INNOVATION AND INVESTMENT IN HIGH-TECH FIRMS IN FINANCIALLY CONSTRAINED ENVIRONMENT

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Abstract:
Present study measures the effect of financing constraints on capital investment and innovation investment of Chinese firms from 2004-2015. Consistent with previous literature we use the sensitivity of investment to cash flow and sensitivity of innovation investment as a signal of financial constraints. Panel data estimation results lead us to arrive at three important conclusions. First; Chinese firms usually face financial constraints problems due to imperfect financial markets. Second; Chinese firms face investment cash flow sensitivity. Third; Chinese high-tech firms face innovation investment cash flow sensitivity. Hence, despite the financial efforts of the Chinese government, capital markets are still not efficient and create liquidity constraints. Results depict that firms classified a priori as more prone to financial constraints (based on KZ index) show higher sensitivity to cash flow.

Key Words: Financing Constraints, Capital Investment, Innovation Investment, Chinese Firms

JEL Classification: G10, G20, G30, O16, O53

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Introduction
The probable presence of financing constraints and their repercussions for investment in capital and innovation both at firm and wider country level is considered as a central problem in corporate finance and industrial organization. Our paper is concerned with this fatal issue. Unfortunately, available stream of research work on this very topic has focused mainly on developed countries. While developing countries, which should not be ignored due to their growing importance in the international economy, have received minimal attention. China is one of these examples.

Political and economic Instabilities and turmoil, ideological rigidness and natural and human-made disasters remained big challenges for first beginning decades after the founding of the communist China in 1949. China’s economy has been showing rapid growth since the start of its economic reform in 1978. Reaching the amount of GDP upto USD8.34 trillion\(^1\) in 2012 by leaving Japanese economy behind is an example of this growth. By 2012, China has become the world’s second largest economy and experts are forecasting that it will become world’s largest economy by next decade (Allen, Qian, & Qian, 2005). Currently China owns 30% of the global reserve (USD2.85 trillion). By this, it becomes the country which has the largest foreign currency reserve in the world (State Administration of Foreign Exchange, 2011). All statistics look strange for a country which has not very mature and old financial system, China’s financial system is quite new, started just two decades ago. Nonetheless, by the end of 2010, its total market capitalization has reached upto USD4.01 trillion\(^2\) by 2010. It represents 66.69% of China’s GDP (China Securities Regulatory Commission, 2011).

Nevertheless, rather than grasping all these economic blessings, Chinese firms do suffer in financing constraints that adversely affect their investments and innovation activities (Guariglia & Yang, 2016; Khan, He, Akram, & Sarwar, 2017). Its credit market has higher amount of non-performing loans and stock prices do not represent fundamental values of equity market (Allen et al., 2005). China presents bank based financial system that is mainly controlled by the four largest state-owned banks. But this banking system is not as

\(^1\) RMB51.93 trillion (by national bureau of statistics of China)  
\(^2\) RMB26.54 trillion
developed as in mostly developed economies. Its financial system is also having a fast growing although newly established equity markets in 1990s. But this market’s scale and significance is not analogous with credit market of China. Smaller scale of firms and the inability of markets and institutions to adequately gather and evaluate information have paved the informational problems in countries having less developed financial systems (Stiglitz, 1989). China is also facing this problem as it demonstrated poor law system, inefficient institutions, weak investor protection systems and corporate governance and less robust accounting standards. All these things make topic of our study more interesting.

Asymmetric information existing in financial market is described as the fundamental reason of higher cost of external financing (Akerlof, 1970; Greenwald & Stiglitz, 1990). Considering the casual relationship between information asymmetry and financing cost, investment-cash flow sensitivity is believed to be an important signal of financial constraints (Bond, Harhoff, & Van Reenen, 1999; Bond & Meghir, 1994b; Fazzari, Hubbard, Petersen, Blinder, & Poterba, 1988; Schiantarelli, 1996). Even though different explanations for such sensitivity have been discussed in literature (Chirinko & Schaller, 1995; Degryse & De Jong, 2006; Kaplan & Zingales, 1997) it is believed unanimously that investment-cash flow sensitivity is the best predictor of financial constraint (Allayannis & Mozumdar, 2004; Alti, 2003; Lyandres, 2007).

