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Investment and Idiosyncratic Volatility: Role of Ownership Concentration

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Abstract

This paper studies the role of ownership concentration in determining the relationship between idiosyncratic volatility shocks and investment across firms. Using a panel of Indian manufacturing firms listed on the Bombay Stock Exchange we find investment to be much more sensitive to idiosyncratic volatility shocks in case of firms with high ownership concentration. Further investigation points towards increased tendency for *overinvestment* by low-ownership concentration firms when faced with higher idiosyncratic volatility as the possible reason behind smaller investment sensitivity to idiosyncratic volatility. Institutional ownership helps in reducing this tendency for overinvestment thereby bringing investment behaviour of low ownership concentration firms closer to that predicted by the real options framework. Presence of a large "Outsider" block holder produces a similar reduction in the tendency for overinvestment. Our results suggest that institutional ownership beyond a certain level can curb the tendency for overinvestment driven by desire of private benefit extraction and thus help protect the interests of minority shareholders.

JEL Classification: F1, F4

Keywords: Idiosyncratic volatility, Ownership concentration, Investment

I. Introduction

Volatility shocks affect corporate investment adversely in the presence of investment irreversibility and imperfect competition (Caballero (1991)). In the absence of financial frictions, only systematic component of risk arising from volatility should affect investment decisions of the corporations while idiosyncratic risks are diversified away by value maximizing shareholders. Recent studies have shown that agency conflicts can create a wedge between the interests of well diversified minority shareholders and undiversified controlling shareholders/managers thereby affecting their response to idiosyncratic volatility shocks. Risk averse, undiversified majority shareholders, by virtue of being subject to both systematic and idiosyncratic risks facing the firm, have the tendency to reject too many investment projects with positive NPV from the perspective of a well-diversified minority shareholder (Zhang (1997)). As increase in idiosyncratic volatility could therefore lead to underinvestment by firms with large controlling shareholders from the perspective of minority shareholders. At the same time, in the absence of monitoring by large controlling shareholder, the controlling manager could approve low net present value projects with the sole objective of extracting private benefits to mitigate the drop in wealth resulting from increased idiosyncratic volatility (Bertrand et. al. (2002)). This would result in overinvestment by firms with low ownership concentration.

The impact of idiosyncratic volatility on investment could therefore depend upon the structure of ownership (including the level of ownership concentration) and the agency conflicts resulting therefrom, apart from capital market frictions and investment irreversibility. Few studies, however, look at the role of agency conflicts in shaping investment response to idiosyncratic volatility. This paper fills an important gap in the literature by looking at the effect of ownership concentration on investment-idiosyncratic volatility relationship for a panel of emerging market firms.

Using data on 2300 Indian manufacturing firms listed on the Bombay Stock Exchange (BSE) for the period 2001-2022, this paper tests the hypothesis that ownership concentration affects investment response to idiosyncratic volatility shocks. We find that investment by firms with low ownership concentration responds much less to idiosyncratic volatility shocks; especially when the institutional ownership is low. Further examination shows evidence of overinvestment by low-ownership concentration firms in the face of idiosyncratic volatility shocks providing potential explanation for their low investment sensitivity to idiosyncratic volatility. These results show that agency conflicts play a possibly important role in shaping firm's investment response to idiosyncratic volatility shocks. Once again, institutional ownership mitigates this tendency for overinvestment amongst low ownership concentration firms. From a policy perspective these results highlight that the role of ownership structure needs to be considered when analysing the impact of volatility on growth and investment. Further, they highlight the role of institutional ownership in mitigating agency conflicts arising from ownership structure.

Rest of the paper is organised as follows. Section 2 presents a brief literature review. Section 3 presents a simple theoretical model of profit maximizing firm to motivate the empirical approach followed in the paper. Section 4 discusses the data while section 5 presents the key empirical findings of the paper. Section 6 concludes.

II. Literature Review

Traditional economic theory has relied on irreversible investment or imperfect financial markets to explain the negative relationship between firm level volatility and investment. While the standard real-options-theory based approach predicts a negative relationship between investment and volatility independent of the financing decision (e.g., Pindyck (1991) and Dixit and Pindyck (1994)), modern macroeconomic and financial theory emphasizes the role of financial frictions emanating from asymmetric information, transaction costs etc (see, e.g., Whited (1992) and Campello et. al. (2010)). Papers focusing on the real options channel for explaining the transmission of volatility shocks to the real activity include Bloom et al. (2007), Bloom (2009), Julio and Yook (2012), Kellogg (2014), and Gulen and Ion (2016). Bolton et. al. (2019) on the other hand, introduce financing constraints in a real options model to show that to avoid costly external financing and accumulate internal funds, financially constrained firms can delay investment significantly. Their model can explain more persistent effects of volatility on investment dynamics in line with the findings of Alfaro et. al. (2016)[1].

