins, R.A. III, 2002. 'The interactions between R&D investment decisions and compensation policy', *Financial Management*, 31(1):5–29.
- Sakakibara, M. and Branstetter, L., 2001. 'Do stronger patents induce more innovation? Evidence from the 1988 Japanese patent law reforms', *RAND Journal of Economics*, 32:77–100.
- Schumpeter, J.A., 1934. *The Theory of Economic Development*, Harvard University Press, Cambridge, Massachusetts (Oxford University Press, New York, 1961). First published in German, 1912.
- 1942. *Capitalism, Socialism, and Democracy*, Harper and Brothers, New York (Harper Colophon edition, 1976).
- Sevilir, M. and Tian, X., 2012. *Acquiring innovation*, AFA 2012 Chicago Meetings Paper.
- Stein, J., 2003. 'Agency, information and corporate investment', in G. Constantinides, M. Harris and R. Stulz (eds.), *Handbook of the Economics of Finance*, North Holland, Amsterdam.
- Sun, Z., 2015. 'Technology innovation and entrepreneurial state: the development of China's high-

- speed rail industry', *Technology Analysis and Strategic Management*, 27(6):646–59.
- Tan, Y., 2016. 'The impacts of risk and competition on bank profitability in China', *Journal of International Financial Markets Institutions and Money*, 40:85–110.
- Xiao, H. and Qu, X., 2012. 'R&D investment behaviors: evidence from Chinese listed firms', *Accounting Research*, 2:42–9 (in Chinese).
- Xie, Z. and Zhang, X., 2015. 'The patterns of patents in China', *China Economic Journal*, 8(2):122–42.
- Yang, J., Chi, J. and Young, M., 2011. 'A review of corporate governance in China', *Asian-Pacific Economic Literature*, 25(1):415–36.
- Yu, T.F., 1997. 'Entrepreneurial state: the role of government in the economic development of the Asian newly industrializing economies', *Development Policy Review*, 15(1):47–64.
- Yuan, R., Xiao, J.Z. and Zou, H., 2008. 'Mutual funds' ownership and firm performance: evidence from China', *Journal of Banking and Finance*, 32(8):1552–65.
- Zhang, J. and Lu, Z., 2012. 'Financing constraint, financing channel and company R&D investment', *The World Economy*, 10:66–90.
- Zhang, A., Zhang, Y. and Zhao, R., 2003. 'A study of the R&D efficiency and productivity of Chinese firms', *Journal of Comparative Economics*, 31: 444–64.
- Zhu, Y., Wittmann, X. and Peng, M.W., 2012. 'Institution-based barriers to innovation in SMEs in China', *Asia Pacific Journal of Management*, 29(4):1131–42.