It is not the matter of investment in capital goods and tangible assets only that are affected in the presence of financing constraints. Whereas, investments in intangible assets (like innovation related research and development activities) are affected more by liquidity effects due to peculiar characteristics of these types of investments. A distinguishing feature of investment on tangible assets than that of intangible assets is the perceived higher level of uncertainty that is associated with every R&D project. This uncertainty remains higher until the outcome of that project becomes visible in the near future. However, motivated and enthusiastic management still wants to continue an R&D project even with the negligible likelihood of its success, and even the project could not qualify by expected return tests like NPV, PBP etc. These facts create two more issues in financing point of view. First, financial markets and institutions would require the
higher rate of return to finance R&D projects of the firm due to uncertainty and sensitivity about perceived knowledge base and its practicability. Second, the impact of changes in the cost of capital would also be difficult to measure due to the slow and inactive response of R&D project. Recently, (Hall, 1992; Hao & Jaffe, 1993; Himmelberg & Petersen, 1994; Kathuria & Mueller, 1995) have produced evidence that liquidity effects are pronounced strongly in investments over R&D activities. But there is no such study which has considered the effects of financing constraints on both investments on tangible as well as intangible assets per se. Present study fills this gap.

The purposefulness of this research is to explore whether Chinese firms face financial constraints on overall investments and investment on innovative activities due to market imperfections using a dynamic investment models. Using panel data methodology, study also provides annual assessment of firms more prone to be under financial constraints. China has gained less consideration in largely available stream of financial literature that has stressed the association of financial constraints, corporate investments and innovation, may be because of peculiar nature of its financial system, corporate structure and economy. And the researchers who tried to study the relationship of financial constraints on corporate investments of Chinese firms, could not discuss this relationship by considering the distinct characteristics of innovation activities. The contribution of this paper is twofold. First, study further explores previous evidence on financial constraints to the Chinese context. Second, study employs a more robust empirical specification by introducing the possibility of yearly changes in firms’ liquidity scenario to specify the impact of financial constraints, as such to avoid the shortcomings of the too rigid a priori classification criteria (Bassetto & Kalatzis, 2011).

The remainder organization of the research paper is set as follows: Section two differentiates the characteristics of investment on corporate expenditures and innovation activities; section three discusses and builds hypothesis; section four presents methodology, data description, test statistics, results and discussion. Last section gives the concluding remarks.

**Different type of investment: capital goods verses innovation**

contrasted with investment on capital goods, investment on innovation has
peculiar characteristics. To start with, they are by and large characterized by high adjustment costs. By and by, around half of innovation investment expenditures is comprised of wages, remuneration and salaries of research staff, including profoundly skilled personnel, researchers, scientists, engineers and different experts. These sorts of workers are likewise described by considerable contracting, terminating and preparing costs (Hall & Lerner, 2010). Grabowski, (1968) indicated that the supply of research personnel and scientists isn't perfectly elastic. These laborers can't hence be subjectively let go amid downturns and in this manner rehired. Maybe more critically, different genuine misfortunes would develop if let go authorities were rehired by the association's rivals. Would the preparation spending end up noticeably sunk, as well as the adversary would emulate innovations and advantage from the transmission of profitable learning (Himmelberg & Petersen, 1994). Pakes & Nitzan, (1983) and Pakes and Nitzan (1983) bring up that organizations which make unique innovations ought to give high wages to profoundly talented specialists to guarantee their maintenance and abstain from setting up an opponent. (Bernstein & Nadiri, 1989) propose that the minimal change expenses of R&D capital are reliably bigger than those of physical venture for generally enterprises. Additionally, (Bernstein & Mohnen, 1998) presume that extensive change costs exist in both the US and Japanese innovation intensive divisions. The second distinguishing feature for innovation investment is its high level of vulnerability, producing from its absence of collateral, irreversibility, uncertain long-term returns, and market impact. As indicated by Hall (1992), patents can't be effortlessly utilized as insurance, because these advancement forms are probably going to be firm-particular and their innovation is still immature.