The studies cited above do not consider the role of agency conflicts associated with firm's ownership structure in shaping its investment policies. With growing evidence in support of the role of agency problems in shaping firm behaviour, this is a serious drawback (see e.g. Bertrand and Schoar (2003), Malmendier and Tate (2005) and, Graham, Harvey and Puri (2013) etc.).
This paper fills an important gap in the literature by looking at the role of ownership concentration shaping firm's investment policies in the face of idiosyncratic shocks in the case of an emerging market. Emerging markets like India see a preponderance of concentrated firm ownership because of weak institutional set up that makes enforcement of agency contracts difficult (see e.g. Dharwadkar et. al. (2000)). While concentrated ownership can reduce the traditional Principal – Agent conflict (PA henceforth) by providing greater incentive to the controlling shareholder to monitor the decisions taken by the managers, it can enhance another type of conflict – that between the controlling shareholders and minority shareholders; also known as the Principal-Principal conflict (PP henceforth)

PP agency problems can cause controlling shareholders to act against the best interests of diversified minority shareholders to extract private benefits (see e.g. Baumol (1959); Marris (1964); Williamson (1964); Johnson et. al. (2000) etc.). These incentives to expropriate minority shareholders tend to go up during crisis as controlling share holders see a decline in their wealth (Johnson et. al. (2000); Mitton (2002); Baek et. al. (2004); Bae et. al. (2012)). At the same time, because of their high-risk exposure to the company's performance, dominant

[1] Other papers in this strand of literature include Campello et. al. (2010) and Campello et. al. (2011)

owners could forgo positive-NPV investments to preserve their private benefits (John et al. (2008); Panousi and Papanikolaou (2012)). Motivated by risk aversion, controlling owners have an incentive to take on less risk than is desired by diversified shareholders or even undertake value-destroying actions that reduce the firm's risk (Jensen and Meckling (1976); Amihud and Lev (1981); Smith and Stulz (1985); Holmstrom (1999); Gormley and Matsa (2016)) thus making investment in such firms more sensitive to idiosyncratic volatility shocks. Ownership concentration can therefore be important in shaping firms' investment response to idiosyncratic shocks.

India provides an interesting case study for looking at the role of ownership in shaping firms' investment policies because the Indian institutional context provides weak *de facto* protection for minority shareholders' rights and is characterized by very limited external market control mechanisms to mitigate agency conflicts (see La Porta et. al. (1998) and Balasubramanian (2010)). Availability of detailed firm level data in recent years has allowed researchers to study the impact of different ownership structures on Indian firms' market value (Balasubramanian et. al (2010)), Mergers and Acquisitions outcomes (Bhaumik and Selarka (2012)) and investment efficiency (Bhaumik et. al. (2012)). This paper adds to this strand of literature by looking at the role of ownership concentration of firm's investment policies in the face of idiosyncratic volatility shocks. To the best of our knowledge, this is the first such study based on Indian firm level data. This is also the first study providing evidence of overinvestment by firms with low ownership concentration in response to higher idiosyncratic volatility.

Our paper relates to three broad strands of literature. Firstly, it relates to the literature on investment under uncertainty. Prominent papers in this literature include Pindyck (1991), Dixit and Pindyck (1994)), Dixit (1995), Leahy and Whited (1996), Abel and Eberly (1999) and Baum et. al (2008). Secondly, this paper relates to the literature on impact of ownership concentration on firm behaviour in the face of idiosyncratic risks (see e.g. Zhang (1998), Wei and Zhang (2008), Panousi and Papanikolaou (2012) and, Wang and Shailer (2015)). Finally, our paper relates to the literature on role of corporate governance during crisis in emerging markets (e.g. Johnson et. al. (2000), Baek et. al. (2004), Bae et. al. (2012) and Caixe (2022)).

Next section presents a model of firm's investment demand in the presence of idiosyncratic volatility shocks to motivate our empirical exercise.

III. Model

This section presents a model of investment demand by value maximizing firm facing convex adjustment costs to motivate the empirical analysis that follows. At time t, all present variables are known to the firm with certainty while all future variables are stochastic. Firm managers are assumed to be risk-neutral and rational[2].

[2] To simplify matters we ignore issuing of new shares by the firm to focus on the effects of restrictions on outside debt.

In the absence of any asset bubbles, the value of the firm is simply the present discounted value of its expected after-tax dividends. The firm maximizes its market value subject to the capital accumulation equation:

$$K_{i,t} = I_{i,t} + (1-\delta)K_{i,t-1}$$

Here, $K_{i,t}$ is the capital stock of firm i at the end of time t, $I_{i,t}$ is its investment at time t, and δ is the constant rate of depreciation. Firm faces an increasing and convex cost of adjusting capital given by - $\varphi\left(I_{i,t}, K_{i,t-1}\right)$.

The firm also faces information costs resulting from asymmetric information creating a wedge between the cost of internal and external finance[3]. $\Gamma\left(Z_{i,t}\right) \geq 0$ captures firm's proneness to information and incentive problems as a function of firm characteristics $Z_{i,t}$ such as age, size, etc. A firm more likely to suffer from information problems has a larger $\Gamma\left(Z_{i,t}\right)$. In the absence of information asymmetry, $\Gamma\left(Z_{i,t}\right) = 0$ and firm is indifferent between internal and external funds.

Cash inflows of the firm include sales and net borrowings while its outflows include dividends, interest payments and investment expenditures.

Firm's dividends can therefore be written as:

$$d_{i,t} = \theta_{i,t}K_{i,t-1}^{\alpha} - \varphi\left(I_{i,t}, K_{i,t-1}\right) - I_{i,t} + B_{i,t} - r_t B_{i,t-1} - \frac{\Gamma(Z_{i,t})}{2}\frac{\left(B_{i,t}-B_{i,t-1}\right)^2}{B_{i,t-1}} \qquad (1)$$

Where:

$\theta_{i,t}$ = Idiosyncratic firm level productivity shock
$B_{i,t}$= Net debt outstanding of firm i at time t
r_t = Interest rate on corporate debt
$\frac{\Gamma(Z_{i,t})}{2}\frac{\left(B_{i,t}-B_{i,t-1}\right)^2}{B_{i,t-1}}$ = Cost wedge between internal and external finance.

