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An Econometric Model of Firms' Investment of Indian Firms

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Abstract: This paper uses a panel of 818 Indian listed firms over the period 2012-2018 to study how the investment-cash flow sensitivity differs across firms facing different levels of internal and external financial constraints, firms with and without state ownership, and firms in different geographical locations. This paper results suggest that the firms facing lower internal constraints have higher investment-cash flow sensitivity, and firms facing higher external constraints have higher sensitivity. The dependency of investment on cash flow is weaker for state controlled firms, especially the large ones, than other firms. Firms in the eastern and central India are subject to significant and stronger financial constraints than firms in western India, which may be closely related to India's regional development policy.

***Keywords*:** Firms' investment; Financial constraints; Error-correction model; India's regional development policy.

1. Introduction

Most of the models in literature on financial structure and investment imply that information asymmetries and incentive problems lead firms to underinvest due to the lack of internal capital and the higher cost of external capital. Frictions in financial markets would cause under price of securities and commercial papers if the investors are worse informed than the firm's manager about the prospects of the firm, and higher interest rates for the borrowers who are more likely to face credit market asymmetries. Thus the potential cost wedge between internal and external funds would have impacts on the investment behaviour of individual firm. Outside financing leads to considerable agency costs that arise when manager's interests are not entirely aligned with those of the shareholders. In both cases, managers would strongly prefer to finance investment with internal funds as they would be cheaper than the external finance. Therefore, firms' liquidity will be an important determinant of their investment if firms facing information and incentive problems. In the presence of sufficient internal funds, such as firms' cash flow, managers may prefer growth to profitability and undertake projects with negative net present value because they may gain more personal benefit by increasing firm size. This could lead firms to overinvest India has been maintaining high levels of capital accumulation and aggregate investment in the past three decades to meet its increasing domestic and foreign demands and fuel the rapid economic development. From 1990 to 2008 India's fixed assets investment had an average annual growth rate of 21.8% (Data source: *India Statistical Yearbook*, various issues, *India Statistics Press, Delhi*). Capital markets have played an important role in firm finance and investment in India. However, many financial market defects influence the roles of financial factors in firms' fixed investment decisions, such as corporate governance associated with agency problems and soft budget constraints, which are both inherited from public ownership structure, fragmented capital market related to information asymmetry problems, and the legal system governing firms' operations and banking and security markets in the presence of government intervention (Love, 2008). Nonetheless, India's economic and financial sector reforms have been deepening in all aspects in recent years. All the reform measures are aiming at building suitable financial institutions, and improving market mechanism and commercial banking and security system, and are expected to contribute to the financing decisions on investment of Indian firms. Hence, there is an obvious need to investigate the relationship between firms' investment decisions and *ex ante* information asymmetry and agency costs in the context of economic transition in India. We will use a sample of listed firms in the Delhi stock exchanges during the period of 2012-2018, to examine how the influence of information and incentive problems vary across firms over time. We also aim to analyse to what extent financial variables significantly influence firms' investment during the financial reform era in India. This research will have momentous policy implications on India's financial market reform, corporate regulation and regional development, which are the priorities of the current Indian leadership under their central theme of developing India into a "harmonious society".

The remainder of the paper is laid out as follows. In Section 2, this paper summarise the main points of the controversy in the finance literature about cash flow's role in determining firms' investment. This paper present some theoretical arguments, supporting the hypothesis that internal and external financial constraints lead to predictions relative to the sensitivity of firms' investment to cash flow. This paper also briefly reviews the current investment decisions and constraints of firms in India. In Section 3, this paper introduces our investment model for the empirical analysis and discusses our estimation methodology. Section 4 describes this paper data set, with some summary statistics. Section 5 presents this paper empirical results and Section 6 concludes with a discussion of our findings and policy implications.

2. Theoretical Predictions

2.1 Financial Constraints and Firms' Investment

Financial system development and growth are found to be closely related both in theoretical and empirical macroeconomics. Financial instruments, markets and institutions may arise to mitigate the effects of information and transaction costs. To ameliorate market frictions, financial arrangements change the incentives and constraints faced by economic agents. Thus, financial systems may influence saving rates, investment decisions, technological innovation and hence long-run growth rates. Financial theory illuminates many of the channels through which the emergence of financial system affect and are affected by economic development. A mounting body of empirical analyses, including firm-level, industrial-level, time-series, panel-investigation and cross-country studies, illustrate a strong positive link between the functioning of the financial system and long-run economic growth.

Modigliani and Miller (1958) theorem suggests that in perfect capital markets, the investment behaviour of a firm is irrelevant to its financing decisions and *vice versa*. However, in the presence of capital market imperfection, financial constraints will reflect on firms' investment decisions. A large microeconometric literature that investigates the role of financial factors in company investment decisions finds evidence that in the well developed market economies like the USA (e.g. Fazzari, Hubbard and Petersen (hereafter FHP), 1988), the UK (e.g. Bond *et al*, 2003a) and Japan (e.g. Hoshi, Kashyap and Scharfstein, 1991), firms face significant financial constraints (see Schiantarelli, 2015; Hubbard, 1998; and Bond and Van Reenen, 2005, for surveys). Findings of a significant correlation between investment and measure of internal (cash flow) or external (debt) funds are usually attributed to capital market imperfections and therefore suggest the incidence of financial constraints.

There are heated debates on whether high sensitivities of firms' investment to their cash flow can be interpreted as indicators of financial constraints, started with FHP (1988) pioneer paper. A number of papers followed support this hypothesis. A significant challenge to FHP (1988) came from Kaplan and Zingales (hereafter KZ) (2018), which rejected the hypothesis.

Guariglia (2008) suggested that the different conclusions reached by these two groups of authors may actually due to the different measurement of financial constraints that they applied. Generally, most studies that have found results supporting those of FHP (1988) considered external financial constraints and accordingly used proxies, such as firms' size (e.g. Carpenter, Fazzari and Pertersen, 2014 & 1998), age (e.g. Devereux and Schiantarelli, 1998), dividend payout ratio (e.g. FHP, 1988), bond rating (e.g. Whited, 2012), as criteria to measure the degree of external financial constraints faced by the firms. They evaluate the extent to which firms are vulnerable to the effects of information asymmetries, which in turn constrain firms' ability of raising external funds.

On the other hand, the majority of the studies that supported the findings in KZ (2018) categorised firm-years according to indicators associated with the level of availability of internal funds to firms. These indicators are used as proxies for firms' degree of internal financial constraints. In particular, KZ

(2018) used variables related to firms' liquidity as their sample separation criteria. Similarly, Cleary *et al.* (2008) construct indices of financial health that are based on measures of financial strength according to traditional financial ratios, which are strongly related to firms' internal funds, e.g. the current ratio and the coverage ratio. They considered that the more internal funds the firms have, the less they can be financially constrained and they found that the firms with the highest level of internal funds had the least sensitivity of investment to cash flow.

These practices strongly suggest that internal and external financial constraints have different effects on the investment cash flow relationship. In this paper, we divide our sample firms using both proxies for internal financial constraints and external financial constraints. Cleary *et al.* (2008) provides the theoretical background for the attempt to distinguish between the effects of the two types of financial constraints on the sensitivity of investment to cash flow. Inspired by Cleary *et al* (2008), Guariglia (2008) using a panel of UK data found that when the sample is split on the basis of the level of internal funds available to the firms, the relationship between investment and cash flow is U-shaped, and, on the other hand, the sensitivity of investment to cash flow tends to increase monotonically with the degree of external financial constraints faced by firms. The results in the paper are consistent with the findings of both FHP (1988) and KZ (2018).

Recent evidence links financial market liberalisation to investment and financing constraints across countries. Employing a sample of 36 countries, Love (2003) finds that financial development positively affects firms' investment by increasing the availability of external finance. Especially, such effect is stronger for financially constrained firms in countries of which financial systems are less developed. In the case of India, which has a relatively small and shallow financial market, this would expect strong constraints for firms.

2.2. Financing Characteristics in India

India represents an interesting exceptional case. Allen *et al.* (2006), among many others, characterises India as a counter example to the findings of the finance and growth literature, as despite its malfunctioning financial system, it is one of the fastest growing economies in the world. Therefore the Indian case may suggest that there might be circumstances under which financial distortions do not obstruct growth. Alternatively the Indian market may have instruments to alleviate the constraints faced by firms. Information about the impact of finance on economic growth will influence the priority that policy makers and advisors attach to reforming financial sector policies.

Mobilisation and allocation of financial resources had been dominated by government in India in the pre-reform period. The allocation of funds largely depended on the government industrial policies, which focused on strategic development in heavy industries, which were typically capital intensive, more for the political purposes rather than economic. The rigid central planning system seriously distorted the market mechanism, misallocated resources, and made the economy highly inefficient. India embarked on its bold programme of reforms and opened itself up to the outside world in the late 1970s. In its adoption of new development strategies, the Indian government put much emphasis on the role of market mechanisms in resource allocation and production efficiency, and on decentralisation in economic decision-making. Since then diversified channels of financing have been introduced to the Indian market. The financial system in India has been changing from a single bank system to a system consisting of a central bank, policy banks, state-owned commercial banks, private banks, foreign banks, stock exchanges, commercial papers, foreign exchanges, futures and options, etc. Before the late 1990s, the development policies were strongly in favour of the eastern coastal area. Firms in the eastern region enjoyed preferential treatments in terms of all means of resources, taxation and public services. The economic gap between the east and the inland had been enlarged significantly.

Before 1990, India's state-owned commercial banks had limited control over their loan decision making. They had to take orders from the government to fund government projects, majority of which were carried out by state-owned enterprises (SOEs), which induced severe soft budget constraints to the SOEs. As commercialisation of banking system was promoted since 1990, decentralisation of credit control and the development of other financial institutions have helped to channel financial resources towards a broad range of sectors in the economy. Hence, the functions of these increasing numbers of financial institutions have improved the market mechanism and relaxed the financial constraints faced by many enterprises, particularly the non-SOEs, in their investment decisions.

Since 1990, ownership reform has been undertaken with the aim of constructing a market economy and establishing a modern corporate system. The private sector was formally recognised as an essential part of the Indian economy for the first time since 1948. As a consequence, the private sector could have access to the formal external financial resources. The rise of stock markets from the early 1990s has promoted the changes in the economic structure and ownership structure and facilitated the rapid growth in the non-state sector. The Indian government has come to realise the importance to stress the development of small- and medium-sized enterprises (SMEs), and has put forth significant efforts to improve the financial environment for them. To support SMEs, some special service system at the local government level, including SME loan guarantee system, credit guarantee institutions, SME service centres and SME credit department within financial institutions, have been established to provide privileged services to SMEs, especially in terms of financing. The Indian state council issued *Some Policy Advices on Encouraging and Promoting the Development of SMEs* in 2000. From 2003, India has put into force the *SME promotion Law*. These measures suggest that the central government has been aware of the financial constraints related to the firm size effect in India, and has greatly promoted the development of relative small firms, and made the external funds easier for them to access.

To meet the increasing demands from the industrial sector and facilitate firms' financing for their investment, the Delhi Stock Exchange (1948) and Bombay Stock Exchange (1878) were established and developed swiftly ever since. This has provided the Indian firms with the opportunities to raise funds through direct finance channel from the public other than government funding and bank credit. The growing diversification of the financing channels has brought significant changes in corporate finance. Firms which are listed in the stock market are subject to market regulations such as information discharge and accounts keeping.

However, Indian firms do not benefit equally from the diversification of financial resources. Due to their own characteristics, such as size, location, ownership, industrial type etc., firms clearly receive different treatment in obtaining loans from financial institutions and raising funds from public markets. India's banking system itself has not been without problems. Yao *et al* (2007), found that during the period 1995-2001 Indian banks had increased their efficiency significantly in general, and that banks facing a harder budget tend to perform better than those heavily capitalised by the state or regional government. Governments have been frequently involved in the credit allocation decisions of state-owned banks. Consequently, banks face severe constraints on their ability to fully perform their role as financial intermediaries, which leads to the problem of soft budget constraints. The state banking system used to suffer badly from the huge sum of cumulated non-performing loans. Although the Indian government has begun to place a considerable emphasis on supporting the development of SMEs and the interior regions in recent years, the allocation of credit by big financial institutions has always been biased towards large firms and the firms located in the efficient areas. As India still lacks a systematic and relatively independent development strategy and long-term policy environment for market discriminated small and private firms and the interior regions, insufficient financial support would impose intense difficulties to the development in these disadvantaged sectors and areas. Furthermore, the Indian government interferes the functioning of capital markets, as the irregularity problem of the markets was vivid, especially in the early development stage of capital markets. The government also interferes with the markets when it wants to send out strong economic signals often for the sake of stability.

The financing environment in India is institutionally different from those in the industrialised countries such as the US and the UK. This raises the question how the investment—cash flow sensitivity model would explain the investment decisions of the Indian firms that are under such transitional economic conditions. Love (2008) argues that since shareholders' rights and legal protections of investors are not clearly defined, the Indian type information and agency problems are overwhelming. As decentralisation and privatisation have been carried out hastily in both the financial sector and the real sector, the market participants incline towards rational behaviour in response to the profit maximisation.

This paper aims to investigate whether the role of financial factors, such as cash flow, in determining firms' investment is similar to the role identified by the exiting literature for the firms in the industrialised countries. This paper uses firm level data to understand whether and how different types of firms are financially constrained.

3. Theoretical Framework

3.1. Model Specifications

The basic econometric model of firms' investment that this paper uses an error-correction model, following Bond *et al* (2003a). It was first introduced into the investment literature by Bean (1981). The basic idea is to construct a long-run specification for firms' demand of capital within a regression model. One can next derive a flexible specification for short-run investment dynamics from this long-run regression model. The short-run dynamic model can be estimated from data and also has the implication for firms' long-run behaviour. This is in sharp contrast to more structural models such as Q models and Euler equations, which are often found in the literature to have the wrong signs on key explanatory variables or to imply implausibly slow speeds of adjustment. The main disadvantage of the error-correction models is that the estimated dynamics compound effects of both capital adjustment and expectation-formation processes. Thus a significant coefficient on cash flow may be due to both financing constraints and the ability of cash flow being a predictor of future sales. Nevertheless, ECM model has been widely used in recent empirical studies of firm investment behaviour.