Moreover, the costs brought about to attempt innovation are typically altogether irreversible, since they are gone for pursuing examination particular hardware and materials, and paying the wages of research staff. Moreover, since Innovation is a sequence of adopting longstanding steps of R&D (examination, preparation, incubation, analysis, illumination, check and application), capital employed in innovation investment is type of long term investment as it is tied with long term project. Firms are dubious about how much exertion and materials are eventually
expected to finish each activity (Pindyck, 1993). Last but not least, no one can be sure about the market demand or acceptance of innovative products as their fortune is uncertain till they are launched in the market. (Tyagi, 2006). In this manner, in light of this extraordinary vulnerability, outer lenders, similar to banks and stock market financial specialists, are hesitant to put their funds in innovative ventures.

**Development of Hypothesis**

Concept of the relationship of finances and investment is not new. Researchers have been trying to explore its different dimension and implications for centuries (Meyer & Kuh, 1957). Its fiercely debate started with influential papers by (Jaffee & Russell, 1976; Stiglitz & Weiss, 1981) which have pointed out the possible equilibrium credit rationing by lenders. The basic postulate was the notion of asymmetric information between borrower and lender. Other seminal works by Myers (Myers, 1977; Myers & Majluf, 1984) also proposed causal association between asymmetric information and the firm's preference for internal finance.

The paper by Fazzari (Fazzari et al., 1988) is taken as the first empirical study explicitly building on these issues. This study has ignited the debate contributed by a large number of researchers who provided a large stream of financial stream on this topic, focusing mainly on the implications of the relationship of financing constraints and corporate investments. The complete portrait is still clouded due to the emergence of difficult econometric and conceptual problems. In debates after 1990s, a concept evolved which expresses that cash flow effects on the decisions of corporations may be considered as reflection of financing constraints. (Kaplan & Zingales, 1997).

Contradicting results of various studies illustrate that it is very difficult to quantify the effects of liquidity constraints precisely in a reliable way.

**Asymmetric Information and Financial Constraints**

Credit markets are unique in relation to standard commodity market in that the moneylender conveys an advance on the borrower's guarantee to pay back the advance and premium. The moneylender's assessment of the borrower's capacity to pay back is urgent for the loaning decision. Equilibrium amount apportioning along these lines develops endogenously because of topsy-turvy data (the bank knows less about the borrower than the borrower herself) and deficiency of agreements (legally binding understandings to control
all parts of borrower conduct are infeasible). On account of proportioning, the bank will choose not to allow an advance to the borrower, regardless of whether the borrower offers a higher financing cost than is seen in the market for advances. Subsequently, the supply of credits does not liken the request at the market loan fee.

The fundamental rationale for all credit proportioning marvels is the self-choice and motivating force impacts forced by loan costs. Unfriendly choice happens, since the normal nature of borrowers will be a diminishing capacity of the loan fee charged by the bank. Besides, as the financing cost expands the borrower will be enticed to attempt less secure ventures unless the credit is completely collateralized. In this specific situation, there may exist a financing cost that boosts the moneylender’s benefit in spite of the fact that supply does not equivalent request. Either a few banks are not ready to get any credit, or the advance size will be beneath the one requested by the borrower.

Asymmetric information may likewise lead directors not to issue new equity. In a compelling paper, Myers and Majluf (1984) break down the impact of asymmetric information if supervisors have advantaged information about the genuine estimation of new ventures and associated assets while financiers (equity holders and creditors) just know the little until the projects are uncovered. Insiders are expected to follow up for the benefit of outsiders. Directors will decide to issue new equity only if this isn't to devalue the wealth of existing investors, i.e. on the off chance that the market's assessment of the new stock is over the particular worth for the current investors. In this manner, directors will just issue shares for ventures with not as much as expected value. Therefore, issuing offers will be seen by the new speculators as an awful flag. Suspecting this, the firm won't issue new offers regardless of whether the activities have positive net present value. In this manner, financing constraints have negative impacts on future investments.