Maximization problem of the firm at time 0 can be written as:

$V_{i,0} = \max_{\{K_{i,t};B_{i,t}\,\forall t\}} E_0 \sum_{t=0}^{\infty} \beta^t \times d_{i,t}$ (2); β is the discount rate

[3] Cost wedge could include underwriting fee, bankruptcy costs etc.

s.t. $K_{i,t} = I_{i,t} + (1-\delta)K_{i,t-1}$.

Solving firm's optimization problem gives us:

$$\beta^t \left(1 + \frac{\partial \varphi(I_{i,t}, K_{i,t-1})}{\partial I_{i,t}}\right) =$$
$$\beta^{t+1} E_0 \left[\alpha \theta_{i,t+1} K_{i,t}^{\alpha-1} - \frac{\partial \varphi(I_{i,t+1}, K_{i,t})}{\partial K_{i,t}} + (1-\delta)\left(1 + \frac{\partial \varphi(I_{i,t+1}, K_{i,t})}{\partial I_{i,t+1}}\right)\right] \quad (3)$$

To proceed further we define the capital adjustment cost function as:

$$\varphi(I_{i,t}, K_{i,t-1}) = \frac{1}{2}\left(\frac{I_{i,t}}{K_{i,t-1}} - c\right)^2 K_{i,t-1} \quad (4)$$

Equation (3) can now be written as:

$$(1-c) + \frac{I_{i,t}}{K_{i,t-1}} = E_0 \Psi_{i,t} \left[\alpha \left(\frac{Y_{i,t+1}}{K_{i,t}}\right) - \left\{c^2 - \frac{1}{2}\left(\frac{I_{i,t+1}}{K_{i,t}}\right)^2\right\} + (1-\delta)\left(1 - c - \frac{I_{i,t+1}}{K_{i,t}}\right)\right] \quad (5).$$

where $\Psi_{i,t} = \left(1 - r_{t+1} - \Gamma(Z_{i,t})\left(\frac{B_{i,t} - B_{i,t-1}}{B_{i,t-1}}\right) - \Gamma(Z_{i,t+1})\left(\frac{B_{i,t+1} - B_{i,t}}{B_{i,t}}\right)\right) = \beta$

Log-linearizing (5) around the steady state gives us:

$$\ln \frac{I_{i,t}}{K_{i,t-1}} = \left[\gamma_0 + \gamma_1 \ln \frac{Y_{i,t+1}}{K_{i,t}} + \gamma_2 \ln \frac{I_{i,t+1}}{K_{i,t}} + \ln \Psi_{i,t} + \varepsilon_{i,t},\ \varepsilon_{i,t} \sim N(0, \sigma_\varepsilon^2)\right]^{4} \quad (6)$$

To derive the empirical demand function, we modify equation (6) in several ways. First, we use sales as a proxy for firm's output and use lagged levels of right-hand side variables to capture their current values[5]. Second, we include index of firm level stock return volatility to capture the impact of uncertainty on investment demand under costly adjustment[6]. Finally, we include firm and time specific fixed effects to control for omitted variable bias to get:

$$\ln \frac{I_{i,t}}{K_{i,t-1}} = \vartheta_0 + \vartheta_1 \ln \frac{S_{i,t-1}}{K_{i,t-2}} + \vartheta_2 \ln \frac{I_{i,t-1}}{K_{i,t-2}} + \vartheta_3 \sigma_{i,t-1}^2 + \ln \Psi_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t},$$
$$\varepsilon_{i,t} \sim iid\ N(0, \sigma_\varepsilon^2) \quad (7)$$

In the absence of information asymmetry $\Gamma(Z_{i,t}) = 0$ and $\ln \Psi_{i,t}$ in the above equation becomes $\ln(1 - r_{t+1})$. In the presence of information asymmetry $\Gamma(Z_{i,t}) > 0$ and the last term

[4]See Appendix for the details of the derivation.
[5] We experiment with different number of lags, but our key results remain unchanged.
[6] See Kang, Lee and Ratti (2014) for details of the firm level volatility index.

becomes - $\ln\left(1 - r_{t+1} - \Gamma(Z_{i,t})\left(\frac{B_{i,t}-B_{i,t-1}}{B_{i,t-1}}\right) - \Gamma(Z_{i,t+1})\left(\frac{B_{i,t+1}-B_{i,t}}{B_{i,t}}\right)\right) \leq \ln(1 - r_{t+1})$. This implies:

$$E\left(\frac{I_{i,t}}{K_{i,t-1}}|t; \Gamma(Z_{i,t}), \Gamma(Z_{i,t+1}) = 0\right) - E\left(\frac{I_{i,t}}{K_{i,t-1}}|t; \Gamma(Z_{i,t}), \Gamma(Z_{i,t+1}) > 0\right) \geq 0 \qquad (8)$$

In other words, financial frictions resulting from information asymmetry restrict investment below the neoclassical level but never above the frictionless level.

