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Banking systems, innovations, intellectual property protections, and financial markets: Evidence from China ☆

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ABSTRACT

One unique feature of the emerging economies in Asia is the rich variation in the development of financial systems and technological sectors across different geographical areas. This unbalanced evolution provides us a potentially more powerful setting to investigate the dynamics among banking systems, innovations, intellectual property (IP) protections, and stock market reactions that are especially useful in understanding the policy–finance–innovation nexus in emerging economies. Using newly available data from China, this study confirms the nurturing role of financial systems on innovations, the value-enhancing function of firms' innovative activities, and the lead–lag predictive role of innovations on stock returns, in the context of emerging economies. More importantly, the study documents that stronger provincial IP protections reduce patent piracy and hence enhance local firms' market values.

1. Introduction

As one of the major emerging economies, China has experienced remarkable development in both financial and technological sectors during the last three decades. While this progress is significant at the country level, the impact across different geographical regions is nevertheless uneven. This unbalanced evolution naturally creates rich variations across different provinces, in terms of financial and technological characteristics. Such variations, which are a somewhat unique feature in emerging economies, provide us with a potentially more powerful setting to investigate the relations among banking systems, innovations, intellectual property protections, and stock market reactions that are especially useful in understanding the perspectives of emerging economies.

This study analyzes the policy–finance–innovation nexus in the context of China by analyzing a unique province-level and firm-level dataset. On the nurturing roles of banking systems on innovations, this paper documents that one standard deviation increase in the local credit market index which boosts local patent output by at least 14%. On the market's valuation of intangible assets associated with innovation, this study demonstrates that firm-level patent capital and province-level intellectual property (IP) protections which strongly and positively explain public firms' market values. One standard deviation change in patent capital and IP protections moves the market value by at least 1.2% and 1.5%, respectively. On the lead–lag predictive role of innovations on stock returns, one standard deviation increment in a firm's patent flow increases its future stock returns by 0.05%–0.10% per month.

In summary, this study's first contribution to the literature is to confirm the important role of financial systems and legal environments in promoting innovation, the value-enhancing function of firms' innovative activities and IP protections, and the lead–lag predictive role of innovations on stock returns, in the context of emerging economies. Although these important relations have been reported in prior studies using the data of developed countries, no studies systematically investigated whether similar results would hold for emerging economies. The authors would like to point out that it is not given that empirical regularities documented in developed countries would automatically prevail in emerging economies, due to different institutional environments.

The major contribution of this research is to document the effect of *provincial* IP protections on public firms' market values. This finding is important because unlike developed countries, emerging economies have enormous degrees of asymmetric development across various geographical regions. Past studies using data from developed countries focused on industrial IP protections. To the best of our knowledge, this study is the first to find that stronger provincial IP protections enhance local firms' market values.

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2. Relevant literature and hypotheses development

The literature has long recognized the positive effect of banking development on real economies. For instance, King and Levine (1993) argue that better-developed financial intermediaries can efficiently fund promising entrepreneurs and, hence, improve the society's innovation progress. Benfratello, Schiantarelli, and Sembenelli (2008) empirically examine this proposition and find that banking development spurs local firms' innovative activities. This research expects that the nurturing role of banking systems on innovation is even stronger in China. First, debt financing plays a dominant role relative to equity financing in China (Allen, Qian, & Qian, 2008). A recent study by Wang (2010) confirms the leading role of China banks in promoting innovations. Specifically, he employs the Directed Acyclic Graph (DAG) model to perform a path analysis for the high-tech firms in China, and finds that the debt financing leads and positively affects the investment in both tangible and intangible assets. Secondly, significant variation in the development of provincial banking systems is present in China due to the fast yet uneven growth since 1978 (Fan, Wang, & Zhu, 2009; Wang, Wong, & Xia, 2008). The rich cross-regional variation provides us a more powerful setting to detect such causal relationship. This study thus develops the first hypothesis, as follows:

H1. Better developed local banking systems lead to more local innovations in China.

Extant literature based on developed countries documents that knowledge capital, measured with the stock of Research and Development (R&D) expenses and patents, are valued by stock markets. The first work in this direction is Griliches (1981), in which R&D capital and patent capital adjusted for asset size explain the Tobin's q of 157 U.S. firms in 1968–1974. Ben-Zion (1984) uses the same data set and reports that firms' R&D and patent flow explain their market values. Several subsequent studies based on extensive U.S. and European data provide concurring results (Blundell, Griffith, & Van Reenen, 1999; Hall, 1993; Hall, Jaffe, & Trajtenberg, 2005; Hall, Thoma, & Torrisi, 2007; Lerner, 1994). Motivated by the aforementioned studies and realizing the fruitful impact of China's three-decade transition from a centralized socialist economy to the free market economy, this study hypothesizes that a similar relation should prevail in China as well:

H2A. The market values of China's public firms increase with their technology capabilities measured by patents.