The conclusions that can be gotten from the Myers/Majluf and different models are quite strong. Given that there is no conflict of interest between insiders and outsiders, firms will get financing in pecking order, i.e. it will prefer internal financing over external financing and if it needs external financing due to unavailability of internal, it will prefer debt financing over issuance of new equity (Bond et al., 1999; Harhoff, 2000; Myers & Majluf, 1984). Moreover,
issuing new offers will regularly prompt a decrease in the stock price. The both views have been strengthened by some observational support. When slack assets are depleted, the firm should get to fulfill its capital needs. The costliest sort of capital will be new equity. Now and again, the firm will preferably decline a venture opportunity than to issue debt. Positive cash flows will prompt greater likelihood to invest in such situations. Note that in the postulates of pecking order financing, there is no well-defined optimal capital structure as it exists in the static Modigliani-Miller theory of capital structure. The model created by Myers and Majluf does not specifically relate with capital structure, but rather the accessibility of slack assets to venture spending (Harhoff, 2000). In a roundabout way, however, the model recommends an intention in prudent corporate saving. Prior work by (Myers, 1977) additionally remarks on the connection between capital structure and the idea of firms’ investments. Assume that the genuine estimation of the firm is given by the estimation of the value of its assets and the estimation of the value of future investment projects. But the estimation of the value of future investment depends whether a firm exploits this opportunity or not. These opportunities act like call options. Suppose firm exploit this opportunity by issuing risky debt, that will create a wedge between marginal value of equity than that of debt. This situation more likely leads the firm to suffer by underinvestment. Besides, lending might be apportioned in this specific circumstance. Value of the firm decreases with leverage in view of rational lenders and equity holders. Myers concludes with the view that more the firm’s value is determined by growth opportunities relative to set up assets, the more it will favor equity financing to escape underinvestment. An implication of this theory conveys that an innovative firm with lesser tangible assets, should prefer to issue equity over debt. Several researchers have tried to test the existence of financing constraints by examining the influence of a change in cash flow on firm level activities. It is well understandable that a firm has to cut short its inventory accumulation and capital expenditures if its cash flow fall down in the situation when the firm is financially constrained, as the firm will be dependent upon expensive external case in such case. On the other hand, if a firm is not financially constrained, dropping out of cash flows will not affect firm level decisions as it can
fulfill its financing need by external sources of financing. It means financially healthy firms can replace the missed internal finance by external one easily or at the same cost from credit or equity markets (perfect market hypothesis). But markets exhibit imperfections due to presence of asymmetric information. This approach to test the liquidity issues was introduced by Fazzari and Peterson (Fazzari et al., 1988) who focused on corporate capital investment. Later researches also supported this argument (Bond & Van Reenen, 2007; Hubbard, 1998).

**Financial constraints and investments**

The seminal MM theory states that in an immaculate and perfect capital market, decisions about future investments are not influenced by the way firms fund themselves (Modigliani & Miller, 1958). This theory has implication that in order to maximize its value, firms will exploit every investment opportunity unless its marginal revenue becomes equal to its marginal cost.

Notwithstanding, substantial empirical researches have demonstrated prominent positive correlation between cash flows and investment opportunities catered (Bond & Van Reenen, 2007; Cleary, 1999; Cumming, Hou, & Lee, 2012; Fazzari et al., 1988; Hubbard, 1998).

There are various theories that are described as reason behind this positive association between cash flows and investments. Most famous one is information asymmetry theory that we have presented in theoretical evidence in previous section. See for example (Carpenter & Guariglia, 2008; Chen, Sun, & Xu, 2016; Fazzari et al., 1988; Guariglia & Yang, 2016; Myers & Majluf, 1984; Richardson, 2006); all these studies provide substantial evidence to recommend that the positive relationship between cash flows and investment comes from the phenomenon of information asymmetry. This can be clarified considering that when outside fund, for example, bank advances, obligation and value are utilized, the imperfections in capital markets prompt a cost premium. The cost as well as difficult accessibility of external finance drive the firms to utilize internal finance, that is retained earnings mostly. In these conditions, financially compelled firms may need to forego great venture tasks to stay away from the too much high cost premiums related with the utilization of external finance. Therefore, “a higher sensitivity of under-investment to cash flow can be seen as evidence of financial constraints” (Guariglia & Yang, 2016; Khan et al., 2017).
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H1: Market imperfections affect firm’s efficiency of capital expenditure, such that firms face financial constraints for investment.