We can use the above insight to express investment demand as a sum of investment frontier given by the neo-classical model and a nonnegative financing constraint effect u_t as follows:

$$\left(\ln\frac{I_{i,t}}{K_{i,t-1}}\right)^{SF} = \vartheta_0 + \vartheta_1 \ln\frac{S_{i,t-1}}{K_{i,t-2}} + \vartheta_2 \ln\frac{I_{i,t-1}}{K_{i,t-2}} + \vartheta_3\sigma^2_{i,t-1} + \mu_i + \lambda_t + \varepsilon_{i,t} \qquad (9.1)$$

And

$$\ln\frac{I_{i,t}}{K_{i,t-1}} = \left(\ln\frac{I_{i,t}}{K_{i,t-1}}\right)^{SF} - u_{i,t};\, u_{i,t} \geq 0; \qquad u_{i,t} \sim \varepsilon\left(\varrho(Z_{i,t})\right) \quad (9.2).$$

Non-negative efficiency term $u_{i,t}$ is assumed to have an exponential distribution. Equation (9.2) shows that $\frac{\mathrm{I}_{i,t}}{\mathrm{I}^{SF}_{i,t}} = exp(-u_{i,t})$; where $\mathrm{I}_{i,t} = \frac{I_{i,t}}{K_{i,t-1}}$ and $\mathrm{I}^{SF}_{i,t} = \left(\frac{I_{i,t}}{K_{i,t-1}}\right)^{SF}$. Therefore, $\frac{\mathrm{I}_{i,t}}{\mathrm{I}^{SF}_{i,t}}$ can be seen as investment efficiency which is bounded between 0 and 1. Assuming that this shortfall is due to financial constraints, we can use - $\frac{\mathrm{I}_{i,t}}{\mathrm{I}^{SF}_{i,t}}$ as a measure of financial frictions.

Finally, we define $\varrho(Z_{i,t})$ as –

$$\varrho(Z_{i,t}) = \omega_0 + \omega_1 \ln\frac{Cash\ Flow_{i,t}}{K_{i,t-1}} + \omega_2 DUMLEV_t + \omega_3 DUMSIZE_t + \omega_4 DUMAGE_t \quad (9.3)$$

Leverage dummy takes a value of 1 if the firm leverage (defined as debt to asset ratio) is above median and zero otherwise. Firm size is defined as the three-year average of total income and total assets of a company[7]. The size dummy takes a value of one if firm size in above median and zero otherwise. Dummy for firm age takes a value of 1 if the firm was incorporated before 1991 and 0 if it was incorporated after the year 1991.

Equations 9.1, 9.2 and 9.3 define the stochastic frontier model that we estimate using annual balance sheet data for a panel of Indian firms.

[7] Detailed definitions of these variables can be found at https://prowessdx.cmie.com/kommon/bin/sr.php?kall=wdddisplay

IV. Data and Empirical Estimation

Our dataset includes a group of around 2300 Indian non-financial firms covering a period between 1988 and 2021. Data on these firms are obtained from widely used CMIE-PROWESS database. It contains data on variables such as sales, investment etc. as well as information regarding the ownership structure of the firm. Apart from these, information regarding the ownership characteristics of the firm such as affiliation to a business group, share of promoter's equity, institutional ownership etc. are also obtained from the CMIE. Our final dataset excludes firms in the utility sector, firms under public sector ownership and firms with less than five years of data. We further restrict our sample to firms listed on the Bombay Stock Exchange with data on daily stock returns for at least five years. This leaves us with about 91,766 firm-year observations. Appendix A provides definitions and summary statistics of our key variables.

Measuring Idiosyncratic Volatility

We calculate our benchmark measure of idiosyncratic volatility using monthly average of daily stock returns for the firms listed on the Bombay Stock Exchange (BSE). The following model, applied to average stock returns gives us our measure of idiosyncratic volatility:

$$r_{i,t,m} = \beta_{0,i} + r^{f}_{t,m} + \beta_1\left(r^{mkt}_{t,m} - r^{f}_{t,m}\right) + \beta_2 \ln Size_{i,t,m} + \beta_3 BM_{i,t,m} + \varepsilon_{i,t,m} \quad (10)$$

Here, $r_{i,t,m}$ is the average daily stock returns for firm i in month m of year t. $r^{f}_{t,m}$ is the risk-free return measured by the yield on 91-day Indian government securities for the same period. $r^{mkt}_{t,m}$ is the market return captured using average daily returns of S&P BSE 500 index (the index captures 95 percent of total market capitalization of BSE and covers almost all major industries). Size is measured using the market value of equity. Finally, BM or book to market value of equity is used to capture the difference in the performance of value stocks versus growth stocks. In line with the literature all the variables are Winsorized at 1 percent to remove the effect of outliers.

Residual $\varepsilon_{i,t,m}$ is then used to create annual measure of idiosyncratic volatility as follows.

$$IV_{i,t} = \sqrt{\sum_{m=1}^{n} \varepsilon^2_{i,t,m} / n} \quad (11)$$

Where n is the number of months in year t.

Calculated in this manner, our measure of idiosyncratic volatility isolates systematic movements in stock return volatility driven by movements in market premium, size, and other firm level characteristics to give us an indicator of conditional idiosyncratic volatility. The average level of idiosyncratic volatility in our sample is 0.01 with a standard deviation of 0.0049.

As a robustness check we also calculate an alternative measure of firm level volatility based on monthly standard deviation of daily stock returns averaged over each year. This provides us with a measure of unconditional volatility. The two measures of volatility are significantly positively correlated with a correlation coefficient of 0.4. Our main results do not change with this alternative measure of volatility.
The next section describes our results.