The role of IP protections on stock market valuation is relatively underdeveloped in the literature. Cockburn and Griliches (1988) find that industry-level patent protection serves as an intermediary variable that enhances stock markets' evaluation of firms' R&D capital and patent capital. Lerner (1994) also reports consistent results by showing that, in the biotechnology industry, firms' market values rise with patent protection. In addition, Schankerman (1998) reports that the private returns to R&D increase with patent protections in different industries in France. These studies on IP protections almost exclusively focus on either intra-industry or inter-industry variations. While an emphasis on industry based variation may make good sense in the U.S. and other Western countries, the provincial variation warrants more attention in China and other large emerging economies. The rationale is that, in contrast to the developed countries, emerging economies have enormous degrees of asymmetric development across various geographical regions. By extending the argument of the aforementioned studies along the geographic dimension, this study hypothesizes the following:

H2B. Firms located in the provinces with better IP protections enjoy higher market values in China.

The literature also suggests that innovations lead stock returns. The pioneering work of Pakes (1985) investigates the dynamics among patent flows, R&D flows, and annual stock excess returns in a data set composed of 120 firms from 1968 to 1975. Later, Lev and Sougiannis (1996) and Chan, Lakonishok, and Sougiannis (2001) document an interesting phenomenon that R&D intensive firms, measured with R&D flow or capital over sales or market value, provide higher subsequent stock returns. Deng, Lev, and Narin (2003) report that U.S. high-tech firms' patent flows significantly forecast stock returns. Eberhart, Maxwell, and Siddique (2004) find that an unexpected rise in R&D expenditures leads to significantly higher stock returns. Such predictability can be attributed to behavioral reasons such as slow information flow or myopia (e.g., Chan et al., 2001; Eberhart et al., 2004) or rational explanations such as productivity and efficiency improvement (e.g., Lin, 2009). All these factors could also exist in China due to its relatively short history of stock markets, less sophisticated investors, and the private sector's fast adoption of latest technologies. Therefore, the last hypothesis of this study conjectures the following:

H3. A lead–lag relationship exists between firms' innovations and stock returns in China.

3. Data

The data comes from several sources, as elaborated later. The authors report summary statistics in Table 1. Panel A includes all province-year variables. The credit market index (denoted as *Credit*), available from Wang et al. (2008) and Fan et al. (2009), is constructed to measure provincial banking development for the period of 1999–2007. A higher index refers to a more developed credit market.

The authors then collect the number of the patents filed in each province since 1991 from the State Intellectual Property Office (hereafter SIPO). *ln (Pat)* denotes the log number of all provincial patents filed in each year. The total R&D expenses in both public and private sectors in each province for the period of 1991–2007 are obtained from the China Science and Technology Statistical Yearbook (2009). *ln (Total R&D)* is the logarithmic number of the total R&D expenditures in

Table 1
Summary statistics.

	Mean	Median	St. dev.	10%	90%	Sample period
Panel A						
Credit	5.34	5.31	2.37	2.12	8.52	1999–2007
ln (Pat)	7.81	7.90	1.48	6.10	9.51	1991–2007
ln (Total R&D)	14.84	14.94	1.49	12.94	16.67	1991–2007
ln (GDP)	7.75	7.88	1.11	6.29	9.05	1991–2007
Deposits	2.15	1.22	3.08	0.54	4.11	1999–2007
Loans	1.53	0.96	1.83	0.47	3.10	1999–2007
IP protection	8.38	6.66	7.46	3.46	13.21	2002–2007
R&D/Pat	0.94	0.25	0.17	0.01	2.62	1991–2007
R&D/Tech	0.32	0.31	0.23	0.21	0.40	1991–2007
Patent law firms	0.16	0.11	0.17	0.06	0.28	2002–2007
Panel B						
Patent flow	3.37	0.00	50.21	0.00	3.00	1991–2007
Patent capital (Pat)	9.31	0.00	127.06	0.00	10.00	1991–2007
Patent flow/S	0.002	0.00	0.02	0.00	0.003	1991–2007
Pat/A	0.003	0.00	0.01	0.00	0.01	1991–2007
ln (MV)	21.21	21.26	1.29	19.96	22.58	1991–2007
ln (A)	21.08	20.97	1.17	20.03	22.36	1991–2007
D/E	1.26	0.88	2.73	0.25	2.41	1991–2007
d ln (S)	0.11	0.12	0.55	−0.29	0.50	1991–2007
Market beta	1.00	0.99	0.24	0.75	1.24	1991–2007
ln (B/M)	−0.35	−0.34	0.75	−1.31	0.61	1991–2007
Investment	0.06	0.04	0.08	0.00	0.15	1991–2007
State ownership	0.32	0.34	0.26	0.00	0.66	1991–2007
Panel C						
Excess stock return	0.02	0.00	0.17	−0.13	0.18	Jan. 1991–Dec. 2007
Momentum	0.19	0.05	0.59	−0.39	1.00	Jan. 1991–Dec. 2007