H2: Firms that are priori more prone to suffer financial constraints are more vulnerable of imperfections prevailing in the financial market. As a consequence, investment of such firms is significantly sensitive to their cash flows.

Financial Constraints and Innovation:
Past exploration discovered huge impacts of financing constraints on innovation, but all these studies remained to confine their study in developed countries only. Very few studies have been conducted in developing economies because innovation is not very prominent over there. A recent study conducted by (Guariglia & Liu, 2014) encompasses the effects of financial constraints on innovative activities of Chinese unlisted companies and confirmed that innovation is affected by financing constraints. We test this imperative on listed companies of China. However, of the best about our knowledge, no paper need tried to the vicinity about these impacts in the Chinese connection. Done late years, some papers have studies the impacts of financial constraints on fixed investments (Ding, Guariglia, & Knight, 2013; Guariglia, Liu, & Song, 2011; Guariglia & Yang, 2016; Khan et al., 2017; Poncet, Steingress, & Vandenbussche, 2010). Because of those defect What's more underdevelopment of the Chinese money market, we have confidence that Chinese firms' innovation activities are probable to suffer from financing constraints.

H3: Market imperfections affect firm’s efficiency to finance its innovation activities, such that firms face financial constraints for investment.

H4: Firms that are priori more prone to suffer financial constraints are more vulnerable of imperfections prevailing in the financial market. Consequently, innovation investment of such firms is significantly sensitive to their cash flows.

Methodology
Econometric specifications for investment are explained by different models. Most famous are investment accelerator model, error-correction, Euler Equation and Tobin’s Q models (Agung, 2000; Bean, 1981; Bond & Meghir, 1994a; Galeotti, Schiantarelli, & Jaramillo, 1994; Whited, 1992). Under the investment theory framework, dynamic investment models have been proposed to incorporate expectations related to investment not
present in previous models (Chirinko & Schaller, 1995). All these models have contributed equally in developing the knowledge base of corporate investments. But for our topic Tobin’s Q and Euler Equation model is preferred. Tobin’s q model has been developed in such a way that it captures firm growth opportunities as a way to explain firm investment. Under the premise of perfect capital markets, q should be the only determinant for investment. However, due to presence of market imperfections, other variables in Q model have also taken their position (Crisóstomo, López-Iturriaga, & Vallelado, 2011). In the same vein, cash flow has become significant coefficient that is translated as signaling that internal and external funding are not perfect substitutes (Bhagat, Moyen, & Suh, 2005; Fazzari et al., 1988). To overcome the deficiencies of Q model, dynamic investment specifications based on the Euler equation have been introduced. Unlike the Q model, Euler models do not rely on information from stock markets as do q models (Schiantarelli, 1996).

**Euler Equation model**

The present study investigates the effects of liquidity constraints by estimating a dynamic investment model based upon Euler equation that is based upon pecking order hypothesis.

In the absence of liquidity constraints, no investment-cash flow sensitivity is expected. Specifically, denoting by I the investment of firm, measured as the increase in K during the current year where K is capital stock of firm, ; with cash flow (CF), defined as the sum of net profits and depreciation ; with sales (S), which is a proxy for output fluctuations; with debt (D), we estimate following Euler equation model:

\[
\left( \frac{I}{K} \right)_{i,t} = \delta + \beta_1 \left( \frac{I}{K} \right)_{f,t-1} + \beta_2 \left( \frac{I}{K} \right)_{f,t-1}^2 + \beta_3 \left( \frac{CF}{K} \right)_{f,t-1} + \beta_4 \left( \frac{S}{K} \right)_{f,t-1} + \beta_5 \left( \frac{D}{K} \right)_{f,t-1}^2 + \chi_f + \chi_t + \chi_{i,t} + \varepsilon_{f,t}
\]