V. Results

Table 1 presents the estimates from our benchmark model. Column 1 presents the estimates using the Arellano and Bond GMM estimator while the remaining columns present the estimates obtained from the stochastic frontier model. All the coefficients are of expected sign and economically significant. Growth rate of investment is positively correlated with lagged Tobin's' q and lagged level and growth rate of sales while it is negatively correlated with lagged level of idiosyncratic volatility. Coefficient on lagged investment rate is positive but small indicating persistence in investment behaviour. Idiosyncratic volatility captured using the stock market returns has a significantly negative effect on investment growth. A one standard deviation shock to the idiosyncratic volatility (~0.0049) lowers investment rate by around fourteen to sixteen percent (columns 2 and 3 in Table 1). With the median investment rate of 7.6 percent this implies a reduction in the investment rate by 1 - 1.2 percentage points indicating a statistically as well as economically significant impact of idiosyncratic volatility on investment.

Looking at the efficiency equation, we interpret it as measuring the degree of financial constraints affecting firm level investment in line with the literature. Once again, all the coefficients are of expected sign. Age, size and cash flow reduce the degree of financial constraints affecting firm level investment while leverage increases these financial constraints. These results are robust to the use of alternative measure of idiosyncratic volatility based on standard deviation of daily stock returns (columns 4 and 5, Table 1).

Next, we check for the presence of non-linearity in the relationship between investment and idiosyncratic volatility. While the real options literature predicts a negative relationship between uncertainty and investment, since greater uncertainty increases the value of the option to wait thereby increasing the threshold for the firms to exercise their option, higher uncertainty also increases the probability of firms breaching this threshold. The overall impact of higher uncertainty on firm's expected investment is therefore ambiguous (see Sarkar (2000)). At lower levels of uncertainty, probability effect of higher uncertainty is likely to dominate while the threshold effect would dominate at higher level of uncertainty. To capture the presence of such non-linearities we introduce dummy variables for different threshold levels of uncertainty. For each year we divide the sample in to four quartiles based on the level of uncertainty. We then create four dummy variables (one for each quartile) that take the value of one if the lagged level of uncertainty belongs to a particular quartile and zero otherwise. Incorporating these dummies and their interactions gives us the following two models:

$\ln \frac{I_{i,t}}{K_{i,t-1}} = \vartheta_0 + \vartheta_1 \ln \frac{I_{i,t-1}}{K_{i,t-2}} + \vartheta_2 \delta_{1,t-1}^{IV} + \vartheta_3 \delta_{2,t-1}^{IV} + \vartheta_4 \delta_{3,t-1}^{IV} + \vartheta_5 \delta_{4,t-1}^{IV} + \vartheta_6 \mathrm{X}_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$, (12) and

$\ln \frac{I_{i,t}}{K_{i,t-1}} = \vartheta_0 + \vartheta_1 \ln \frac{I_{i,t-1}}{K_{i,t-2}} + \vartheta_2 \sigma_{t-1} \times \delta_{1,t-1}^{IV} + \vartheta_3 \sigma_{t-1} \times \delta_{2,t-1}^{IV} + \vartheta_4 \sigma_{t-1} \times \delta_{3,t-1}^{IV} + \vartheta_5 \sigma_{t-1} \times \delta_{4,t-1}^{IV} + \vartheta_6 \mathrm{X}_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$, (13)

Here, $\delta_{1,t-1}^{IV}$, $\delta_{2,t-1}^{IV}$, $\delta_{3,t-1}^{IV}$ and $\delta_{4,t-1}^{IV}$ are dummy variables for the first. second, third and fourth quartile of idiosyncratic volatility respectively while $\mathrm{X}_{i,t}$ is the set of control variables that include lagged level and growth rate of sales, Tobin's q, etc. Both (12) and (13) are estimated using the stochastic frontier technique with indicators of cash-flow, leverage, size and age used to estimate the efficiency equation. Table 2 presents the estimates of these results. The relationship between investment growth and Idiosyncratic volatility exhibits significant non-linearity. Columns 1 to 3 in Table 2 present the results from model (i). The negative relationship between idiosyncratic volatility and investment rate is significantly stronger for higher levels of volatility as indicated by the coefficients on quartile dummies. A jump in the idiosyncratic volatility from the first to the fourth quartile brings investment rate down by nine 9-11 percentage points, other things being equal. At the same time, investment sensitivity to idiosyncratic volatility also increases as volatility jumps from the first to the fourth quartile. The increases in investment sensitivity to idiosyncratic volatility is not monotonic though. A one standard deviation increase in idiosyncratic volatility reduces investment rate by 1.3 to 2.9 percent more as one moves from the first to the fourth quartile. This non-linearity is consistent with the presence of both the 'threshold' and the 'probability' effect of higher idiosyncratic volatility. Overall, the evidence of a negative effect of idiosyncratic volatility on investment rate remains robust to the incorporation of non-linearities in the model.

Ownership Concentration and Idiosyncratic Volatility

Recent literature has emphasised the role of ownership concentration and the resulting incentives in shaping firm's investment response to idiosyncratic volatility (see e.g., Panousi and Papanikolaou (2012), Glover and Levine (2015, 2017), Gormley and Matsa (2016)). Agency conflicts can drive a wedge between the optimal investment policies of well diversified shareholders and controlling managers. Specifically, undiversified controlling managers can "underinvest" from the perspective of diversified shareholders when subject to idiosyncratic risks. At the same time, higher idiosyncratic volatility can encourage 'overinvestment' by controlling managers wishing to extract private benefits by making it easier to hide such behaviour. In both the cases, the actual investment behaviour in the face of idiosyncratic volatility is sub-optimal from the perspective of a diversified shareholder and leads to inefficient growth outcomes. This section, therefore, looks at the role of ownership concentration in determining investment sensitivity to idiosyncratic volatility.