In the error-correction model the short-run investment dynamics are found from an empirical specification derivation, rather than being imposed a priori. Bloom (2008) shows that the actual capital stock series chosen by a firm under partial irreversibility has a long-run growth rate equal to that of the hypothetical capital stock series that the same firm would choose in the absence of adjustment costs, essentially because the difference between these two series is bonded. This implies that the logarithms of the two series should be cointegrated and thus one can consider an ECM model of capital stock adjustment. This paper uses K_{it} to denote the replacement value of actual capital stock for firm i in period t, and k_{it} its (natural) logarithm. The cointegration relationship indicates that

$$k_{it} = k^*_{it} + e_{it} \quad (1)$$

where k_{it}^{*} is the capital stock this firm would have chosen if capital adjustment is costless, and e_{it} is a stationary error term. This paper can specify this hypothetical frictionless level of the capital stock as

$$k_{it}^{*} = s_{it} + \varepsilon_i + \varepsilon_t \quad (2)$$

where s_{it} denote the logarithm of real sales (representing output), and ε_i and ε_t are unobserved firm-specific and time-specific effects reflecting possible variation across firms in the components of and response to the user cost of capital (Chetty, 2008). This paper can therefore impose the assumption as in the simple neoclassical model, in which it is assumed that sales and capital stock are proportional in the long run. Meanwhile, in the short run the dynamics relating these two variables are specified in an *ad hoc* distributed lag form (Mairesse *et al*, 1999). Assuming the absence of adjustment costs, this paper can specify the long-run desired level of capital stock as a log-linear function of output and the user cost of capital. Letting c_{it} denote the logarithm of the real user cost of capital, this paper writes the desired capital stock as

$$k_{it} = a_i + s_{it} - \sigma c_{it} \quad (3)$$

where a_i is a firm-specific intercept, which may reflect a firm-specific markup parameter in a monopolistic competition framework, or a firm-specific distribution parameter in the production function. In the absence of any adjustment costs or barriers to immediate adjustment, this would be consistent with firms' profit maximisation subject to constant return to scale Constant Elasticity of Substitution (CES) production function (Arrow *et al*, 1961) and iso-elastic demand. This implies that the logarithms of the actual capital stock and real sales are cointegrated, provided the user cost of capital is stationary (Bloom *et al*, 2007). This log-linear formulation nests the possibility of a fixed capital-output ratio (σ = 0), and this formulation with σ = 1 is also consistent with a Cobb-Douglas production function (Cobb and Douglas, 1928), with or without constant return to scale (The derivation of eq. (3) can be referred to Appendix A in Mairesse *et al* 1999). This paper can construct this equation (3) within a general dynamic regression model, taking into account slow adjustment of the actual capital stock to the desired capital stock level. This implicitly assumes that the firm's desired capital stock in the presence of adjustment costs is proportional to its desired capital stock in the absence of adjustment costs, and that the short-run investment dynamics are stable enough over the sample period to be well approximated by the distributed lags in the regression model.

This paper specify a dynamic adjustment mechanism between k and s as an autoregressive-distributed lag model with up to second-order dynamics (an ADL (2,2) model), which nests equation (3) as its long-run solution. This paper also assumes that variations in the user cost of capital term c_{it}

can be controlled for in the equation by including time-specific and firm-specific effects. These assumptions yield the following accelerator-type equation:

$$k_{it} = b + \alpha_1 k_{i,t-1} + \alpha_2 k_{i,t-2} + \beta_0 s_{it} + \beta_1 s_{i,t-1} + \beta_2 s_{i,t-2} + v_i + v_t + e_{it} \tag{4}$$

where b is a constant term, v_i is an unobserved firm-specific time-invariant heterogeneity influencing firms' performance, for example, firms' culture, background, managerial skills etc., v_t is a time dummy accounting for possible business cycle effects common to the entire industrial sector and e_{it} is an idiosyncratic error term. It is convenient to parameterise this ADL model into error-correction form:

$$\begin{aligned}\Delta k_{it} &= b + (\alpha_1 - 1)\Delta k_{i,t-1} + \beta_0 \Delta s_{it} + (\beta_0 + \beta_1)\Delta s_{i,t-1} - (1 - \alpha_1 - \alpha_2)(k_{i,t-2} - s_{i,t-2}) \\ &+ (\beta_0 + \beta_1 + \beta_2 + \alpha_1 + \alpha_2 - 1)s_{i,t-2} + v_i + v_t + e_{it}\end{aligned} \tag{5}$$

which expresses the growth rate of capital stock as a function of both growth rates and levels of information including: its own lagged growth rate, the growth in current and one-period-lagged sales, and an error-correction term of the log of the capital-output ratio and a two-period-lagged sales scale factor. The first three growth variables in the equation (5) capture the short-run dynamics, while the last two terms provide simple *t*-tests for error-correction behaviours. The error-correction coefficient, $-(1 - \alpha_1 - \alpha_2)$, is expected to be negative, implying that if firm's capital is less than its desired level the future investment will be higher and *vice versa*. This paper also expect that the scale coefficient, $(\beta_0 + \beta_1 + \beta_2 + \beta_1 + \beta_2 - 1)$, will not be significantly different from zero, as equation (3) implies that the long-run elasticity of capital with respect to sales (output) is unit (Equation (1) and (2) imply that $\beta = \beta_0 + \beta_1 + \beta_2$ and $\alpha = 1 - \alpha_1 - \alpha_2$, and $\beta/\alpha = 1$. This will be the case if a Cobb-Douglas function or a CES function with constant returns to scale is a good enough approximation to the underlying production function (Mairesse *et al*, 1999)). Equation (3) and (4) imply that $\beta = \beta_0 + \beta_1 + \beta_2$ and $\alpha = 1 - \alpha_1 - \alpha_2$, and $\beta/\alpha = 1$. This will be the case if a Cobb-Douglas function or a CES function with constant returns to scale is a good enough approximation to the underlying production function (Mairesse *et al*, 1999).

Thus, imposing the long-run unit-elasticity restriction $(\beta_0 + \beta_1 + \beta_2)/(1 - \alpha_1 - \alpha_2) = 1$, this gives:

$$\begin{aligned}\Delta k_{it} &= b + (\alpha_1 - 1)\Delta k_{i,t-1} + \beta_0 \Delta s_{it} + (\beta_0 + \beta_1)\Delta s_{i,t-1} \\ &- (1 - \alpha_1 - \alpha_2)(k_{i,t-2} - s_{i,t-2}) + v_i + v_t + e_{it}\end{aligned} \tag{6}$$

This error-correction specification is simply a parameterisation of the same equation (4) so that it retains information about long-run equilibrium between capital and sales in addition to the short-run relationship between the growth rates of these two variables.

Finally, letting I_{it} denote gross investment of firm i in period t and δ_i the (possible firm-specific) rate of depreciation, we can use the approximation

$$\Delta k_{it} = \log\left(\frac{K_{it}}{K_{i,t-1}}\right) = \log\left(1 + \frac{\Delta K_{it}}{K_{i,t-1}}\right) \approx \frac{\Delta K_{it}}{K_{i,t-1}} \approx \frac{I_{it}}{K_{i,t-1}} - \delta_i \tag{7}$$

to obtain a specification for the investment rate, i.e. a firm's change of capital stock, taking depreciation into account, is approximately its investment rate. Substituting the current and lagged capital stock growth rates in equation (6) by their correspondent investment to capital stock ratios, the firm-specific depreciation rate disappears in the model, since it does not vary over time.

To investigate the role of financial variables in firms' investment decisions, following the financial constraints literature we augment the additional current and lagged cash flow CF_{it} terms into the estimation equation. Thus this paper obtains a model for the investment rate rather than the growth rate of the capital stock:

$$\begin{aligned} \frac{I_{it}}{K_{i,t-1}} &= b + \rho \frac{I_{i,t-1}}{K_{i,t-2}} + \gamma_0 \Delta s_{it} + \gamma_1 \Delta s_{i,t-1} + \phi(k_{i,t-2} - s_{i,t-2}) \\ &+ \pi_0 \frac{CF_{it}}{K_{i,t-1}} + \pi_1 \frac{CF_{i,t-1}}{K_{i,t-2}} + v_i + v_t + e_{it} \end{aligned} \tag{8}$$

In the model, investment and cash flow variables are all normalised by beginning-of-period capital stock. This can control for possible heteroscedasticity due to differences in firm size.

This type of ECM model, which allows for flexible adjustment of the capital stock toward its long-run equilibrium value, is a commonly used specification for estimating reduced-form empirical investment equations. This paper has, however, to treat the interpretation of this model with caution, because, as emphasised in the introduction, in this reduced-form investment equation, the interpretation of the additional financial variable is ambiguous. Cash flow may actually contain information about firms' future investment opportunities. For example, if the firm faces strictly convex adjustment costs, one can show that the current level of capital stock would depend not only on current output and prices, as in equation (3), but also on the inherited level of the capital stock, and on expectations of future output and prices. Thus a significant relationship between cash flow and investment could be simply caused by the correlation between them rather than financial constraints on the firms. If information on cash flow helps to forecast output, for example, such information will help to explain investment spending in a reduced-form model, even in the absence of financial constraints. A simple illustration can show these implications clearly. Suppose that the desired capital stock in the absence of adjustment costs is proportional to output (sales), and that the actual capital stock in the presence of adjustment costs is given by

$$k_{it} = \alpha k_{i,t-1} + \beta s_{it} + \psi E_t[s_{i,t+1}] \tag{9}$$

where $E_t\,[s_{i,t+1}]$ denotes the expected value of $s_{i,t+1}$ given information in period t. Evidently, if expectations of future output depend on financial variables as well as past output, then these financial variables would be significant in a reduced form model of investment, even in the absence of financing constraints. For example, if

$$E_t[s_{i,t+1}] = \eta_0 s_{it} + \eta_1 s_{i,t-1} + \eta_2\left(\frac{CF_{it}}{K_{i,t-1}}\right) + \eta_3\left(\frac{CF_{i,t-1}}{K_{i,t-2}}\right) \tag{10}$$

then by substitution we can obtain the reduced form model:

$$k_{it} = \alpha k_{i,t-1} + (\beta + \psi\eta_0)s_{it} + \psi\eta_1 s_{i,t-1} + \psi\eta_2\left(\frac{CF_{it}}{K_{i,t-1}}\right) + \psi\eta_3\left(\frac{CF_{i,t-1}}{K_{i,t-2}}\right) \tag{11}$$

which illustrates how these models compound influences from the structural adjustment process (ψ) and the expectations-formation process (η_n, n = 0, 1, 2, 3) (Bond *et al.*, 2003b).

Whilst this is apparently the case for reduced form models, any mis-specified structural models will be affected by this kind of problem as well (Bond *et al.*, 2003b). Many studies have therefore focussed on differences in the coefficients on financial variables between different sub-samples of firms. For this reason we will emphasise differences in the results on the cash flow terms between different types of firms. However, following Bond *et al.* (2003b)'s method we will go one further step beyond the common practice in the literature by investigating whether differences in the cash flow coefficients in the investment equations can be accounted for by differences in the ability of cash flow to forecast firms' future sales growth, i.e. by differences in the η_n coefficients in VAR models of real sales. This paper also include firms' investment rate, as obviously it affects firms' future output. The VAR forecasting equation for real sales has the following form:

$$s_t = d + s_{t-1} + s_{t-2} + \frac{CF_{t-1}}{K_{t-2}} + \frac{CF_{t-2}}{K_{t-3}} + \frac{I_{t-1}}{K_{t-2}} + \frac{I_{t-2}}{K_{t-3}} + v_i + v_t + e_{it} \tag{12}$$

where d is a constant term. If firms' cash flow does not help with forecasting their future sales, then significant cash flow effects in the investment equation might indeed indicate the existence of financial constraints.

In imperfect markets, financial leverage is also an important determinant of investment decisions (Bond and Meghir, 2014). High leverage is related to bankruptcy costs and agency costs. Thus high-leveraged firms have to pay a higher premium on external finance, leading to a negative effect on their investment. Higher level of leverage suggests that a greater proportion of firms' cash flow must be used to meet their interest payment on debt. When their cash flows fall, firms may have difficulty to meet their obligations on debt, and, consequently, the likelihood of bankruptcy increases. Firms with high leverage may also be expected to have higher agency costs. High-leveraged firms may invest in excessively risky projects due to the limited liability nature of debt contracts. Myers (2007) shows that a firm's debt overhangs may induce it to forego profitable investment opportunities, even when managers are fully aligned with shareholders' interests. In India, corporate borrowing started to increase significantly in 1988 when India's banking system reform began. The banking sector has been the dominant source of corporate financing since then. Therefore, we include current and lagged total debt variables TD_{it} normalised by firms' capital stock in the regression model, as firms' investment decisions in India are likely to respond to the debt-related costs. The error-correction model we estimate then has the form:

$$\frac{I_{it}}{K_{i,t-1}} = b + \rho \frac{I_{i,t-1}}{K_{i,t-2}} + \gamma_0 \Delta s_{it} + \gamma_1 \Delta s_{i,t-1} + \phi(k_{i,t-2} - s_{i,t-2}) + \pi_0 \frac{CF_{it}}{K_{i,t-1}} + \pi_1 \frac{CF_{i,t-1}}{K_{i,t-2}} + \varphi_0 \frac{TD_{it}}{K_{i,t-1}} + \varphi_1 \frac{TD_{i,t-1}}{K_{i,t-2}} + v_i + v_t + e_{it} \quad (13)$$

In this error-correction specification, in addition to assessing the sign of the coefficients, we can test whether the financial variables play the role of a long-run determinant of investment, or whether they are only short-run variables which can be interpreted as reflecting the transitory availability of funds for investment purposes. A significant cash flow effect could reflect the long-run cash flow effects on investment as well as short run effects. This might indicate the presence of financial constraints on investment. When firms are financially constrained, an increase in the cash flow, which is assumed to convey no new information about firms' future profitability or investment opportunities, would be associated with a rise in investment spending. We would expect a positive coefficient on cash flow variable in this regression model, if firms' investment were influenced by their availability of internal funds due to the imperfections in the capital markets.

