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Is R&D cash flow sensitive? Evidence from Chinese industrial firms

Qian Weng^{a,*}, Måns Söderbom^b^a School of Labor and Human Resources, Renmin University of China, No. 59 Zhongguancun Street, Haidian District, Beijing 100872, China^b Department of Economics, School of Business, Economics and Law, University of Gothenburg, Vasagatan 1, 405 30 Gothenburg, Sweden

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ABSTRACT

We hypothesize that research and development (R&D) is sensitive to cash flow fluctuations due to asymmetric information and agency problems in the credit market. We adopt a variant of the Q model for R&D investment using the value of the firm, physical capital and employment to capture firm fundamentals as proxies for investment opportunities. We add cash flow to this specification, and estimate the augmented model separately for R&D participation and spending decisions using data on Chinese industrial firms for the period 2001–2006. We find that R&D participation and spending are sensitive to cash flow fluctuations, conditional on firm fundamentals. We also find that the cash flow sensitivity of R&D varies across firms depending on ownership.

1. Introduction

Research and development (R&D) is considered one of the essential driving forces of endogenous economic growth (e.g., [Aghion & Howitt, 1998](#); [Grossman & Helpman, 1991](#)). Like in other parts of the world, R&D has become an increasingly important type of investment in China during the past decades. [Fig. 1](#) plots the gross domestic expenditure on R&D as percentage of GDP for Japan, the US, the Organization for Economic Cooperation and Development (OECD), the European Union (EU, 15 countries) and China for the past twenty years. In the early 1990s there was a significant gap between China and other economies represented in the graph. This gap has been gradually reduced over the last 20 years, and by 2012 the difference between the EU and China was negligible. The boom in R&D in China after 2000 is the result of two broad developments: First, the advantage of cheap labor, which played a central role in China's rapid economic growth since its economic reforms starting in 1979, has gradually been eroded due to the rise in labor costs since the late 1990s ([Li, Li, Wu, & Xiong, 2011](#)). Second, moving up the product sophistication ladder by altering the production structure to products that embody high productivity and generate positive learning spillovers to the rest of the economy requires R&D ([Hausmann, Hwang, & Rodrik, 2007](#)).

A natural question to ask then is how R&D gets financed. R&D requires both a large upfront investment, for example setting up an R&D department, and steady financing to pay for continuous expenses, for example staff costs. Lack of finance or excessively expensive finance could thus seriously hamper either the initiation or progress of R&D. Like other forms of investment, R&D could be financed with internally generated profits, or external sources such as debt or equity. Due to asymmetric information problems, uncertain returns, and lack of collateral value, R&D may be difficult to finance with external funds ([Hall & Lerner, 2010](#)). China's stock markets were developed in the early 1990s and only the largest and most prominent firms are publicly listed. This limits most firms' ability to use external equity finance. Although debt is proved disfavored in the US ([Brown & Petersen, 2009](#); [Brown & Petersen, 2011](#)) and Europe ([Brown, Martinsson, & Petersen, 2012](#)) compared to equity, it remains the primary external source of finance for most Chinese firms. A typical Chinese phenomenon as a legacy from the planned economy era is that the central government and

* Corresponding author.

E-mail addresses: qian.weng@ruc.edu.cn (Q. Weng), mans.soderbom@economics.gu.se (M. Söderbom).