In emerging countries like India, large firms typically have large controlling shareholders, such as the founding families and other corporations, that own a significant fraction of equity (La Porta et al. (1999)). These large shareholders can effectively control the decision-making by the management and in many cases directly participate in the management of the company through the presence of their members in management. While concentration of ownership in the hands of insider-managers can potentially reduce the agency conflicts between owners and managers of the firms (see Shleifer and Vishny (1997)), it can create another type of agency conflict – that between the large shareholders and minority shareholders (see Villalonga and Amit (2006)). We therefore focus on the role of ownership concentration in shaping investment response to idiosyncratic volatility and take as our measure of ownership concentration, the proportion of shares held by promoters and persons acting in concert with the promoters (PAC) (see Bhaumik and Selarka (2012)). While ownership concentration can be endogenous to the potential private gains from such concentration which can in turn affect the relationship between investment and idiosyncratic uncertainty, in case of emerging markets like India with relatively illiquid capital markets, one finds such concentration to be stable across time. In our sample, promoters' share of equity changes by more than one percent for less than thirty percent of the observations while it changes by more than ten percent for about 2.5 percent of the firm-year observations. The median change in promoter's share of equity is zero. We therefore regard promoters' share of equity to be exogenous for the rest of the analysis.

Our first step is to divide the sample based on promoter's equity share. Since absolute control is associated with the ownership of more than 50 percent share, we use that as the threshold for defining high (low) ownership concentration. We then estimate the investment demand function for the two sub-samples separately using the stochastic frontier technique. Table 3 presents the results from this exercise. While most of the coefficients retain their sign and significance after the sample split, coefficient on idiosyncratic volatility changes signs between the two sub-samples. For firms with low ownership concentration (share of promoter's equity less than or equal to 50 percent), higher idiosyncratic volatility has a positive (but statistically insignificant) impact on the rate of investment while the opposite is true for firms with high ownership concentration. A one standard deviation shock to the idiosyncratic volatility reduces investment rate by roughly 2 percentage points for firms with high ownership concentration, it increases the investment rate slightly (by 0.3 percentage points) for low ownership concentration firms. This result remains robust to the choice of control variables included in the model.

Technological Characteristics and Idiosyncratic Volatility

Technological characteristics such as depreciation, lumpiness of investment and investment specific technological change affect responsiveness of economic activity to business cycle and volatility shocks (Samaniego and Sun (2015, 2019)). To check whether our results are driven by omission of these industry level characteristics we conduct robustness tests by including interaction terms between industry characteristics and idiosyncratic volatility. We divide our sample into 28 different industry groups based upon three-digit Standard Industrial Classification (ISIC). Using industry specific measures for capital durability (DEP_i), investment lumpiness (LMP_i) and Investment Specific Technical Change ($ISTC_i$) from Samaniego and Sun (2015) we check the robustness of our results across different industry characteristics.

Table 4 presents the results of this exercise. Our key results remain unchanged with the incorporation of these industry level technological characteristics and their interactions with firm level idiosyncratic volatility. Idiosyncratic volatility slows down investment rate much more for firms in industries with faster capital depreciation, greater investment lumpiness and higher degree of investment specific technical change. Yet, the decline in investment due to idiosyncratic volatility remains significantly higher for firms with higher ownership concentration.

These results complement the findings of Samaniego and Sun (2015) that establish the role of industry specific characteristics in determining the impact of business cycle shocks. They also support the results of Samaniego and Sun (2019) who use a model with irreversible investment to show that growth is more sensitive to uncertainty shocks in industries where rate of depreciation (and by extension lumpiness of investment) is higher.

Institutional Ownership and Idiosyncratic Volatility

Stronger impact of idiosyncratic volatility on investment rate of firms with higher ownership concentration would be consistent with greater monitoring by the shareholder-owners reducing agency problems and curbing overinvestment for private gains by the managers. At the same time, it could reflect 'underinvestment' by undiversified controlling shareholders when exposed to idiosyncratic risks. A significant equity ownership by institutional investors could reduce the former problem since they have both the ability and the incentive to monitor and discourage suboptimal investment choices by firms. Institutional ownership can therefore mitigate the adverse impact of idiosyncratic volatility on firm's investment policy. We test this hypothesis by looking at the effect of equity ownership by institutional investors on the relationship between investment and idiosyncratic volatility.

Defining institutional ownership as the ownership of equity by institutions – both as promoters and as non-promoters, we capture the level of institutional ownership using the percentage of equity held by institutional shareholders. A dummy variable for high institutional ownership (above twenty six percent) is then used to examine the impact of institutional ownership on investment behaviour. Table 5 presents the result from this exercise. Our main variable of interest is the interaction term between the institutional ownership dummy and idiosyncratic volatility. As expected, higher institutional ownership reduces the adverse impact of idiosyncratic volatility on investment rate for firms with high ownership concentration while it makes the impact of idiosyncratic volatility negative and significant for firms with low ownership concentration. The latter effect is economically and statistically much more significant. A one standard deviation increase in the idiosyncratic volatility reduces investment rate by 3.6 percentage points for low ownership concentration firms when the level of institutional ownership is high while it increases the rate of investment slightly (by 0.05

percentage points) for the rest. For high ownership concentration firms, on the other hand, investment rate declines by 2 percentage points when institutional ownership is low (below 26 percent) while it declines by only 1.8 percentage points when the institutional ownership is high. Overall, these results indicate presence of significant overinvestment by firms with low ownership concentration in the presence of idiosyncratic volatility. These results also indicate that substantial ownership by institutional investors can mitigate the problem of suboptimal investment policy resulting from agency problems. In case of low ownership concentration firms where insufficient investor protection combined with imperfect monitoring can encourage managers to overinvest in response to higher idiosyncratic volatility with an eye to extract private benefits, institutional shareholders with significant shareholdings can reduce the extent of over-investment through monitoring and prevent sub-optimal investment behaviour by firms[8].