When focusing on the differential impact of cash flow on the investment of different categories of firms, this paper interact the cash flow variable in our specifications with dummy variables indicating the degree of internal and external financial constraints faced by firms, and with regional dummies and ownership dummies, instead of estimating our investment equations on separate subsamples of firms as in Cleary *et al.* (2007). This approach allows us to avoid problems of endogenous sample selection bias, to gain degree of freedom and to take into consideration the fact that firms can transit between groups. Therefore our sample splitting estimations have the following form:

$$
\begin{aligned}
\frac{I_{it}}{K_{i,t-1}} &= b + \rho\frac{I_{i,t-1}}{K_{i,t-2}} + \gamma_0\Delta s_{it} + \gamma_1\Delta s_{i,t-1} + \phi(k_{i,t-2} - s_{i,t-2}) \\
&+\pi_0\frac{CF_{it}}{K_{i,t-1}}\times TYPE1_{it} + \pi_1\frac{CF_{it}}{K_{i,t-1}}\times TYPE2_{it} \\
&+\pi_2\frac{CF_{i,t-1}}{K_{i,t-2}}\times TYPE1_{it} + \pi_3\frac{CF_{i,t-1}}{K_{i,t-2}}\times TYPE2_{it} \\
&+\varphi_0\frac{TD_{it}}{K_{i,t-1}}\times TYPE1_{it} + \varphi_1\frac{TD_{it}}{K_{i,t-1}}\times TYPE2_{it} \\
&+\varphi_2\frac{TD_{i,t-1}}{K_{i,t-2}}\times TYPE1_{it} + \varphi_3\frac{TD_{i,t-1}}{K_{i,t-2}}\times TYPE2_{it} + v_i + v_t + e_{it}
\end{aligned} \tag{14}
$$

where $TYPE1_{it}$ and $TYPE2_{it}$ refer to the firm type dummy variables based on the degree of internal and external financial constraints that firms confront, and firms' ownership and location types. This kind of formulation allows the parameters of the model to differ across observations in the two or more (if we interact the financial variables with more types of dummies) subsamples.

3.2. Estimation Methodology

This paper estimates equation (9) and (10) using a first-difference Generalised Method of Moments (GMM) specification developed by Arellano and Bond (2011). The GMM estimator treats the model as a set of equations, one for each time period. The equations differ only in their instrument or moment condition sets. The predetermined and endogenous variables in first differences are instrumented with suitable lags of their own levels. Allowing for the heteroscedasticity of the disturbances across firms and their possible correlation over time, GMM method of estimation takes the two biases caused by firm-specific effects and endogenous regression simultaneously into account. This technique eliminates the firm-specific effects by taking the first difference of the equations, and control for possible endogeneity problems by using the model variables lagged two or more periods as instruments. Year dummies are included in all the specification we report. The GMM results reported are one-step estimates. All standard errors are asymptotically robust to heteroscedasticity.

In order to test whether our model is correctly specified, we apply two criteria: the Sargan test (or *J* test) and the *m2* test for second-order serial correlation of the residuals in the differenced equation. If the model is correctly specified, the variables in the instrument set should be uncorrected with the error term in equation (9) and (10). The *J* statistic tests over-identifying restrictions. Under the null of instrument validity, it is asymptotically distributed as a chi-square with degrees of freedom equal to the number of instruments less the number of parameters. Holding the weighting matrix fixed the difference in the *J* statistic between different models specifications can be seen as a test of whether the model is improved significantly. The *m2* test is asymptotically distributed as a standard normal under the null of no second-order serial correlation of the differenced residuals. It provides a further check on the specification of the model and on the legitimacy of variables dated *t*-2 as instruments in the equation.

However, Blundell and Bond (2008) suggest that simple first-difference GMM is likely to suffer from the finite small sample biases, which is often the case when in autoregressive models with persistent series and high ratio of the variance of fixed-effects to the variance of transitory shocks. Therefore, for comparison, we also present the pooled Ordinary Least Squares (OLS) estimates and the Fixed Effects or Within Groups estimates. OLS estimate is upward biased and the fixed-effects estimate is downward biased. If the coefficient on the lagged dependent variable investment rate from the first-difference GMM lies between the corresponding estimation coefficients obtained by OLS and fixed-effects methods, then we can be confident about the appropriateness of applying the method of first-difference GMM, as this suggests that the GMM estimator is unlikely to suffer from a weak instrument bias (Bond *et al.*, 2003a).

4. Data

4.1. Main Features of the Data Set

The main data set used in this paper, DSE-2018, is from the Delhi Stock Market Financial Database (Annual Report) (the DSE- Database). The database is designed and developed by the Centre for India Financial Research in Delhi, India. It is a major database system, which encompasses data on the trading of the India stock markets and the financial statements of India's listed companies. The database is in line with such international databases as Compustat. The DSE- Database amasses all the data of available in the annual reports of share companies listed on the Delhi Stock Exchange and the Mumbai Stock Exchange.

The firms in the database are all consolidated. The main statement in the database, the balance sheet statement, covers the period of 2012-2018, and the cash flow statement covers 2012-2018. Therefore, this paper uses firm-level accounting data covering all India-quoted manufacturing companies from 2012 to 2018.

This paper manually collects provincial gross domestic products (GDP) deflator and capital goods deflator from various issues of *India Statistical Yearbook*, complied by the *National Bureau of Statistics of India*. The GDP deflator is the item "Indices of Gross Domestic Product (preceding year = 100)" and the capital good deflator the "Price Indices of Investment in Fixed Assets by Region" in the *India Statistical Yearbook*, various issues, *India Statistics Press, Delhi*.

The DSE- database does not contain the firm-level information of these two deflators, as they are not required by India's firm accounting regulations. According to the firm location information (indicating the provinces where firms headquarter) in the data set, we use the provincial capital goods deflator to deflate the capital variables in our regression models and the GDP deflator to treat other variables. This paper recalculates the indices at the constant price of 1990. In a few cases that provincial figures are missing in the yearbooks, this paper uses the national figures instead.

Firms' ownership information is collected from company registration information in Delhi and Mumbai stock exchanges. This paper defines firms' ownership type according to their controllers' type.

The main variables this paper uses are flows of investment, sales, cash flows, and total debts. Investment spending is measured as the changes of firms' capital stock, adjusted by provincial price indices for investment goods prices and firm-specific depreciation of fixed assets. This paper uses real sales as a proxy for output. Cash flow and total debts deflated by provincial price indices for GDP.

At the end of 2008, there were 1398 non-financial industry companies and 8 financial industry companies listed on the Delhi and Mumbai Stock exchanges. In our data sample we have 818 manufacturing firms and 4,128 observations in the 8-year period of 2012-2018, which suggest that each firm on average has 5.06 observations. This restricts our analyses to 8 manufacturing industries. The sample has an unbalanced structure. By allowing for both entry and exit, the use of an unbalanced panel can release potential selection and survival bias. Firms with less than 3 years of consecutive observations are excluded. To eliminate potential influence of outliers, those observations characterised by a ratio of investment to capital stock greater than one and those in the 1% tails for each of the regression variables are excluded as well. These types of rules are common in the investment literature and this paper follows them so that this paper results are comparable with previous works (e.g. Bond *et al.*, 2003a; Cummins *et al.*, 1988).

To examine the idiosyncratic characters of India's capital market and the investment behaviours of Indian firms we classify our sample firms by four categories of variables. The first sample splitting device measures the degree of internal financial constraints that firms face, the second assesses the degree of external financial constraints to firms, the third one indicates firms' ownership and the last one indicates firms' regional location. Following the literature, this paper uses the level of cash flow available to firms as a proxy for the first one and level of cash stock as an alternative measurement for robustness check, and firms' total assets representing firm size as a proxy for the second one and firms' sales as an alternative.

4.2. Descriptive Statistics

Table 1a reports some summary statistics for the full sample and for the subsamples of firm-years with high and low cash flow, and high and low total assets. The first column of the figures presents variable means for the entire sample, whereas the second and third sections respectively refer to firm-years sorted by internal constraints, cash flow, and external constraints, total assets. The total firm-years have 998 observations. The firm-years with more flexible internal financial resources have 500 observations and those less flexible firm-years have 498. Large firm-years, in terms of firms' real total assets have 528 observations and the smaller ones have 478. Compared with the less flexible firm-years the firm-years with higher cash flow to capital rate generally have much higher investment to capital rate, sales growth, real total assets, real sales and real cash stock, but lower total debt to capital rate. They also have higher absolute value of capital to sales ratio, i.e. the error-correction term. The statistics may suggest that the firms with more internal financial resources have much better performance than the firms with less. In the firm size groups, larger firm-years have higher investment rate, sales growth, cash flow to capital rate, and total assets, sales and cash stock. They also have a higher absolute value of error-correction term than the small firm-years. They have, however, slightly lower debt ratio. Larger firms appear to be the healthier group than the smaller firms.

It seems that firms with more cash flow have a significantly higher investment rate and grow much faster than the firms with less cash flow. Larger firms in our sample are also the ones having more cash flow and more cash stock, and making more investment relative to the small size firms.

Contrary to common wisdom that small and young firms normally are faster growing than large and established firms, this paper finds that publicly listed small firms show lower level of investment rate and slower sales growth rate than their larger counterparts during the period from the late 1990s to early 2000s. It may not be surprising in the Indian case. India's economic policy has long been in favour of large firms and the financial system is traditionally biased towards large firms. Relative speaking, listed firms are all generally large in size, and majority of the listed firms in India are state-holding companies. The Indian government has made great effort and given intensive support to the SOEs to reform the state sector. One of the important measures is to reform the ownership structure of SOEs and make them become publically listed and subject to the market regulations. Such strategy so far has been successful. During the period 1998 to 2008 SOEs notably improved their profitability. Therefore, it is reasonable to observe better growth in large firms than in smalls ones.

Indeed, the statistics in Table 1b confirms that two thirds of our sample firms are SOEs (686 out of 888) and on average these SOEs are the larger ones than non-SOEs in terms of firms' total assets and sales. Listed SOEs in our sample indeed grow much faster and have higher investment rates than non-SOEs. Comparing with other firms, SOEs have a slightly higher cash flow to capital ratio, lower total debt to capital ratio and keep much more cash stock on hand. The data statistics seem to suggest that the state sector enjoys a more favourable environment and is cash rich. However, the rapid growth of these large listed SOEs does not necessarily imply better efficiency or profitability relative to non-SOEs. Therefore, it would be advantageous for the financial market to channel more financial resources to the more efficient firms in order to improve the overall productivity and efficiency.

Table 1b also reports the summary statistics for the firm-years grouped according to the firm locations. There are 498 observations, which are nearly

Table 1a: Descriptive Statistics on Financial Constraints

	All firm-years	*Firm-years sorted by internal constraints*		*Firm-years sorted by external constraints*	
		Lower half of CF/K	*Upper half of CF/K*	*Lower half of total assets*	*Upper half of total assets*
$I_{it}/K_{i\,t-1}$	0.158	0.095	0.221	0.122	0.191
	(0.217)	(0.187)	(0.227)	(0.218)	(0.211)
ΔS_{it}	0.131	0.071	0.191	0.088	0.170
	(0.275)	(0.300)	(0.233)	(0.302)	(0.242)
$k_{i,t-2} - S_{i,t-2}$	-0.623	-0.423	-0.821	-0.499	-0.734
	(0.695)	(0.667)	(0.666)	(0.670)	(0.699)
$CF_{it}/K_{i,t-1}$	0.301	0.056	0.545	0.267	0.332
	(0.423)	(0.251)	(0.418)	(0.453)	(0.393)
$TD_{it}/K_{i,t-1}$	0.985	1.030	0.941	1.006	0.966
	(0.772)	(0.741)	(0.801)	(0.718)	(0.818)
Real total assets	2.60 e +09	1.89 e +09	3.31 e +09	9.93 e +08	4.04 e +09
	(3.87 e +09)	(1.45 e +09)	(5.17 e +09)	(4.46 e +08)	(4.88 e +09)
Real sales	2.00 e +09	1.09 e +09	2.89 e +09	5.07 e +08	3.33 e +09
	(4.05 e +09)	(1.40 e +09)	(5.40 e +09)	(3.86 e +08)	(5.22 e +09)
Real cash stock	3.63 e +08	2.45 e +08	4.80 e +08	1.42 e +08	5.61 e +08
	(5.27 e +08)	(2.58 e +08)	(6.79 e +08)	(1.12 e +08)	(6.58 e +08)
Number of observations	996	496	500	471	525

Notes: The table reports the sample means. Standard deviations are presented in parentheses. The subscript *i* indexes firms, and the subscript *t*, time, where *t*=2012-2018. *I* represents the firm's investment; *K*, the replacement value of its capital stock; *k*, the (natural) logarithm of *K*; *s*, the logarithm of firm's real sales; *CF*, firms' cash flow; and TD, firms' total debt. The measure of real assets, real sales and real cash stock is Rupees (approximately the exchange rate of USD : Rupees = 1:69.56).