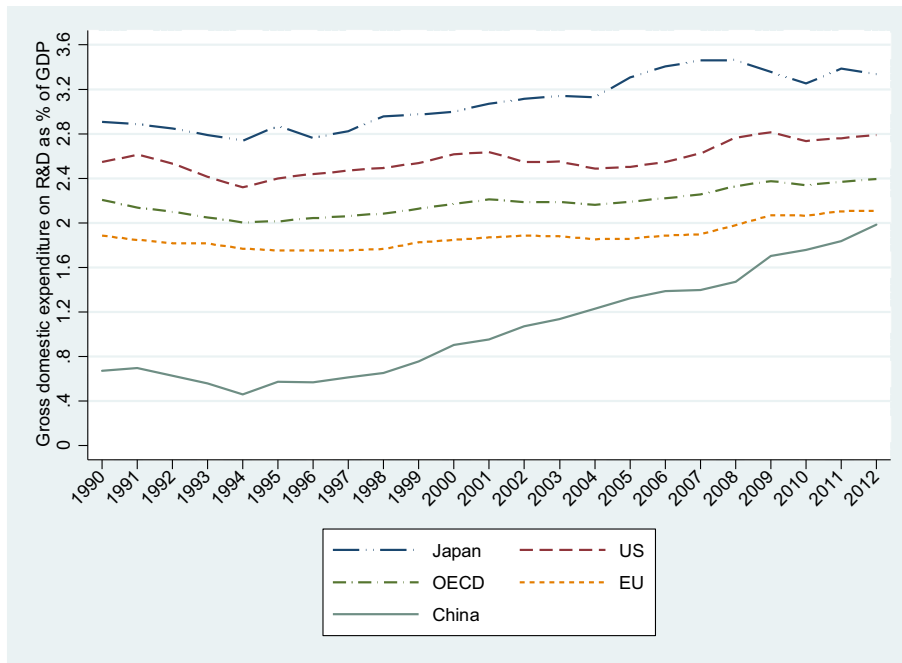


Fig. 1. Aggregate R&D intensity.

Notes: Figure plots the gross domestic expenditure on R&D as percentage of GDP for Japan, the US, OECD, EU (15 countries) and China from 1990 to 2012. Data for Japan, the US, OECD, EU are obtained from OECD Main Science and Technology Indicators database. Data for China are obtained from *China Statistical Yearbook* (1991–2013).

banks treat state-owned firms preferentially over non-state-owned firms. The “political pecking order” (Huang, 2003) in credit allocation make non-state-owned firms rely exclusively on internal funds for investment (Ding, Guariglia, & Knight, 2013; Guariglia, Liu, & Song, 2011; Poncet, Steingress, & Vandebussche, 2010). Therefore, when internal funds are exhausted, these firms tend to face binding financing constraints.

In this paper, we examine whether R&D participation and expenditure in Chinese industrial firms are financially constrained over the period 2001–2006. The dataset, developed and maintained by the National Bureau of Statistics of China (NBS), covers all “above-scale” Chinese industrial firms. The vast majority of the firms in this dataset are *unlisted companies*¹, and there is significant variation across the firms in terms of age, size, ownership and industry. We adopt a variant of the Q model for R&D investment using the value of the firm, physical capital and employment as proxies for expected future profitability of R&D investments (i.e., investment opportunities or “fundamentals”).² Following Gilchrist and Himmelberg (1995), we estimate a log-linear forecasting equation using firms’ stream of profits to date to estimate the expected future profits and consequently the value of the firm. We subsequently estimate regressions separately for R&D participation and spending decisions controlling for investment opportunities, without and with cash flow added to the specifications. The simple idea behind this strategy is that, if R&D is sensitive to changes in cash flow conditional on investment opportunities, this is consistent with the presence of financing constraints. Moreover, in a set of extended specifications, we follow Brown and Petersen (2011) and add the *change* in cash reserves as an explanatory variable in the model. Hypothesizing that R&D is (very) costly to adjust, Brown and Petersen (2011) predict a negative coefficient on the *change* in cash holdings in the R&D regression “...for firms who are likely to face financing frictions: all else equal, reductions in cash holdings free liquidity for R&D” (Brown & Petersen, 2011, p.695). The main purpose of this extension of the model is to investigate whether our estimated R&D-cash flow sensitivity is robust to the inclusion of a control variable for R&D smoothing.

We are contributing to a very thin literature on R&D and finance for the very large population of “above-scale” industrial firms in China. To the best of our knowledge, the only other study in this general research area present in the international research arena is that by Guariglia and Liu (2014). These authors also use the NBS database, but their focus is on the effect of financing constraints on the sales of new products. Our study, on the other hand, focuses on R&D spending. Our results can thus primarily speak to the relationship between the firm’s financial status and its decision to invest in R&D, while the findings in Guariglia and Liu (2014) are informative about the relationship between finance and one eventual *output* of R&D, namely the introduction of new products. As has

¹ In their description of the NBS dataset, Guariglia and Liu (2014) comment that listed firms “...represent only a very small proportion of our sample: in 2007, for example, there were only 1550 listed firms out a total of 93,552 firms. In addition, as their legal identification numbers are changed when they become public, it is difficult to track these firms.” Guariglia and Liu (2014), footnote 12.

² While the Q model is traditionally developed to study physical capital investment, it can accommodate R&D investment if we assume that the production function includes not only stocks of physical capital and labor but also a stock of technology which is acquired and accumulated through R&D investment (Himmelberg & Petersen, 1994).

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