Idiosyncratic Volatility and Overinvestment

To test our hypothesis that agency conflicts can explain the difference in investment response to idiosyncratic volatility by low ownership concentration firms, we try to find direct evidence of overinvestment by low ownership concentration firms in the face of idiosyncratic volatility. For this we first need to measure overinvestment by firms. Following Richardson (2006) we do this using the model for expected level of investment given below –

$$\ln\frac{I_{i,t}}{K_{i,t-1}} = \rho_0 + \rho_1 \ln\frac{I_{i,t-1}}{K_{i,t-2}} + \rho_2 \ln\frac{S_{i,t-1}}{K_{i,t-2}} + \rho_3 \ln\frac{C_{i,t-1}}{K_{i,t-2}} + \rho_4\sigma^2_{i,t-1} + \rho_5\Phi + \epsilon_{i,t} \quad (14)$$

Here Φ includes a set of year and firm level dummies along with their interactions. We estimate the model in equation (14) using the Arellano and Bond (1991) dynamic panel data estimator separately for low and high ownership concentration firms. Subtracting the actual rate of investment from the expected rate of investment given by (14) provides us with our measure of overinvestment. We then use this to study the impact of idiosyncratic volatility on the size and probability of overinvestment by firms with low level of ownership concentration.

Table 6 presents the results from this exercise. The table presents the marginal effects of idiosyncratic volatility, cash flow and other firm level characteristics on the probability of overinvestment by firms[9]. Idiosyncratic volatility increases the probability of overinvestment by firms with low levels of ownership concentration while reducing it for firms with high levels of ownership concentration. A one standard deviation shock to idiosyncratic volatility increases the average probability of overinvestment by roughly 3 percentage points (0.0049*6.3) for low ownership concentration firms while reducing it by about 4.7 percentage points for firms with high ownership concentration. The interaction term between idiosyncratic volatility and high

[8] Using alternative thresholds for institutional ownership gives similar results. In unreported results, we find that institutional ownership continues to increase the negative impact of idiosyncratic volatility on investment for low ownership concentration firms even at lower thresholds for institutional ownership. This effect, however, increases with the level of institutional ownership.

[9]Marginal effects are obtained from the following probit model - $DUM_{Overinvest,i,t} = \alpha_0 + \alpha_1\sigma^2_{i,t-1} + \alpha_2\sigma^2_{i,t-1} \times \delta^{INST}_{I.,t} + \aleph_{i,t} + \varepsilon_{i,t}$ where $\aleph_{i,t}$ is a set of control variables including lagged cash flow, sales, Tobin's q and industry and time dummies.

institutional ownership dummy has a negative and significant marginal effect on the probability of overinvestment. This further confirms the role of institutional ownership in reducing the probability of overinvestment resulting from agency conflicts in the case of low ownership concentration firms.

Of the remaining variables, cash flow and Tobin's Q have a positive impact on the average probability of overinvestment by low ownership concentration firms while Sales growth has a negative impact. All the variables are lagged one period to avoid possible endogeneity.

The last two columns of Table 6 present the results for low ownership concentration firms with low leverage and non-positive debt growth respectively. Our results remain unchanged for these sub-samples except that idiosyncratic volatility has an even bigger impact on the probability of overinvestment by low ownership concentration firms when leverage is low, or they have not experienced an increase in their debt levels in the previous period. This does indicate that higher leverage (or debt growth) can reduce overinvestment by committing a larger fraction of firm's cash flow to debt service obligations thereby reducing the discretionary funds under managerial control (D'Mello and Miranda (2010)).

Large "Outsider" Block holders and Overinvestment

Equity ownership by large "Outsider" block holder - where an "Outsider" is defined as a non-promoting shareholder who is not identified as a PAC to suit the Indian context - can mitigate the problem of overinvestment arising from PA conflict in low-ownership concentration firms. Having concentrated shareholding gives block holders the incentive as well as the ability (in the form of voting rights) to act as a deterrent against extraction of private benefits by controlling owner-managers. Mehran (1995) show that outside block holding can act as a substitute for incentive-based compensation indicated by CEO ownership (a proxy for insider ownership at the corporate governance level). At the same time, large block holders can collude with the controlling managers to extract private benefits negating the monitoring hypothesis. Overall effect of large outsider block holder on firm behaviour is therefore ambiguous. To check whether large outsider block holders can act as monitors and thereby prevent or mitigate the problem of overinvestment in low ownership concentration firms we define a block ownership dummy $\delta_{I.,t}^{LBH}$, that takes a value of 1 if the firm has at least one "outsider" shareholder that owns at least five percent of the firm's outstanding shares. If the "monitoring" hypothesis is indeed correct, then we should see a smaller increase in the probability of overinvestment due to an idiosyncratic volatility shock in the presence of large outsider block holders. We therefore estimate the following probit model -

$$DUM_{Overinvest,i,t} = \alpha_0 + \alpha_1\sigma_{i,t-1}^2 + \alpha_2\sigma_{i,t-1}^2 \times \delta_{I.,t}^{LBH} + \alpha_3\delta_{I.,t}^{LBH} + \aleph_{i,t} + \varepsilon_{i,t}$$