Table 1b: Descriptive Statistics on Ownerships and Regions

	Firm-years sorted by firm ownership			*Firm-years sorted by firm location*	
	SOE	*Non-SOE*	*East region*	*Central region*	*West region*
$I_{it}/K_{i\,t-1}$	0.168	0.140	0.175	0.111	0.178
	(0.198)	(0.252)	(0.212)	(0.220)	(0.218)
ΔS_{it}	0.147	0.099	0.155	0.081	0.137
	(0.260)	(0.301)	(0.249)	(0.316)	(0.271)
$k_{i,t-2} - S_{i,t-2}$	-0.643	-0.583	-0.761	-0.481	-0.495
	(0.692)	(0.702)	(0.687)	(0.689)	(0.667)
$CF_{it}/K_{i,t-1}$	0.306	0.292	0.231	0.523	0.202
	(0.422)	(0.426)	(0.223)	(0.652)	(0.318)
$TD_{it}/K_{i,t-1}$	0.900	1.159	0.969	0.957	1.049
	(0.722)	(0.841)	(0.816)	(0.629)	(0.821)
Real total assets	2.88 e +09	2.03 e +09	2.91 e +09	2.32 e +09	2.26 e +09
	(4.36 e +09)	(2.49 e +09)	(4.67 e +09)	(3.00 e +09)	(2.62 e +09)
Real sales	2.26 e +09	1.46 e +09	2.39 e +09	1.80 e +09	1.39 e +09
	(4.35 e +09)	(3.32 e +09)	(4.73 e +09)	(3.73 e +09)	(2.49 e +09)
Real cash stock	4.06 e +08	2.75 e +08	3.80 e +08	3.05 e +08	3.91 e +08
	(6.00 e +08)	(3.15 e +08)	(4.86 e +08)	(5.15 e +08)	(6.13 e +08)
Number of observations	668	328	494	264	238

Notes: The table reports the sample means. Standard deviations are presented in parentheses. Also see *Notes* to Table 1a. The Eastern states include the following 5 states : West Bangal, Bihar, Jharkhand, Odisha, and Andman and Nicobar Islands. The Central region includes the following 2 states: Chattishgarh and Madhyapradesh. The Western region includes the following: 5 states and 2 union territories: Goa, Gujarat, Karnataka, Maharashtra, Rajasthan, Dadar and Nagar Haveli and Daman and Diu.

half of our sample firm-years, located in the eastern coastal region of India. The central and western regions have 268 and 238 observations respectively. The average firm size reflected by firms' real total assets and real sales is the largest in the eastern India, intermediate in the central and the smallest in the west. Firm-years in the eastern and western regions have similar per capital investments, 0.175 and 0.178 respectively and higher than the firm-years in the central regions, 0.111. The sales growth rate is the highest in the east and lowest in the central provinces. The eastern firms also have a much higher responsive rate to disequilibria in their capital investment than the central and western firms. However, the central region has much higher per capital cash flow (0.523), whereas the per capital cash flows of the east and the west are less than half of the central with the figure of the east (0.231) is slightly higher than that of the west (0.202). It seems that the eastern and the western firms have similar investment rates and similar cash flow rates, however, the central firms have the highest investment rate but lowest cash flow rate. The central firms keep the lowest cash stock, and the eastern and western firms have similar and higher cash stock. Firms' total debt-to-capital ratios are relatively similar across three regions, with the west having the ratio a little greater than one and the east and the central lower than one.

It seems that in general our sample firms in the eastern and western regions grow faster than the ones in the central India and most of the large firms choose to locate in the eastern coastal areas of India. The east is the best developed region in India. It has long been favoured by India's opening up policy since the late 1970s. The Indian government implemented the so called "development of western India" policy in the late 1990s and has been investing heavily in the resource-rich region to explore its economic potential. Therefore it should be interesting to see whether firms in the east and the west are actually better off in terms of financing constraints.

5. The Pattern of Financial Constraints to Indian Listed Firms

5.1. Full Sample

The error-correction models of the forms outlined in equations (8) and (9) are initially estimated. This paper uses three econometric methods to estimate. To control for the time-specific component, time dummies v_t, which account for possible business cycle effects, are included in all the specifications. Table 2 reports the estimates of equations (8) and (9) for the full sample of firms. The error correction terms are correctly signed by all three estimation methods, but only significantly different from zero in OLS, Within-groups and the more parsimonious GMM regressions. The lagged dependent variable and current and lagged sales growth variables also both have short-run effects on investment rates by OLS and Within-groups estimations, but again are generally not statistically significant by the GMM estimations in the full sample. By all the data treatment mentioned in section 4 we end up with 1003 observations in the specification of equation (8) and 998 observations in equation (9) by OLS and Within-groups estimations, and 824 and 818 observations respectively for equation (8) and (9) by first-difference GMM method.

Column (1) of Table 2 gives the pooled OLS estimates. The pooled OLS is a simple approach, which treats the panel data as if it is from a single data set and treats the variation in the dependent variable and all the independent variables across time period t in the same way as the variation across the firm index i. It simply ignores the unobserved effects or the fixed effects. Thus the pooled OLS actually estimates the equation (8) and (9) without the firm-specific effects v_i. The coefficients on all the explanatory variables are statistically significant except the lagged cash flow terms. The values of the R^2 indicate that the inclusion of firms' total debt and its lagged term apparently improves

Table 2: The Effects of Cash Flow on Investment: Alternative Estimators

Dependent Variable: $I_{it}/K_{i\,t-1}$	*OLS (pooled) (1)*		*Within-groups (2)*		*First-difference GMM(3)*	
$I_{i,t-1}/K_{i\,t-2}$	0.103***	0.182***	-0.321***	-0.266***	-0.241	-0.196
	(0.029)	(0.028)	(0.034)	(0.035)	(0.148)	(0.174)
ΔS_{it}	0.119***	0.105***	0.164***	0.130***	0.012	-0.074
	(0.026)	(0.025)	(0.033)	(0.032)	(0.148)	(0.133)
$\Delta S_{i,t-1}$	0.130***	0.120***	0.220***	0.185***	0.311*	0.226
	(0.026)	(0.024)	(0.038)	(0.036)	(0.159)	(0.168)
$k_{i,t-2} - S_{i,t-2}$	-0.047***	-0.045***	-0.367***	-0.319***	-0.322**	-0.253
	(0.011)	(0.010)	(0.041)	(0.039)	(0.159)	(0.167)
$CF_{it}/K_{i,t-1}$	0.098***	0.095***	0.148***	0.166***	0.466***	0.475***
	(0.027)	(0.031)	(0.038)	(0.036)	(0.138)	(0.119)
$CF_{i,t-1}/K_{i,t-2}$	-0.045	-0.052	0.098**	0.102**	0.004	0.039
	(0.030)	(0.032)	(0.042)	(0.041)	(0.106)	(0.097)
$TD_{it}/K_{i,t-1}$		0.135***		0.177***		0.181*
		(0.019)		(0.020)		(0.099)
$TD_{i,t-1}/K_{i,t-2}$		-0.132***		-0.006		-0.022
		(0.018)		(0.021)		(0.125)
Sample size	1003	996	1003	996	624	619
R^2	0.154	0.218				
ρ			0.739	0.788		
J (p-value)					0.795	0.667
m2 (p-value)					0.603	0.786

Notes: The figures reported in parentheses are asymptotic standard errors. The GMM results reported are one-step estimates. Time dummies are included in all specifications. The specification in section (3) also contains industry dummies. Standard errors and test statistics are asymptotically robust to heteroscedasticity. *r* represents the proportion of the total error variance accounted for by unobserved heterogeneity. The *J* statistic, or Sargan/Hansen test, is a test of the overidentifying restrictions, asymptotically distributed as chi-square under the null of instrument validity. Here we always report the Sargan statistics. *m2* is a test for second-order serial correlation in the first-difference residuals, asymptotically distributed as standard normal, *N*(0,1), under the null of no second-order serial correlation. *m2* test also can be used as a further check on the model specification and on the legitimacy of variables dated *t*-2 as instruments. If the instruments are acceptable, the p-values of *J* test and *m2* test should be both greater than 0.05 Instruments in the left column of section (3) are $I_{it}/K_{i,t-1}$, Ds_{it}, $(k_{i,t-2}-s_{i,t-2})$, $CF_{it}/K_{i,t-1}$, all lagged three periods, time dummies and industry dummies. Instruments in the right column of section (3) include all the instruments for the left column and $TD_{it}/K_{i,t-1}$ lagged three periods. Also see *Notes* to Table 1. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

the model specification, although it does not affect the importance of cash flow very much. Cash flow is positively associated with investment as in many previous literatures. However, the lagged dependent variable are necessarily correlated with firm-specific heterogeneity with the method of OLS, and also due to the possible endogeneity of the regressors, OLS estimates are therefore likely to subject to upwards biases.

Column (2) presents the Within-groups or fixed-effects estimates, which can control for the firm-specific effect bias. After transforming the data to deviations from firm means, Within-groups estimators are then obtained using the method of OLS. The transformation process of Within-groups estimation, however, induces another downward bias in autoregressive (AR) models estimated from short-time period panel (Bond *et al*, 2003a). The model specified by equation (8) and (9) includes the dependent variable lagged one period as an explanatory variable, so it can be regarded as an AR(1) model. The data set used in this paper is in fact a quite short panel covering the years from 1998 to 2004. Furthermore, the Within-groups estimators may still be affected by endogeneity bias. Nevertheless, comparing the fixed-effects estimates with the pooled cross-section, it appears that the effect of the lagged dependent variable is greatly diminished. This may suggest that the unobserved fixed effects are strongly correlated with the lagged investment to capital stock ratio variable, causing upward bias in the pooled OLS estimate. In particular, in the Within-groups estimations we also find a positive and significant relationship between cash flow and investment with or without the contribution of total debt variables. The r coefficient represents the proportion of the total error variance accounted for by unobserved heterogeneity. The values of r, 0.739 and 0.788, suggest that it is highly important to take the unobserved firm-specific characteristics into account.

To avoid these biases, the main results are estimated using the first-difference GMM estimator developed by Arellano and Bond (2011). Column (3) of Table 2 presents the GMM estimation results for the full sample. A first-difference GMM estimator can eliminate the firm-specific effects by taking the first difference of the equations, and solve the endogeneity problem using lagged values of endogenous regressors as instruments. However, the first-difference GMM estimators can suffer from finite small sample biases, when the instruments, which are usually the endogenous variables, lagged two or more periods, are not very informative. Hence, it is useful to compare the first-difference GMM estimates with the OLS and Within-groups estimates. GMM estimation allows for contemporaneous correlation between variables and shocks to the investment equation, as well as correlation with unobserved firm-specific effects.

The standard time dummies, which are defined at the aggregate level, can remove the common cyclical variance to the entire industry sectors (Carpenter, Fazzari, and Pertersen, 2014). In addition, industry dummies, which are included in all the GMM specifications and the instrument sets, control for differences in the industry-specific heterogeneity, such as technology of firms, their capital-output ratios, the rate at which their capital depreciates and the rate of return required by financial markets, or the construction of the accounting measures used for estimation. They also correspond to industry-wide movements in the costs of production, such as the costs of labour, raw materials and capital. These dummies therefore can control for the industry-specific shifts in investment demand or expectations.

The estimated coefficient by GMM on the lagged dependent variable, lies between the corresponding estimates obtained using pooled OLS and the Within-groups estimators. This suggests that the GMM estimator is not likely to suffer from the bias due to a weak instrument set (Carpenter and Guariglia, 2008). The sign of the coefficient on this variable remains positive, which is consistent with the pooled OLS estimate, but not the Within-groups estimate. However, the lagged investment rate variable is insignificant. The coefficient on the current cash flow variable is again positive and statistically significant. The large magnitude of the coefficients indicates a close relationship between the cash flow and investment variables. The error correction term describes how the firms adjust their investment for the departure from the desired level of capital stock. The sign of the coefficient for the error correction term is negative as expected though only in the parsimonious model it is significant, which may still imply that when firms' capital stock is off its long-run equilibrium, on average firms adjust its investment expectation accordingly. The significance of the coefficients on cash flow and error correction term also suggests that the error correction model may hold for the long run. However, this paper may need to bear in mind that this interpretation might not be so plausible in our particular case, as we have a rather short-period panel data, which may barely suggest long-term effects. Nonetheless this time-series characteristic model has been widely applied in the financial constraints and investment literature (e.g. Bond *et al*, 2003a, Bond *et al*, 2003b, Mairesse *et al*, 1999).

Table 2 also reports two tests for the GMM results, a *J* test and an *m2* test. The *J* statistic, or Sargan/Hansen test, is a test of the over-identifying restrictions, under the null of instrument validity. *m2* is a test for second-order serial correlation in the first-differenced residuals, under the null of no second-order serial correlation. The regression well passes the Sargan test and the *m2* statistic also shows no second-order serial correlation of the residuals. Both tests suggest that the instruments used are valid and that there is no gross misspecification in our error-correction models.

All the specifications reported in Table 2 show a positive relationship between current cash flow and investment variables, similar to results obtained in previous studies for the US, the UK and other counties. It indicates an important implication that the estimates for cash flow are quantitatively robust to the choice of estimation methods. The significant and positive relationship is also consistent with the theoretical prediction that if the capital market is imperfect, firms on average are financially constrained by the availability of their internal funds.

There is heated debate in the investment literature on the usefulness of firms' cash flow-investment sensitivity as an indicator for firms' financial constraints. Cash flow plays a more prominent role in a reduced-form investment equation, e.g. our ECM model, in one sample may simply because current or lagged cash flow variables are more informative for forecasting future sales growth in that particular sample. In part this is the motivation for considering VAR forecasting models. Due to the following reasons we decide to apply the VAR model for our sample, though we are aware that our 8-year panel is usually too short for a time series model such as VAR. First, the purpose of using the VAR model is simply to do a forecasting equation rather than trying to identify any causal relations between the variables. Second, in a short panel asymptotic theory focuses on the number of observations N for a fixed time period T rather than on T as in standard time series. Identification of the model should work well for large sample size, which we have, when we do such a VAR style regression. These two are also the reasons for which we use the simple pooled OLS estimation method. Last, the forecasting ability of firms' cash flow for future sales growth has been well documented, and the VAR model has also been applied for short panels in the investment literature (e.g. Bond *et al*, 2003b).

We then estimate the VAR model specified in section 3 in order to check the time series relationship between the cash flow variable and the real sales variable. The VAR(2) specification we estimate using all the variables included in our investment models. Table 3 presents the OLS estimation of our VAR model. None of the cash flow variables are significant, and the cash flow variables lagged two periods are even incorrectly signed. It seems to be unlikely that those Indian firms' cash flow would do a good job of forecasting their future demand. Therefore, the significant cash flow effects on investment we have found in our sample should indeed reflect the financial constraints that firms face, rather than the endogeneity of the model.