(1)

In Equation 1, subscript \( t \) refers to the period and \( i \) refers to firm. The error term in Equation is made up of four components. \( \chi_f \) is error term related to firm-specific effects, which we control for by including time dummies capturing business cycle effects; \( \chi_t \), a time specific effects; \( \chi_{i,t} \) is industry specific effect, which we control
for by including industry dummies; \( \chi_{lt} \) takes into account industry-specific business cycle, which we take into account by including industry dummies interacted with time dummies; \( \varepsilon_{f,t} \) is an idiosyncratic component.

\[
\left( \frac{R}{K} \right)_{i,t} = \delta + \beta_1 \left( \frac{R}{K} \right)_{f,t-1} + \beta_2 \left( \frac{R}{K} \right)_{f,t-1}^2 + \beta_3 \left( \frac{CF}{K} \right)_{f,t-1} + \beta_4 \left( \frac{S}{K} \right)_{f,t-1} + \beta_5 \left( \frac{D}{K} \right)_{f,t-1}^2 + \\
\chi_f + \chi_t + \chi_{lt} + \varepsilon_{f,t}
\]  

(2)

Following (Bond & Meghir, 1994a; Goergen & Renneboog, 2001; Lima Crisóstomo, Javier López Iturriaga, & Valledaldo González, 2014), our study uses an augmented model in which interacted variables have been introduced to account for financial constraints effects. In this extended model, we make the interaction term of the dummy variable for financial constraint (DFC) with each of the determinant in model 1. \( DCF_{f,t} \) measures the presence or absence of financial constraints of firm \( i \) in year \( t \). Dummy variable \( DCF_{f,t} \) gets the value of 1 when the firm-year observation is evaluated as under financial constraints, and zero otherwise.

\[
\left( \frac{I}{K} \right)_{i,t} = \delta + \beta_1 \left( \frac{I}{K} \right)_{f,t-1} + \beta_2 \left( \frac{I}{K} \right)_{f,t-1}^2 + \beta_3 \left( \frac{CF}{K} \right)_{f,t-1} + \beta_4 \left( \frac{S}{K} \right)_{f,t-1} + \beta_5 \left( \frac{D}{K} \right)_{f,t-1}^2 + \\
+ \beta_1 \left( \frac{I}{K} \right)_{f,t-1} \ast DCF_{f,t-1} + \beta_2 \left( \frac{I}{K} \right)_{f,t-1}^2 \ast DCF_{f,t-1} + \beta_3 \left( \frac{CF}{K} \right)_{f,t-1} \ast DCF_{f,t-1} + \beta_4 \left( \frac{S}{K} \right)_{f,t-1} \ast DCF_{f,t-1} + \beta_5 \left( \frac{D}{K} \right)_{f,t-1}^2 \ast DCF_{f,t-1} + \\
\chi_f + \chi_t + \chi_{lt} + \varepsilon_{f,t}
\]  

(3)
The corresponding R&D model can be written as follows:

\[
\left( \frac{R}{K} \right)_{i,t} = \delta + \beta_1 \left( \frac{R}{K} \right)_{f,t-1}^2 + \beta_2 \left( \frac{R}{K} \right)_{f,t-1} + \beta_3 \left( \frac{S}{K} \right)_{f,t-1} + \beta_4 \left( \frac{D}{K} \right)_{f,t-1}^2 + \beta_5 \left( \frac{D}{K} \right)_{f,t-1} + \beta_1 \left( \frac{R}{K} \right)_{f,t-1} \cdot DCF_{f,t-1} + \beta_2 \left( \frac{R}{K} \right)_{f,t-1}^2 \cdot DCF_{f,t-1} + \beta_3 \left( \frac{CF}{K} \right)_{f,t-1} \cdot DCF_{f,t-1} + \beta_4 \left( \frac{S}{K} \right)_{f,t-1} \cdot DCF_{f,t-1} + \beta_5 \left( \frac{D}{K} \right)_{f,t-1} \cdot DCF_{f,t-1} + \chi_f + \chi_t
\]