Then we further evaluate how exactly the impacts of the financial constraints are different across various types of firms. The paper next estimates the extended investment model given by equation (10), which differentiates between types of firm-years. Specifically, we estimate, both separately and jointly, the effects of internal financial constraints and external financial constraints on firms' investment. The internal constraints are based on the level of internal funds available to the firm and the external constraints are based on the degree of capital market imperfections faced by the firm. More specifically, this paper interact firms' cash flow variables with firms' financial status dummies and with their size dummies.

Table 3: VAR Forecasting Models for Real Sales

Dependent Variable: S_t	*OLS*	
	(1)	*(2)*
S_{t-1}	1.026***	1.027***
	(0.086)	(0.087)
S_{t-2}	-0.017	-0.019
	(0.088)	(0.090)
CF_{t-1}/K_{t-2}	0.055	0.058
	(0.082)	(0.082)
CF_{t-2}/K_{t-3}	-0.072	-0.068
	(0.072)	(0.073)
I_{t-1}/K_{t-2}	0.197***	0.213***
	(0.043)	(0.050)
I_{t-2}/K_{t-3}	0.091***	0.074*
	(0.033)	(0.042)
TD_{t-1}/K_{t-2}		-0.029
		(0.037)
TD_{t-2}/K_{t-3}		0.029
		(0.035)
R^2	0.923	0.923
J (p-value)		
m2 (p-value)		
Number of observations	1017	1009

Notes: The figures reported in parentheses are asymptotic standard errors. A full set of time and firm dummies are included in all regressions. Estimations are by OLS. Also see *Notes* to Table 1a. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

5.2. Sub-samples Based on the Firms' Degree of Internal Financial Constraints

Table 4 presents the first-difference GMM estimation of equation (10), where the interaction terms are based on the cash flow to capital ratio in section (1) for the investment model with and without total debt variables in the first and second column respectively, and on the cash stock in section (2). The cash stock has been widely used in the literature on the effects of financial constraints on the firms' activities (for example, Carpenter *et al.*, 1998; Harrison and McMillan, 2003; Gan, 2007), therefore we use this variable as our alternative measure of firms' internal funds to check the robustness of our results. We separate the sample into two subgroups with low and high internal funds available. The group having low internal funds is defined as those firm-years whose cash flow or cash stock fall below the fiftieth percentile of the distribution

Table 4: Differentiations between Low and High Financial Flexibility Firm-years: Effects of Internal Financial Constraints

Dependent Variable: $I_{it}/K_{i\,t-1}$	*Cash flow groups (1)*		*Cash stock groups (2)*	
$I_{i,t-1}/K_{i\,t-2}$	-0.126	-0.106	-0.241*	-0.283**
	(0.165)	(0.141)	(0.143)	(0.129)
ΔS_{it}	-0.105	-0.023	0.075	0.056
	(0.121)	(0.131)	(0.110)	(0.112)
$\Delta S_{i,t-1}$	0.084	0.147	0.215*	0.291**
	(0.158)	(0.146)	(0.128)	(0.123)
$k_{i,t-2} - S_{i,t-2}$	-0.120	-0.164	-0.289**	-0.329***
	(0.154)	(0.151)	(0.134)	(0.126)
$(CF_{it}/K_{i,t-1})\times LOW\text{-}_{it}$	0.363**	0.305**	0.301***	0.369***
	(0.165)	(0.154)	(0.111)	(0.132)
$(CF_{it}/K_{i,t-1})\times(1\text{-}LOW\text{-}_{it})$	0.663***	0.566***	0.368***	0.511***
	(0.116)	(0.129)	(0.132)	(0.142)
$(CF_{i,t-1}/K_{i,t-2})\times LOW\text{-}_{it}$	-0.087	-0.059	0.004	0.043
	(0.142)	(0.117)	(0.110)	(0.095)
$(CF_{i,t-1}/K_{i,t-2})\times(1\text{-}LOW\text{-}_{it})$	0.125	-0.006	0.029	-0.080
	(0.120)	(0.113)	(0.138)	(0.174)
$(TD_{it}/K_{i,t-1})\times LOW_{it}$	0.313**		0.285**	
	(0.154)		(0.123)	
$(TD_{it}/K_{i,t-1})\times(1\text{-}LOW_{it})$	0.191**		0.119	
	(0.083)		(0.084)	
$(TD_{i,t-1}/K_{i,t-2})\times LOW_{it}$	0.042		-0.056	
	(0.175)		(0.104)	
$(TD_{i,t-1}/K_{i,t-2})\times(1\text{-}LOW_{it})$	0.013		0.010	
	(0.105)		(0.099)	
Sample size	619	624	619	624
J (p-value)	0.844	0.868	0.537	0.444
m2 (p-value)	0.690	0.978	0.860	0.971

Notes: The results are all first-difference GMM estimates. The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. In the first two columns of results the sample firms are sorted by their cash flow and in the last two columns of results the sample firms are sorted by their cash stock. LOW_{it} is a dummy variable equal to 1 if firm *i*'s cash flow or cash stock falls below the 50^{th} percentile of the distribution of the cash flow or cash stock of all firms at time *t*, and equal to 0 otherwise. Instruments used are $I_{it}/K_{i,t-1}$, Ds_{it}, $(k_{i,t-2}-s_{i,t-2})$ and all other variables in each regression lagged two or more periods. Time dummies and industry dummies are always included in the GMM specifications and instrument sets. Also see Notes to Table 1a and Table 2. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

of the cash flow or cash stock of all firms at time *t*. The high internal funds group is defined as the rest of the firm-years.

Focusing on section (1) of Table 4, we can see that the coefficients associated with current cash flow are significant for both firms with higher and lower availability of internal funds. The absolute values of the cash flow coefficients are much higher for the high cash flow groups of firms. These results are consistent with the findings in KZ (2018), according to which the sensitivity of investment to cash flow is highest for those firms having the most cash flow. KZ (2018) argued that these firms were the least financially constrained. When the cash stock is used to differentiate the effects of cash flow on firms' investment, similar results take place as shown in section (2). Firms' debt ratio seems to matter more to their investment for those firms keeping a lower internal funds level. It might be explained that firms with high internal financial resources may be the ones less able to raise external funds, and they are therefore highly constrained by their own availability of internal financial resources. Firms having low internal funds may be the one more able to generate external finance and as a result become somehow dependent on debt as well as on their internal funds for their investment. All four regressions well pass the *J* tests and *m2* tests, indicating that the models do not have over-identifying problem or second-order serial correlations.

It is likely that those firms keeping high levels of internal financial flexibility are actually more constrained because they have to use their own cash flows to finance their investment projects when needed, otherwise they cannot raise enough external resources to meet their demand.

5.3. Sub-samples Based on Firms' Degree of External Financial Constraints

We then investigate whether cash flow has a different impact on the investment of firms facing different degree of external financial constraints. Table 5 presents the results of the estimation of equation (10), when firm-years are differentiated into small and large size. To verify the robustness of our results, we use two alternative measures of firm size, namely firms' total assets and their sales, to split our sample. Smaller firms are likely to face more severe problems of asymmetric information as they are more likely to suffer from idiosyncratic risk, and to have lower collateral values relative to their liabilities, as well as higher bankruptcy costs and short track records. Therefore, we expect as in the literature small firms may be more financially constrained than large firms, since their ability of raising external funds may be less. Similarly, we define small firm-years as those whose total assets or sales in year *t* are in the lower fifty percents of the distribution of the total assets or sales of all firms in that particular year, and the large firm-year group is the rest of the firm-years.

In section (1) of Table 5 both regression models indicate that small firm-years display positive and precisely determined sensitivities of investment to cash flow. Their sensitivities are much stronger than those of their larger

Table 5: Differentiations between Small and Large Size Firm-years: Effects of External Financial Constraints

Dependent Variable: $I_{it}/K_{i\,t-1}$	*Total assets groups (1)*		*Sales groups (2)*	
$I_{i,t-1}/K_{i\,t-2}$	-0.219	-0.033	-0.286	-0.110
	(0.186)	(0.254)	(0.204)	(0.216)
ΔS_{it}	-0.033	-0.422	0.017	-0.223
	(0.125)	(0.345)	(0.215)	(0.341)
$\Delta S_{i,t-1}$	0.238	0.056	0.280	0.158
	(0.161)	(0.272)	(0.177)	(0.230)
$k_{i,t-2} - S_{i,t-2}$	-0.290*	-0.032	-0.316*	-0.168
	(0.155)	(0.268)	(0.173)	(0.224)
$(CF_{it}/K_{i,t-1})\times SMALL\text{-}_{it}$	0.486***	1.010***	0.483**	0.796***
	(0.142)	(0.204)	(0.238)	(0.200)
$(CF_{it}/K_{i,t-1})\times(1\text{-}SMALL\text{-}_{it})$	0.313*	0.352	0.153	0.383
	(0.188)	(0.455)	(0.334)	(0.521)
$(CF_{i,t-1}/K_{i,t-2})\times SMALL\text{-}_{it}$	-0.037	0.192	0.036	0.099
	(0.146)	(0.270)	(0.138)	(0.212)
$(CF_{i,t-1}/K_{i,t-2})\times(1\text{-}SMALL\text{-}_{it})$	0.087	0.454	0.350	0.357
	(0.196)	(0.372)	(0.273)	(0.352)
$(TD_{it}/K_{i,t-1})\times SMALL_{it}$	0.368**		0.175	
	(0.172)		(0.235)	
$(TD_{it}/K_{i,t-1})\times(1\text{-}SMALL_{it})$	0.097		0.196	
	(0.104)		(0.125)	
$(TD_{i,t-1}/K_{i,t-2})\times SMALL_{it}$	-0.086		0.082	
	(0.152)		(0.218)	
$(TD_{i,t-1}/K_{i,t-2})\times(1\text{-}SMALL_{it})$	0.061		-0.037	
	(0.123)		(0.138)	
Sample size	619	624	619	624
J (p-value)	0.668	0.950	0.466	0.813
m2 (p-value)	0.734	0.921	0.836	0.875

Notes: The results are all first-difference GMM estimates. The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. In the first two columns of results the sample firms are sorted by their total assets and in the last two columns of results the sample firms are sorted by their sales. $SMALL_{it}$ is a dummy variable equal to 1 if firm *i*'s total assets or sales fall below the 50^{th} percentile of the distribution of the total assets or sales of all firms at time *t*, and equal to 0 otherwise. Instruments used are $I_{it}/K_{i,t-1}$, Ds_{it}, $(k_{i,t-2}-s_{i,t-2})$ and all other variables in each regression lagged twice or more. Time dummies and industry dummies are always included in the GMM specifications and instrument sets. Also see Notes to Table 1a and Table 2. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

counterparts, especially in the model without total debt variables. For the large firms, the coefficients associated with cash flow are quite poorly determined in both columns. A similar pattern can be observed in section (2), where firms' sales are used to group the sample firms instead of their total assets. In all the four models the cash flow coefficients for the small firm groups are always greater than the coefficients for the large firm groups.

Lagged investment rate and sales variables do not play any significant roles in this type of firms groups. The coefficients of the error-correction terms are all negative as expected, though only weakly significant when the total debt variables are augmented in the model. Only the investment of the small firms in the total assets groups are positively affected by their total debt.

It appears, therefore, that the sensitivity of investment to cash flow is larger for the small firm-years, which are more prone to face asymmetric informational problems. The estimates in Table 5 are in line with the findings in FHP (1988), according to which firms that are more likely to face external financial constraints exhibit higher sensitivities of investment to cash flow.

These findings have important policy implications. Small business is the most prosperous and fastest growing sector in India. However, it is more difficult for them to raise external funds than the large firms, as India's state-dominated banking sector is strongly biased towards the large and/or state-owned firms. One of India's economic reform strategies is to create and enhance large enterprise groups, making them internationally competitive. India wants to make sure that the state is in control of important industrial sectors. Consequently, the large firms are even better off. The fact that smaller firms exhibit higher sensitivity of investment to cash flow suggests that in order to make the smaller business thrive, policies aiming at making the access to finance easier for relative small firms are likely to be particularly effective.

Our results so far are along the lines of the findings of KZ (1997) and with the empirical results in FHP (1988). Theoretically, using Indian listed firms' data, we reproduce the results similar to both FHP (1988) and KZ (2018). Therefore, our results suggest that the different conclusions argued by FHP (1988) and KZ (2018) on whether higher sensitivities of investment to cash flow can be interpreted as evidence of firms facing stronger financial constraints, are probably due to the different criteria used in their studies to partition their samples. Practically, we find that the investment behaviours of Indian listed firms and the India's financial market demonstrate some characteristics similar as firms and markets in the developed countries, such as the US (Cleary *et al*, 2008) and the UK (Guariglia, 2008).

5.4. Sub-samples Based on Combinations of Firms' Internal and External Financial Constraints

We next analyse the sensitivities of investment to cash flow when the sample is divided on the basis of combinations of different degrees of internal and external financial constraints. Table 6 shows the results. We use low and high cash flow and cash stock firms-years respectively to combine with small and large firm-years, which are indicated by firms' total assets and sales separately. We use the model with total debt in all the regressions.

Column (1) and (2) report the estimates relative to the interactions between cash flow and total assets and sales dummy variables. It appears that when total assets is used to measure firm size cash flow attracts a positive and statistically significant effect only for those small firm-years with relatively high cash flow, and these firm-years have the strongest cash flow effects on their investment (0.699). When we use firms' sales instead of total assets to indicate firms' size, the results remain similar. As shown in column (2), again the small high-cash flow firms demonstrate the strongest positive cash flow effects (0.555), higher than that of the large high-cash flow firms (0.452), and higher than that of the small low-cash flow firms (0.310). In this case, the latter two types of firms also display certain significant investment-cash flow sensitivities, but not as large and significant as small high cash flow firms. The total debt helps to explain the investment of a few types of firms to some degree. The investment of large firms with high cash flow is responsive to their total debt, and that of small firms, measured by sales, no matter with low or high cash flow is also responsive to their total debt.

We also use firms' cash stock instead of cash flow to interact with the two external constraints indicators. Similar results are presented in column (3) and (4) of Table 6. Small firms' investments are seriously constrained by their availability of cash flow, but it is not the case for large firms. Again, the investment of those small firms with high cash stock is the most constrained. Lagged investment rate and lagged sales growth variables also have significant effects. The error-correction term again has negative and significant coefficients for both regressions. The *J* and *m2* tests do not suggest problems with the specification of the model or the instruments chosen in all four regressions.

We can interpret the results in Table 6 as follow. Firms are financially constrained both internally and externally. When the two types of constraints affect the firms in the same direction, the firms have the highest sensitivities of investment to cash flow. These findings are consistent with those in Guariglia (2008). Firms having high cash flow are more likely those which are internally constrained, as they are more dependent on their internal funds to finance their investment projects (Table 4). These firms, therefore, have to keep a high degree of internal financial flexibility to meet their investment needs. Due to the information asymmetry problem, small firms are more vulnerable to suffer from difficulties of raising external funds. Thus they also show a higher sensitivity of investment to their own cash flow than the large firms do (Table 5). It is, consequently, not surprising to see that those firm-years which are both internally and externally constrained, i.e. small firms with high cash flow, exhibit the highest sensitivities.

Table 6: Differentiation among Firm-years Based on Combinations of Different Degrees of Internal and External Financial Constraints

Dependent Variable: $I_{it}/K_{i\,t-1}$	*Cash flow and total assets interactions*	*Cash flow and sales interactions*	*Cash stock and total assets interactions*	*Cash stock and sales interactions*
$I_{i,t-1}/K_{i\,t-2}$	-0.201 (0.136)	-0.205 (0.144)	-0.424*** (0.130)	-0.222* (0.131)
ΔS_{it}	-0.102 (0.110)	-0.031 (0.113)	0.099 (0.104)	-0.003 (0.102)
$\Delta S_{i,t-1}$	0.162 (0.129)	0.151 (0.119)	0.325** (0.128)	0.201* (0.118)
$k_{i,t-2} - S_{i,t-2}$	-0.203* (0.121)	-0.209 (0.131)	-0.429*** (0.134)	-0.271** (0.124)
$(CF_{it}/K_{i,t-1})\times LOW\text{-}_{it}\times SMALL_{it}$	0.211 (0.141)	0.310** (0.126)	0.306** (0.128)	0.365*** (0.121)
$(CF_{it}/K_{i,t-1})\times LOW\text{-}_{it}\times (1\text{-}SMALL_{it})$	-0.139 (0.299)	-0.005 (0.258)	0.180 (0.282)	0.352 (0.324)
$(CF_{i,t-1}/K_{i,t-2})\times LOW\text{-}_{it}\times SMALL_{it}$	0.011 (0.134)	0.089 (0.111)	0.041 (0.095)	0.044 (0.100)
$(CF_{i,t-1}/K_{i,t-2})\times LOW\text{-}_{it}\times (1\text{-}SMALL_{it})$	0.042 (0.232)	-0.391 (0.410)	-0.035 (0.303)	-0.309 (0.387)
$(CF_{it}/K_{i,t-1})\times (1\text{-}LOW\text{-}_{it})\times SMALL_{it}$	0.699*** (0.129)	0.555*** (0.128)	0.795** (0.377)	0.448*** (0.148)
$(CF_{it}/K_{i,t-1})\times (1\text{-}LOW\text{-}_{it})\times (1\text{-}SMALL_{it})$	0.238 (0.194)	0.452* (0.262)	0.142 (0.180)	0.209 (0.296)
$(CF_{i,t-1}/K_{i,t-2})\times (1\text{-}LOW\text{-}_{it})\times SMALL_{it}$	0.081 (0.140)	0.070 (0.113)	-0.391 (0.432)	-0.068 (0.181)
$(CF_{i,t-1}/K_{i,t-2})\times (1\text{-}LOW\text{-}_{it})\times (1\text{-}SMALL_{it})$	0.257 (0.162)	0.094 (0.253)	0.247 (0.169)	0.175 (0.251)
$(TD_{it}/K_{i,t-1})\times LOW_{it}\times SMALL_{it}$	0.135 (0.176)	0.275** (0.118)	0.226* (0.117)	0.314** (0.123)
$(TD_{it}/K_{i,t-1})\times LOW_{it}\times (1\text{-}SMALL_{it})$	0.149 (0.201)	0.365 (0.226)	0.520** (0.257)	0.178 (0.219)
$(TD_{i,t-1}/K_{i,t-2})\times LOW_{it}\times SMALL_{it}$	0.027 (0.138)	0.038 (0.119)	0.089 (0.109)	-0.058 (0.114)
$(TD_{i,t-1}/K_{i,t-2})\times LOW_{it}\times (1\text{-}SMALL_{it})$	-0.001 (0.245)	0.006 (0.209)	-0.244 (0.276)	0.247 (0.213)
$(TD_{it}/K_{i,t-1})\times (1\text{-}LOW_{it})\times SMALL_{it}$	0.183 (0.171)	0.197** (0.081)	0.211 (0.311)	0.129 (0.124)
$(TD_{it}/K_{i,t-1})\times (1\text{-}LOW_{it})\times (1\text{-}SMALL_{it})$	0.238*** (0.073)	0.197* (0.107)	0.135 (0.090)	0.172* (0.093)

contd. table 6

Dependent Variable: $I_{it}/K_{i\,t-1}$	*Cash flow and total assets interactions*	*Cash flow and sales interactions*	*Cash stock and total assets interactions*	*Cash stock and sales interactions*
$(TD_{i,t-1}/K_{i,t-2})\times(1\text{-}LOW_{it})\times SMALL_{it}$	-0.051 (0.119)	0.047 (0.104)	0.028 (0.244)	0.099 (0.140)
$(TD_{i,t-1}/K_{i,t-2})\times(1\text{-}LOW_{it})\times(1\text{-}SMALL_{it})$	-0.074 (0.120)	0.023 (0.077)	-0.016 (0.102)	-0.018 (0.106)
Sample size	619	619	619	619
J (p-value)	0.577	0.992	0.307	0.863
m2 (p-value)	0.559	0.515	0.527	0.960

Notes: The results are all first-difference GMM estimates. The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. In the four columns of results the sample firms are sorted by the two indicators of cash flow and total assets, cash flow and sales, cash stock and total assets, and cash stock and sales respectively. LOW_{it} is a dummy variable equal to 1 if firm *i*'s cash flow or cash stock falls below the 50th percentile of the distribution of the cash flow or cash stock of all firms at time *t*, and equal to 0 otherwise. $SMALL_{it}$ is a dummy variable equal to 1 if firm *i*'s total assets or sales fall below the 50th percentile of the distribution of the total assets or sales of all firms at time *t*, and equal to 0 otherwise. Instruments used are $I_{it}/K_{i,t-1}$, Ds_{it}, $(k_{i,t-2}-s_{i,t-2})$ and all other variables in each regression lagged two or more periods. Time dummies and industry dummies are always included in the GMM specifications and instrument sets. Also see Notes to Table 1a and Table 2. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

In light of these results, in order to achieve an economic thrive, India's development policies should endeavour to make the accessibility to finance easier for firms, especially for those small firms characterised by maintaining relatively high levels of internal funds. In the current stage of development, the rate of return on investment is relatively high in the Indian market. Firms in India are enthusiastic in investing. The efficiency of the investments by SMEs is much higher than those by large firms. However, traditionally bank loans would strongly prefer large firms than the SMEs, especially under India's state dominant banking system. Therefore, the government policy should help to channel funds into the relative small firms and support them convert additional finance into efficient investment.

5.4. Sub-samples Based on the Firm Ownership

India's economic structure during the pre-reform period decided the critical importance of state ownership. So far, after three decades of economic reform, the economy has been transformed from a strictly central planned system to a market oriented system, but the state sector remains in control. Since the 1990s the target of SOE reform is to cultivate large state enterprises to make them become internationally competitive. Therefore, it will not be surprising to see large SOEs have extra support in terms of finance. Our results in Table 7 verify such prediction. Both models with and without total debt terms show that although SOEs are financially constrained to a certain degree too, non-SOEs are suffering much stronger constraints, i.e. 0.425 and 0.569 with less than one percent significance comparing respectively with 0.292 and 0.316 with only ten percent significance for the cash flow coefficients. The investment of the non-SOEs is also dependent on their total debt, which is not the case for the SOEs. Both models well passed the *J* and *m2* tests.

The statistics in Table 1b indicates that SOEs seem to be healthier than the non-SOEs, as they are generally bigger, growing faster and much cash-richer. India's high economic growth in the past decades has been heavily driven by investment, of which government-led investment has formed the major part. Most of the government investment projects are carried out by SOEs. These listed SOEs in our sample had plenty of resources to maintain high investment rate.

5.5. *Sub-sample Based on Combinations of Firm Ownership and Internal and External Financial Constraints*

To further identify the types of firm facing different degrees of financial constraints, we interact firms' ownership dummies with their internal and external constraints dummies respectively. Table 8 presents the results of ownership and internal constraints interactions. We find distinctive features in our sample. Those non-SOEs with high cash flow level are the most financially constrained. Comparing with SOEs and/or those keeping low cash flows on hand, they have the highest cash flow coefficient, i.e. 0.668. Those non-SOEs with low cash flow level and those SOEs with high cash flow level also have significant cash flow effects on their investment to a less extent. These results seem to point at the direction that non-SOEs and firms which maintain high levels of internal financial flexibilities are the types of constrained firms. Our results also show that the non-SOEs with high internal cash flows are constrained by not only their availability of cash flow but also their total debt. It seems that this type of firms is seriously short of financial resources for their investment projects. They do not have state support and have to constantly save money out of their cash flow and raise loans. Those firms with low internal cash flows, no matter they are SOE or not, are somehow constrained by their debts too. The lagged investment capital ratio, sales growth and error-correction variables are all significant. The *J* and *m2* tests suggest that the model specification and the instrument set are appropriate. In the column (2) of Table 8 where cash stock is used instead of cash flow to measure firms' internal financial resource the results are similar to those in column (1).

We apply similar dummy variable interactions to combine firms' ownership and external constraints. Results in Table 9 again verify our expectations that small non-SOEs are the most financially constrained by both their cash flows

Table 7: Differentiation among Firm-years Based on Firm Ownerships

Dependent Variable: $I_{it}/K_{i\,t-1}$		
$I_{i,t-1}/K_{i\,t-2}$	-0.252*	-0.282*
	(0.134)	(0.147)
ΔS_{it}	-0.006	0.040
	(0.106)	(0.124)
$\Delta S_{i,t-1}$	0.303**	0.329**
	(0.122)	(0.143)
$k_{i,t-2} - S_{i,t-2}$	-0.338***	-0.351**
	(0.127)	(0.144)
$(CF_{it}/K_{i,t-1}) \times SOE_{it}$	0.292*	0.316*
	(0.151)	(0.269)
$(CF_{it}/K_{i,t-1}) \times (1-SOE_{it})$	0.425***	0.569***
	(0.150)	(0.157)
$(CF_{i,t-1}/K_{i,t-2}) \times SOE_{it}$	-0.147	-0.025
	(0.138)	(0.150)
$(CF_{i,t-1}/K_{i,t-2}) \times (1-SOE_{it})$	0.051	0.057
	(0.100)	(0.102)
$(TD_{it}/K_{i,t-1}) \times SOE_{it}$	-0.002	
	(0.111)	
$(TD_{it}/K_{i,t-1}) \times (1-SOE_{it})$	0.256**	
	(0.118)	
$(TD_{i,t-1}/K_{i,t-2}) \times SOE_{it}$	0.055	
	(0.142)	
$(TD_{i,t-1}/K_{i,t-2}) \times (1-SOE_{it})$	-0.122	
	(0.115)	
Sample size	619	624
J (p-value)	0.954	0.675
m2 (p-value)	0.518	0.878

Notes: The results are all first-difference GMM estimates. The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. $SOE\text{-}_{it}$ is a dummy variable equal to 1 if the controller type of firm *i* is registered as either local SOE or central SOE at time *t*, and equal to 0 otherwise. There are also 6 other types of firm ownership, including private, collective, university, employees' union, foreign and other. Instruments used are $I_{it}/K_{i,t-1}$, Ds_{it}, $(k_{i,t-2}-s_{i,t-2})$ and all other variables in each regression lagged two or more periods. Time dummies and industry dummies are always included in the GMM specifications and instrument sets. Also see Notes to Table 1a and Table 2. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 8: Differentiation among Firm-years Based on Combinations of Firms' Ownership and Different Degrees of Internal Financial Constraints