In order to analyze the role of financial development and financial structure upon financially constrained and non-financially constrained firms, we split the sample into two classifications. Basic intention is to find how explanatory variable determine the behavior regarding the investment of the firms in the scenario when firms have financing constraints and when firms have not financing constraints. One advantage to gain by this is to allow the firms degree of financial constraints change by each period, thereby changing the financial status of the firm vary through time dimension. To get this objective practically, we employ KZ index of financial constraints. This index acts as like its higher values signalizes the higher financial constraints. For each firm, we compute KZ index value for each year. We calculate the median value of whole sample and divide the sample into financially constrained or financially unconstrained on the basis of this median value.

The KZ index proposed by Lamont et. Al. (2001) is as follows:

\[
KZ_{it} = -(1.002 \frac{CF}{K_{t-1}})_{it} + (0.283Q)_{it} + (3.139 \frac{CD}{TotCap})_{it} - (39.368 \frac{Div}{K_{t-1}})_{it} - (1.315 \frac{Cash}{K_{t-1}})_{it}
\]

where \( K_{it} \) is capital stock; \( CF_{it} \) is the cash flow; \( Q_{it} \) is Tobin’s Q; \( D_{it} \) is debt; \( TotCap_{it} \) is total capitalization; \( Div_{it} \) is the dividends; \( Cash_{it} \) is cash and marketable securities. The data used in this paper are derived from the CSMAR and RESSET databases. These databases are constituted by the financial
records of all the companies listed in either Shanghai or Shenzhen stock exchange during the period 1994–2015. Following up a classification of (Hall & Lerner, 2010) and (Guariglia & Liu, 2014), we select only high tech firms. High-tech firms belong to industries of Chemical & Plastic, Machinery & Equipment, Electrical Equipment, Transport Equipment, medicine & precision, computer equipment, telecommunication, aviation, and aerospace.

To minimize the potential influence of outliers, we winsorize data observations in the one percent tails for the main regression variables. At last, we omit the data of all those firms which have less than three years of consecutive observations. All variables are deflated using the GDP factor (derived from National Bureau of Statistics of China). Hence, we get our final sample consists of 665 high tech listed listed firms.

**Results and Discussions**

Our study employs the panel data estimation techniques to treat the unobservable heterogeneity associated with fixed firm effects. Estimation results for the whole sample of Chinese firms, shown in Table 2, lead us to reject null hypothesis of perfect markets and the absence of financial constraints (H1). It portrays that Chinese financial markets are imperfect and Chinese firms face financing constraints. Results also report the positive significant relationship between investment and cash flow. Direction of this relationship portrays that Chinese firms face difficulties in accessing external funds and are thus forced to use internal funds to finance investment. This notion also expresses that Chinese financial markets are imperfect due to presence of information asymmetry that results in financing constraints. Same results are reported for the relationship of financial constraints and innovation investments.

Results reported in table 2 lead us to accept H2 illustrating that investments of firms a priori categorized as more likely to be in liquidity troubles are more sensitive to their financing constraints. Table 2 reports coefficients of equation 3 and 4 estimates under which a firm is classified as financially constrained on the basis of KZ index. Results show that the subsample of firms classified as under financial constraints exhibits a significant positive sensitivity of investment to cash flow.

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3 Our sample period is 2004 to 2015 as data for R&D expenditures prior to 2004 were unavailable.
\[(\frac{CF}{K})_{f,t-1} \times DCF_{f,t-1}\] in contrast to the absence of such a correlation in the whole sample \[(\frac{CF}{K})_{f,t-1}\]. In addition to the results on investment-cash flow sensitivity, it is worth mentioning that financially constrained firms are less persistent on investment since the lagged investment term is negative and significant for such group of firms \[(\frac{I}{K})_{f,t-1} \times DCF_{f,t-1}\].

Same results are reported for equation 4 which encompasses the effect of financial constraints on innovation.