Dependent Variable: $I_{it}/K_{i\,t-1}$	*Ownership and cash flow interactions* (1)	*Ownership and cash stock interactions* (2)
$I_{i,t-1}/K_{i\,t-2}$	-0.238**	-0.403***
	(0.103)	(0.134)
ΔS_{it}	0.162**	0.154
	(0.079)	(0.113)
$\Delta S_{i,t-1}$	0.289***	0.460***
	(0.091)	(0.138)
$k_{i,t-2} - S_{i,t-2}$	-0.337***	-0.486***
	(0.097)	(0.147)
$(CF_{it}/K_{i,t-1})\times LOW_{it}\times SOE_{it}$	0.124	0.299
	(0.141)	(0.190)
$(CF_{it}/K_{i,t-1})\times LOW_{it}\times(1\text{-}SOE_{it})$	0.235*	0.325*
	(0.135)	(0.171)
$(CF_{i,t-1}/K_{i,t-2})\times LOW_{it}\times SOE_{it}$	-0.161	-0.197
	(0.173)	(0.198)
$(CF_{i,t-1}/K_{i,t-2})\times LOW_{it}\times(1\text{-}SOE_{it})$	-0.182	-0.022
	(0.160)	(0.129)
$(CF_{it}/K_{i,t-1})\times(1\text{-}LOW_{it})\times SOE_{it}$	0.387**	0.206
	(0.175)	(0.194)
$(CF_{it}/K_{i,t-1})\times(1\text{-}LOW_{it})\times(1\text{-}SOE_{it})$	0.668***	0.281
	(0.147)	(0.306)
$(CF_{i,t-1}/K_{i,t-2})\times(1\text{-}LOW_{it})\times SOE_{it}$	-0.072	0.023
	(0.162)	(0.198)
$(CF_{i,t-1}/K_{i,t-2})\times(1\text{-}LOW_{it})\times(1\text{-}SOE_{it})$	0.212	0.221
	(0.153)	(0.255)
$(TD_{it}/K_{i,t-1})\times LOW_{it}\times SOE_{it}$	0.290*	-0.121
	(0.157)	(0.152)
$(TD_{it}/K_{i,t-1})\times LOW_{it}\times(1\text{-}SOE_{it})$	0.263*	0.605***
	(0.156)	(0.196)
$(TD_{i,t-1}/K_{i,t-2})\times LOW_{it}\times SOE_{it}$	-0.033	0.373**
	(0.218)	(0.160)
$(TD_{i,t-1}/K_{i,t-2})\times LOW_{it}\times(1\text{-}SOE_{it})$	-0.007	-0.114
	(0.143)	(0.150)
$(TD_{it}/K_{i,t-1})\times(1\text{-}LOW_{it})\times SOE_{it}$	0.060	0.174
	(0.118)	(0.122)
$(TD_{it}/K_{i,t-1})\times(1\text{-}LOW_{it})\times(1\text{-}SOE_{it})$	0.280***	0.177
	(0.088)	(0.138)
$(TD_{i,t-1}/K_{i,t-2})\times(1\text{-}LOW_{it})\times SOE_{it}$	0.077	0.019
	(0.104)	(0.119)

contd. table 8

Dependent Variable: $I_{it}/K_{i\,t-1}$	*Ownership and cash flow interactions* (1)	*Ownership and cash stock interactions* (2)
$(TD_{i,t-1}/K_{i,t-2})\times(1-LOW_{it})\times(1-SOE_{it})$	-0.186** (0.088)	0.010 (0.169)
Sample size	619	619
J (p-value)	0.967	0.965
m2 (p-value)	0.942	0.863

Notes: The results are all first-difference GMM estimates. The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. LOW_{it} is a dummy variable equal to 1 if firm *i*'s cash flow or cash stock falls below the 50th percentile of the distribution of the cash flow or cash stock of all firms at time *t*, and equal to 0 otherwise. $SOE\text{-}_{it}$ is a dummy variable equal to 1 if the controller type of firm *i* is registered as either local SOE or central SOE at time *t*, and equal to 0 otherwise. There are also 6 other types of firm ownership, including private, collective, university, employees' union, foreign and other. Instruments used are $I_{it}/K_{i,t-1}$, Ds_{it}, $(k_{i,t-2}-s_{i,t-2})$ and all other variables in each regression lagged two or more periods. Time dummies and industry dummies are always included in the GMM specifications and instrument sets. Also see Notes to Table 1a and Table 2. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

and total debt. It is easy to understand, since these firms are the most vulnerable in the market. They are subject to the conventional market discrimination and do not have any favour from the state.

The investment of small SOEs is also constrained to a less extent. This is not surprising. India's SOE reform strategy during our data period was the so called "grasping the big and letting go the small" initiated by the Premier then Zhu, Rongji in 1997. The key idea was for the government to make great efforts to cultivate strong and competitive large enterprise and enterprise groups and develop them into cross-regional, cross-sectional, multi-ownership and multinational big firms. On the other hand, the government allows the relative small sized SOEs to face market forces. The ultimate goal of this strategy was that the government would only control a limited number of large central and local SOEs and privatise most of the rest. Therefore, it is reasonable to observe financial constraints for smaller SOEs in our sample, as they are not the key focus of the state.

It might be interesting to notice that the cash flow coefficients for those large non-SOEs are insignificant and even incorrectly signed. The results may indicate that they are the truly strong and competitive Indian firms, since they are private, large, publically listed and able to raise external funds for their profitable projects.

When firms' total assets and sales are used to measure firm size, the results largely remain unchanged. Both two regressions in Table 9 have significant

Table 9: Differentiation among Firm-years Based on Combinations of Firms' Ownership and Different Degrees of External Financial Constraints

Dependent Variable: $I_{it}/K_{i\,t-1}$	*Ownership and total assets interactions* (1)	*Ownership and sales interactions* (2)
$I_{i,t-1}/K_{i\,t-2}$	-0.295**	-0.254*
	(0.145)	(0.132)
ΔS_{it}	0.033	-0.054
	(0.114)	(0.108)
$\Delta S_{i,t-1}$	0.410***	0.262**
	(0.156)	(0.106)
$k_{i,t-2} - S_{i,t-2}$	-0.382***	-0.324***
	(0.143)	(0.115)
$(CF_{it}/K_{i,t-1})\times SMALL_{it}\times SOE_{it}$	0.404**	0.230*
	(0.186)	(0.138)
$(CF_{it}/K_{i,t-1})\times SMALL_{it}\times(1-SOE_{it})$	0.502**	0.419***
	(0.198)	(0.158)
$(CF_{i,t-1}/K_{i,t-2})\times SMALL_{it}\times SOE_{it}$	-0.059	-0.082
	(0.203)	(0.120)
$(CF_{i,t-1}/K_{i,t-2})\times SMALL_{it}\times(1-SOE_{it})$	0.080	0.081
	(0.139)	(0.115)
$(CF_{it}/K_{i,t-1})\times(1-SMALL_{it})\times SOE_{it}$	0.141	-0.009
	(0.296)	(0.230)
$(CF_{it}/K_{i,t-1})\times(1-SMALL_{it})\times(1-SOE_{it})$	-0.034	0.233
	(0.186)	(0.321)
$(CF_{i,t-1}/K_{i,t-2})\times(1-SMALL_{it})\times SOE_{it}$	-0.041	0.053
	(0.196)	(0.235)
$(CF_{i,t-1}/K_{i,t-2})\times(1-SMALL_{it})\times(1-SOE_{it})$	0.469	0.077
	(0.397)	(0.219)
$(TD_{it}/K_{i,t-1})\times SMALL_{it}\times SOE_{it}$	-0.256	-0.013
	(0.262)	(0.110)
$(TD_{it}/K_{i,t-1})\times SMALL_{it}\times(1-SOE_{it})$	0.450**	0.304***
	(0.177)	(0.104)
$(TD_{i,t-1}/K_{i,t-2})\times SMALL_{it}\times SOE_{it}$	0.103	0.122
	(0.152)	(0.140)
$(TD_{i,t-1}/K_{i,t-2})\times SMALL_{it}\times(1-SOE_{it})$	-0.192	-0.097
	(0.141)	(0.097)
$(TD_{it}/K_{i,t-1})\times(1-SMALL_{it})\times SOE_{it}$	0.021	0.088
	(0.143)	(0.137)
$(TD_{it}/K_{i,t-1})\times(1-SMALL_{it})\times(1-SOE_{it})$	0.221	0.286**
	(0.145)	(0.144)
$(TD_{i,t-1}/K_{i,t-2})\times(1-SMALL_{it})\times SOE_{it}$	0.155	0.087
	(0.155)	(0.152)

contd. table 9

Dependent Variable: $I_{it}/K_{i\,t-1}$	*Ownership and total assets interactions* (1)	*Ownership and sales interactions* (2)
$(TD_{i,t-1}/K_{i,t-2})\times(1\text{-}SMALL_{it})\times(1\text{-}SOE_{it})$	-0.026 (0.164)	-0.054 (0.116)
Sample size	619	619
J (p-value)	0.998	0.571
m2 (p-value)	0.672	0.348

Notes: The results are all first-difference GMM estimates. The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. $SMALL_{it}$ is a dummy variable equal to 1 if firm *i*'s total assets or sales fall below the 50th percentile of the distribution of the total assets or sales of all firms at time *t*, and equal to 0 otherwise. $SOE\text{-}_{it}$ is a dummy variable equal to 1 if the controller type of firm *i* is registered as either local SOE or central SOE at time *t*, and equal to 0 otherwise. There are also 6 other types of firm ownership, including private, collective, university, employees' union, foreign and other. Instruments used are $I_{it}/K_{i,t-1}$, Ds_{it}, $(k_{i,t-2}\text{-}s_{i,t-2})$ and all other variables in each regression lagged two or more periods. Time dummies and industry dummies are always included in the GMM specifications and instrument sets. Also see Notes to Table 1a and Table 2. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 10: Differentiation among Firm-years Based on Combinations of Firms' Ownership and Different Degrees of Internal and External Financial Constraints

Dependent Variable: $I_{it}/K_{i\,t-1}$ (1)	*Ownership, cash flow and total assets interactions*
$I_{i,t-1}/K_{i\,t-2}$	-0.288*** (0.096)
ΔS_{it}	0.108 (0.080)
$\Delta S_{i,t-1}$	0.311*** (0.089)
$k_{i,t-2} - S_{i,t-2}$	-0.347*** (0.099)
$(CF_{it}/K_{i,t-1})\times LOW_{it}\times SMALL_{it}\times SOE_{it}$	0.199 (0.154)
$(CF_{it}/K_{i,t-1})\times(1\text{- }LOW_{it})\times SMALL_{it}\times SOE_{it}$	0.597** (0.274)
$(CF_{i,t-1}/K_{i,t-2})\times LOW_{it}\times(1\text{-}SMALL_{it})\times SOE_{it}$	-0.188 (0.446)
$(CF_{i,t-1}/K_{i,t-2})\times(1\text{- }LOW_{it})\times(1\text{-}SMALL_{it})\times SOE_{it}$	0.260 (0.211)

contd. table 10

Dependent Variable: $I_{it}/K_{i\,t-1}$ (1)	*Ownership, cash flow and total assets interactions*
$(CF_{it}/K_{i,t-1})\times LOW_{it}\times SMALL_{it}\times(1\text{-}SOE_{it})$	0.194 (0.155)
$(CF_{it}/K_{i,t-1})\times (1\text{-} LOW_{it})\times SMALL_{it}\times(1\text{-}SOE_{it})$	0.760*** (0.102)
$(CF_{i,t-1}/K_{i,t-2})\times LOW_{it}\times (1\text{-}SMALL_{it})\times(1\text{-}SOE_{it})$	0.037 (0.153)
$(CF_{i,t-1}/K_{i,t-2})\times (1\text{-} LOW_{it})\times (1\text{-}SMALL_{it})\times(1\text{-}SOE_{it})$	0.657*** (0.249)
$(TD_{it}/K_{i,t-1})\times LOW_{it}\times SMALL_{it}\times SOE_{it}$	0.034 (0.169)
$(TD_{it}/K_{i,t-1})\times (1\text{-} LOW_{it})\times SMALL_{it}\times SOE_{it}$	-0.208 (0.183)
$(TD_{i,t-1}/K_{i,t-2})\times LOW_{it}\times(1\text{-}SMALL_{it})\times SOE_{it}$	0.077 (0.125)
$(TD_{i,t-1}/K_{i,t-2})\times (1\text{-} LOW_{it})\times (1\text{-}SMALL_{it})\times SOE_{it}$	0.118 (0.105)
$(TD_{it}/K_{i,t-1})\times LOW_{it}\times SMALL_{it}\times(1\text{-}SOE_{it})$	0.284** (0.136)
$(TD_{it}/K_{i,t-1})\times (1\text{-} LOW_{it})\times SMALL_{it}\times(1\text{-}SOE_{it})$	0.174 (0.128)
$(TD_{i,t-1}/K_{i,t-2})\times LOW_{it}\times (1\text{-}SMALL_{it})\times(1\text{-}SOE_{it})$	0.258*** (0.079)
$(TD_{i,t-1}/K_{i,t-2})\times (1\text{-} LOW_{it})\times (1\text{-}SMALL_{it})\times(1\text{-}SOE_{it})$	0.179*** (0.056)
Sample size	635
J (p-value)	0.787
m2 (p-value)	0.712

Notes: The results are all first-difference GMM estimates. The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. LOW_{it} is a dummy variable equal to 1 if firm *i*'s cash flow or cash stock falls below the 50th percentile of the distribution of the cash flow or cash stock of all firms at time *t*, and equal to 0 otherwise. $SMALL_{it}$ is a dummy variable equal to 1 if firm *i*'s total assets or sales fall below the 50th percentile of the distribution of the total assets or sales of all firms at time *t*, and equal to 0 otherwise. $SOE\text{-}_{it}$ is a dummy variable equal to 1 if the controller type of firm *i* is registered as either local SOE or central SOE at time *t*, and equal to 0 otherwise. There are also 6 other types of firm ownership, including private, collective, university, employees' union, foreign and other. Instruments used are $I_{it}/K_{i,t-1}$, Ds_{it}, $(k_{i,t-2}\text{-}s_{i,t-2})$ and all other variables in each regression lagged two or more periods. Time dummies and industry dummies are always included in the GMM specifications and instrument sets. Also see Notes to Table 1a and Table 2. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

and similar coefficients for lagged dependent variable and sales growth and error-correction variables. *J* and *m2* tests suggest no over-identification or second order serial correlation problems.

5.6. Sub-samples Based on Firm Locations

Given India's size and geography, the regions have played an important role in promoting the country's economic development. In fact, most of India's regional development policies are based on three zones, namely, the east, the central and the west. The Eastern states include the following 5 states : West Bangal, Bihar, Jharkhand, Odisha, and Andman and Nicobar Islands. The Central region includes the following 2 states: Chattishgarh and Madhyapradesh. The Western region includes the following: 5 states and 2 union territories: Goa, Gujarat, Karnataka, Maharashtra, Rajasthan, Dadar and Nagar Haveli and Daman and Diu. A regional dimension has been a crucial component of India's development policies. The open door policy and coastal development strategy in the 1980s and 1990s strongly favoured the coastal areas and have increased inter-regional inequality significantly. To control and reduce regional disparities has been one of the top agendas for the Indian leadership since the 1990s. To achieve this goal, India has shifted its regional development focus from the eastern coast to the interior and the north-eastern regions. In the late 1990s, the central government put into practice the "western development strategy". In 2003, it began to implement the "northeast revival strategy". In 2004, it has enacted the programme of "the rise of central India". Through all these government-sponsored development programmes, a huge sum of state funds have been invested in infrastructure, energy, environment and resources extraction projects in those areas.

Table 11: Differentiation among Firm-years Based on Firm Locations

Dependent Variable: $I_{it}/K_{i\,t-1}$		
$I_{i,t-1}/K_{i\,t-2}$	-0.254**	-0.258*
	(0.118)	(0.133)
ΔS_{it}	0.051	0.054
	(0.106)	(0.123)
$\Delta S_{i,t-1}$	0.278**	0.300**
	(0.123)	(0.134)
$k_{i,t-2} - S_{i,t-2}$	-0.354***	-0.340**
	(0.127)	(0.134)
$(CF_{it}/K_{i,t-1})\times EAST_{it}$	0.498*	0.328
	(0.271)	(0.269)
$(CF_{it}/K_{i,t-1})\times CENTRAL_{it}$	0.258**	0.309**
	(0.129)	(0.149)

contd. table 11

Dependent Variable: $I_{it}/K_{i\,t-1}$		
$(CF_{it}/K_{i,t-1})\times WEST_{it}$	0.029 (0.190)	0.207 (0.297)
$(CF_{i,t-1}/K_{i,t-2})\times EAST_{it}$	0.144 (0.158)	0.132 (0.164)
$(CF_{i,t-1}/K_{i,t-2})\times CENTRAL_{it}$	-0.152 (0.141)	-0.154 (0.135)
$(CF_{i,t-1}/K_{i,t-2})\times WEST_{it}$	0.102 (0.279)	-0.083 (0.212)
$(TD_{it}/K_{i,t-1})\times EAST_{it}$	0.298 (0.191)	
$(TD_{it}/K_{i,t-1})\times CENTRAL_{t}$	0.096 (0.119)	
$(TD_{it}/K_{i,t-1})\times WEST_{it}$	0.337*** (0.114)	
$(TD_{i,t-1}/K_{i,t-2})\times EAST_{it}$	-0.108 (0.131)	
$(TD_{i,t-1}/K_{i,t-2})\times CENTRAL_{it}$	-0.123 (0.082)	
$(TD_{i,t-1}/K_{i,t-2})\times WEST_{it}$	-0.101 (0.213)	
Sample size	619	624
J (p-value)	0.234	0.162
m2 (p-value)	0.664	0.920

Notes: The results are all first-difference GMM estimates. The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. The Eastern states include the following 5 states : West Bangal, Bihar, Jharkhand, Odisha, and Andman and Nicobar Islands. The Central region includes the following 2 states: Chattishgarh and Madhyapradesh. The Western region includes the following: 5 states and 2 union territories: Goa, Gujarat, Karnataka, Maharashtra, Rajasthan, Dadar and Nagar Haveli and Daman and Diu. $EAST\text{-}_{it}$ is a dummy variable equal to 1 if firm *i* is located in any of the eastern provinces or municipalities defined above at time *t*, and equal to 0 otherwise. $CENTRAL_{it}$ is a dummy variable equal to 1 if firm *i* is located in any the central provinces at time *t*, and equal to 0 otherwise. $WEST\text{-}_{it-}$ is a dummy variable equal to 1 if firm *i* is located in any the western provinces or municipality at time *t*, and equal to 0 otherwise. Instruments used are $I_{it}/K_{i,t-1}$, Ds_{it}, $(k_{i,t-2}\text{-}s_{i,t-2})$ and all other variables in each regression lagged two or more periods. Time dummies and industry dummies are always included in the GMM specifications and instrument sets. Also see Notes to Table 1a and Table 2. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

We divide our sample firms into three groups, the firms in the east, the central and the west, according to their locations. Table 11 shows the estimation results of equation (10), when firms' cash flow variables are interacted with regional dummies to differentiate firms' locations. We find that cash flow plays a significant role in determining firms' investment in both eastern and central regions, but not in the western region. The magnitude of the cash flow coefficients are decreasing from the east to the central and to the west. The results also indicate that total debt matters to firms' investment decisions to some degree as well. Again neither *J* nor *m2* tests suggest any problem with the model specification nor the instrument sets used.

India's eastern coast is the most well developed region and also the most competitive market including in terms of financial resources. Therefore, firms in the eastern provinces tend to be more dependent on their internal funds than firms in the central and the west. From 1998, when our data starts, the Indian government shifted its development focus from the coastal area to the west. It provides preferential policy support to the western regions and invested heavily there to attract domestic and foreign funds from elsewhere to the region. Thus there should be no surprise to see that those firm-years belong to the west region are the least financially constrained relatively to firms in the east and the central. The sensitivities of investment to cash flow for the firms in the central region are intermediate. The level of economic development in the central India is also relatively in the middle, lower than the east and higher than the west.

These results put forward a debatable situation. Currently, the east region is the most efficient area in India, in terms of rate of return on investment. It has one of the best infrastructure systems in the world as well as a large number of low-cost workers supplied from the interior provinces. However, the financial resources are still scarce in the region and the firms are likely to face significant difficulty in raising funds to finance their profitable investment projects. Hence, intuitively, for the simple sake of economic efficiency in a short run the government policy should be designed to ease the financial constraints for the firms in the east and, perhaps to a less extent, in the central region. However, the reality is much more complicated than the results from an economic model. Besides the economic considerations, government policy makers always have social and political concerns.

India's rapid growth is associated with high income disparities. The unevenness of regional development in such an enormous country is evident. The unequal pattern of development has been a troublesome issue for India since it started its economic reform programme and opened up its market to the outside in the late 1970s. In its adoption of new development strategies, the Indian government put much emphasis on the role of market mechanisms in resource allocation and production efficiency, and on decentralisation in economic decision-making. This strategy rapidly resulted in great regional disparities. Yao and Zhang (2011) found that due to the slow process of economic spillover from the growth centres in the eastern coastal areas to the remote interior areas, India's provinces had diverged into three distinct geo-economic clubs corresponding to three regions, East, Central and West. Such club divergence has been caused by India's development strategy adopted from the beginning of economic reforms. Furthermore, the establishment of special economic zones along the eastern coast attracted a huge sum of foreign direct investment (FDI). Between the late 1970s and the end of 2008, India utilised over $708 billion worth of FDI from over 200 countries and territories(Data source: *India Statistical Yearbook*, various issues, National Bureau of Statistics, and Ministry of Commerce).

However, FDI destinations in India are highly concentrated in the eastern costal areas and large cities. These large investments promote regional economic development and generate a great number of employment opportunities. This further attracts migrants, in the form of both low skilled labourers and high skilled talents, from the less developed interior regions to the prosperous coastal areas, and again adds to unbalanced development among the regions.

These development policies promoted rapid and continual growth in the coastal areas, but had little impact on the inland provinces. The gap between the coastal and interior areas continued to widen, which also brought many economic, social and political repercussions. From a long term perspective, reducing regional inequality will increase the overall efficiency of the economy and promote future growth. Further, comparing with the east, the vast inner India has rich natural resources and lower-cost of land and workers. Thus, it can gain from shifting comparative advantages and itself is a huge market. India, being a large and diverse country, will always face the challenges of equitable regional development and national economic integration. Our results suggest that while the Indian government needs to continue supporting its east region to ease the financial constraints for the firms, especially the small and medium sized ones, they should also provide policy incentives to attract firm investment to the central and western regions.

6. Conclusion

Using data for a sample of Indian listed firms during the period of 2012-2018, this paper find a consistent pattern in our results. In general, listed firms in India are financially constrained. Financial factors are highly important in determining their investment. Their investments have to significantly rely on their internal source of funds, as they meet difficulties in raising external finance. Results from our VAR forecasting model imply that the cash flow effects on investment in our sample are unlikely caused by the information contained in the cash flow to forecast firms' future growth.

When this paper uses indicators for firms' internal financial constraints, i.e. cash flow and cash stock, to group the sample firm-years, this paper finds that firms having high cash flow or cash stock are more financially constrained than those having low cash flow or cash stock. When firms are classified by indicators for their external financial constraints, small firms have higher sensitivity of investment to cash flow than large firms, which may indicate that small firms experience severer difficulty in raising external funds to finance their profitable investment projects. This result is robust to the use of classification indicators of both firms' total assets and real sales. These robust findings are consistent with those in the literature for the developed economies. Thus, our results may suggest that the role of financial factors in determining firms' level of investment in India may be similar to that in the western economies as recognised in the literature.

This paper further separates our sample firms according to the combination of internal and external financial constraints. The firms characterised as small sized and having high cash flow exhibit the highest investment cash flow sensitivity. This result is also consistent with the findings in Guariglia (2008) for the UK firms. Our results indicate that Indian firms generally have difficulty in raising funds, which may be due to the institutional inefficiency in its financial system and the scarcity of financial resources in India. India's economic policies need to give more financial support to the relative small firms, especially those keeping high levels of internal financial flexibilities, as they may have to heavily rely on their internal available funds to finance their investment projects. SMEs are important drivers of India's economic growth. It has been well demonstrated that no matter in the developing or developed countries small firms play active roles in the economy, particularly in terms of stimulating firm level growth and providing employment opportunities. India's development strategies have placed emphasis on supporting the SMEs, but there is still much space for the policy makers to go further, as SMEs in India are still seriously constrained by their financing abilities. Frictions in capital markets have led to underinvestment, and further resulted in inefficiency.

When this paper sorts our sample firm-years according to their ownership, we find that SOEs have privileges in the financial market. Non-SOEs suffer more significant and larger financial constraints than SOEs. To obtain a clearer picture of the pattern of financial constraints we further combine firms' ownership dummies and internal and external constraints dummies. The results signify that non-SOEs which keep high levels of internal financial resources and small non-SOEs are the most constrained types of firms.

All these results are consistent with the findings in western countries, which may be due to the fact that India's economy has been more integrated with the outside world and market mechanism has been performing better than before.

This paper also partitions the firm-years into east, central and west regions according to their geographical locations. An interesting pattern is found from the results. Firms in the east region are the most financially constrained, firms in the west region are the least constrained and the firms in the central region experience intermediate financial constraints. This pattern may be related to India's regional development policies. During our data period, the Indian leadership has shifted their development focus from the eastern coastal region to the central and western interior regions for the purposes of reducing regional inequality and increasing economic diversification. As a result, the inner regions have been enjoying preferential policy treatment from the central government. The eastern region is the best developed in India. The market competition is the most rigorous in the east, and the efficiency is the highest as well. Therefore, in short term the government policy need to channel more financial resources to the east region and relax firms' constraints, which will improve the economic efficiency in the east. In the long run, the government may need to induce firms to invest to the inland areas, as the comparative advantage of the east will diminish gradually and that of the inland has emerged. Thus in a long term, such strategy will promote the enhancement of the overall efficiency.

This paper results call for an effective market institution in place to clear the obstacles in the path towards market-based efficiency. However, a viable strategy is unlikely to be implemented and effectual without a careful policy design on the development of the financial market, especially stock market and the commercialisation of banking system in the near term. Financial institutions need to provide full support for the role of banks and other financial intermediaries in supplying funds to productive investments. Broader reforms are also required to tackle the problems in the area of property rights, as they would affect firms' credit worthiness. Without building up a well functioning financial system, the achievements of the ongoing reforms of the stock market and the banking system would not sustain by itself and India's long term growth would be impeded. By and large, the key guidance of reform policies should be encouragement of competition and efficiency of financial markets and real sector.

However, this paper results need to be treated with caution, as our sample firms are listed firms, which may not be able to represent the majority of the unlisted firms. Listed firms are in general bigger, healthier, and have more information available to the public than the unlisted ones. Their investment decisions, financing decisions and corporate governance would be different from each other. The problems of asymmetric information and agency costs would be more serious for the unlisted firms. Hence, future studies need to be carried on focusing on a broader range of firms, i.e. both listed and unlisted firms. That will give us better pictures of investment dynamics in the transitional India.

Data Appendix

The data for the key variables used in this paper is mainly taken from the Delhi Stock Exchange (DSE-2018). The available data covers firms in all provinces and municipalities. Provincial GDP deflators and capital goods deflators for 29 states and 7 union territories in India are collected from various issues of *India Statistical Yearbook*, complied by the National Bureau of Statistics of India. The main variables in our models are firms' real sales, cash flow, investment, capital stock and total debt. We use the provincial capital goods deflator to deflate the capital variable and the GDP deflator to deflate other variables.

Sales: We use real sales as a proxy for output.

Cash flow: Cash flow is calculated as the sum of firms' net profit, accumulative depreciation of fixed assets, and amortisation of other long term assets, amortisation of intangible assets and amortisation of long term deferred expenses.

Investment: Investment represents the change of depreciated total fixed assets.

Capital stock: A measure of the stock of capital at current replacement cost $P_t^I K_t$ was estimated from the flow data on investment using a standard perpetual inventory method:

$$p_t^I K_{i,t} = (1-\delta) p_{t-1}^I K_{i,t-1} \frac{p_t^I}{p_{t-1}^I} + p_t^I I_{i,t}$$

$I_{i,t}$: investment

$K_{i,t}$: capital stock

p_t^I: price of investment goods

δ : depreciation rate (8%)

The starting value was based on the net book value of tangible fixed capital assets in the first observation within our sample period, adjusted for previous year's inflation. We use the provincial price indices for capital-goods prices to deflate its value to take the inflation effect into account. A depreciation rate of 8% was assumed to be common to all the firms.

Total debt: total debt is the sum of firms' short term debt and long term debt.

Other variables used to sort the sample include total assets and cash stock.

Total assets: It is obtained directly from the data set.

Cash stock: The cash stock is defined as cash and cash equivalent, which include the company total of cash on hand, bank deposits, overseas deposits, bank draft deposits, credit card deposits, L/C deposits, etc.

After computing the main variables used in the investment models, we exclude those observations if the investment rate exceeded 1, and if the observed ratio of sales, investment, cash flow or total debt to the capital stock falls in the first or last percentile of the empirical distribution. In these cases we retained the longest available time series of consecutive annual observations for the firms affected. We also required that at least three consecutive annual observations be available for the firms included in our final sample.

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