Table 2: Estimation results for the Euler equation model for financially constrained firms

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<td>(.0242)</td>
<td>(.0524)</td>
<td>(.0328)</td>
<td>.0251</td>
</tr>
<tr>
<td>((\frac{S}{K})_{f,t-1})</td>
<td>.0284***</td>
<td>.01457</td>
<td>.1034***</td>
<td>.0654</td>
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<tr>
<td></td>
<td>(.0183)</td>
<td>(.0052)</td>
<td>(.0232)</td>
<td>.0095</td>
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<tr>
<td>((\frac{D}{K})^{2}_{f,t-1})</td>
<td>.0064</td>
<td>.00245</td>
<td>.0032</td>
<td>.0052</td>
</tr>
<tr>
<td></td>
<td>(.0048)</td>
<td>(.0025)</td>
<td></td>
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<tr>
<td>((\frac{I}{K})<em>{f,t-1} \times DCF</em>{f,t-1})</td>
<td></td>
<td></td>
<td>-.2739***</td>
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<tr>
<td></td>
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<td>(.0964)</td>
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<tr>
<td>((\frac{I}{K})^{2}<em>{f,t-1} \times DCF</em>{f,t-1})</td>
<td></td>
<td></td>
<td>.2885***</td>
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<td>.0984</td>
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<tr>
<td>((\frac{R}{K})<em>{f,t-1} \times DCF</em>{f,t-1})</td>
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<td>.1084</td>
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Conclusion

After the pioneering paper of Fazari (Fazzari et al., 1988), The influence of financial constraints on corporate fixed investment have been extensively debated. Fazzari’s study gave the direction to future researchers that investment cash flow sensitivity may be used as an indicator of financing constraints. After that, a large stream of literature ahs used that indicator to analyze the impact of of financial constraints on other corporate activities, such as inventory investment, employment, and export participation. Unfortunately, the crucial effects of financing constraints on innovation has been ignored particularly in developing countries like China. Our study fills this gap by not only studying the effects of financing constraints on capital investments, but also on innovation investments.

Based on a sample of 665 high-tech firms quoted in the Shenzhen stock exchange and Shanghai stock exchange during period 2004-2015, a dynamic investment models have been estimated. Consistent with previous literature we use the sensitivity of investment to cash flow and sensitivity of

| $\left(\frac{R}{K}\right)^2_{f,t-1} * DCF_{f,t-1}$ | .0241 |
| $\left(\frac{CF}{K}\right)_{f,t-1} * DCF_{f,t-1}$ | .3060*** .03251 |
| $\left(\frac{S}{K}\right)_{f,t-1} * DCF_{f,t-1}$ | .0988  .0001 |
| $\left(\frac{D}{K}\right)^2_{f,t-1} * DCF_{f,t-1}$ | -.0547 .0074 |
| Model | FE FE |
| R-sq | 0.92 0.91 |
| Wald | 51.02 68.19 |

Note: Column I,II,III and IV represent the GLS estimation results of equation 1,2,3 and 4 and 4 respectively. *,**,*** represent statistical significance of the coefficients at 1, 5 and 10 percent respectively.
innovation investment as a signal of financial constraints.

Estimating results lead us to arrive at three important conclusions. First; Chinese firms usually face financial constraints problems due to imperfect financial markets. Second; Chinese firms face investment cash flow sensitivity. Third; Chinese high tech firms face innovation investment cash flow sensitivity. Hence, despite the financial efforts of the Chinese government, capital markets are still not efficient and create liquidity constraints. Results depict that firms classified a priori as more prone to financial constraints (based on KZ index) show higher sensitivity to cash flow.

Our paper contributes to the existing stream of literature in regard to informational problems in financial markets of emerging countries. Consistent with most of the literature on the international arena, our study also concludes that financial constraints are emerged as a result of the imperfect substitutability of internal and external funds due to adverse selection. Policy makers should work on efficient disclosure of corporate information. This is done by improving the corporate control mechanism, investor protection measures and developing accounting standards. It would be interesting to investigate whether similar results apply in other developing countries.

References


Galeotti, M., Schiantarelli, F., & Jaramillo, F. (1994). Investment decisions and the role of debt, liquid assets and