Here, $\aleph_{i,t}$ is a set of control variables including lagged cash flow, sales, Tobin's q and industry and time dummies Table 7 presents the results from this exercise. As expected, presence of large block holders mitigates the impact of idiosyncratic volatility shocks on the probability of overinvestment. For low ownership concentration firms without a large block holder, a one standard deviation shock to idiosyncratic volatility increases the probability of overinvestment by 9.5 percent, presence of large outsider block holder offsets this effect completely as seen by the coefficient on the interaction term $\sigma_{i,t-1} \times \delta_{I.,t}^{LBH}$. In fact, probability of overinvestment comes down in the face of idiosyncratic volatility shock for firms with large outsider block holder. This result remains unchanged when we change the threshold for defining large block holder to 10 percent. For firms with high ownership concentration (column (6), Table 7), on the other hand, the effect is opposite. Idiosyncratic volatility shocks reduce the probability of overinvestment for firms with large ownership concentration with no large "outsider" block holder, but the impact is offset completely by the presence of at least one large outsider block holder.

VI. Conclusion

This paper looks at the role of ownership concentration on investment sensitivity to idiosyncratic volatility. Our results indicate that while firms with low ownership concentration do not adjust their investment significantly in response to idiosyncratic volatility shocks (unlike firms with high ownership concentration), high institutional ownership increases responsiveness of low ownership concentration firms to idiosyncratic volatility correcting potentially sub-optimal excessive investment driven by managerial incentives for private gains. We also find evidence for an increase in the probability of overinvestment by low ownership concentration firms in response to idiosyncratic volatility. This increase is significantly greater in cases where leverage is low or there is no growth in debt in the previous period. Institutional ownership as well as the presence of a large outsider block holder seem to reduce this tendency for overinvestment in the face of higher idiosyncratic volatility. Overall, these results emphasize the role of managerial incentives in shaping firms' response to idiosyncratic volatility shocks.

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Table 1 Investment and Idiosyncratic Volatility

Dependent Variable: $\ln\left(\frac{I_{i,t}}{K_{i,t-1}}\right)$	(1) GMM Est.	(2) SFM	(3) SFM	(4) (Alternative measure of uncertainty)	(5) (Alternative measure of uncertainty)
$\ln\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right)$	0.05*** (7)	0.1*** (3.5)	0.03 (0.9)	0.1*** (3.6)	0.03 (0.9)
$\ln(Tobin's\ Q_{t-1})$	0.1*** (2.9)	0.2*** (3.6)	0.23*** (3.1)	0.2*** (3.2)	0.2*** (2.7)
$\ln\left(\frac{Sales_{i,t-1}}{K_{i,t-2}}\right)$	1.5*** (31)	0.9*** (11)	1.1*** (10)	0.9*** (11)	1.1*** (11)
$\Delta\ln\left(\frac{Sales_{i,t-1}}{K_{i,t-2}}\right)$	1.4*** (44)	0.9*** (11)	1*** (8.7)	0.9*** (11.3)	0.96*** (9.8)
$\Delta\ln\left(\frac{Sales_{i,t-1}}{K_{i,t-2}}\right)^2$	0.06*** (3.3)	0.02 (0.5)	0.1** (2.1)	0.03 (0.5)	0.08 (1.63)
$\sigma_{i,t-1}$	-19*** (-5.2)	-33*** (-3.2)	-28** (-2.3)	-30.3*** (-5)	-31*** (-4.5)
$\delta_{I.,t}^{INST}$			0.3 (0.8)		0.25 (0.6)
Efficiency Equation					
$\ln\left(\frac{Cash\ Flow_{i,t}}{K_{i,t-1}}\right)$		-0.3** (-2.2)	-0.09 (-0.4)	-0.36*** (-2.6)	-0.2 (-1)
$\delta_{I.,t}^{Age}$		-0.9*** (-2.8)	-0.65*** (-2.1)	-1*** (-3)	-0.8** (-2.5)
$\delta_{I.,t}^{Size}$		-0.3 (-0.9)	-0.3 (-1)	-0.3 (-1)	-0.3 (-0.8)
$\delta_{I.,t}^{Lev}$		0.4* (1.9)	0.5** (2.5)	0.4 (1.64)	0.5** (2.2)
$Constant$		-0.9** (-2.1)	-0.3 (-0.7)	-0.9** (-2.2)	-0.6 (-1.3)
No. of Observations	12337	3088	2595	3085	2592
No. of Groups	2024	391	344	391	344
Wald stat (p-val.)	0.00	0.00	0.00	0.00	0.00
Year Dummy	Yes	Yes	Yes	Yes	Yes
Industry Dummy	No	Yes	Yes	Yes	Yes

Table 2. Non-linearity in Investment and Uncertainty Relationship

Frontier (Dependent Variable $\ln\left(\frac{I_{i,t}}{K_{i,t-1}}\right)$)	(1)	(2)	(3)	(4)	(5)	(6)
$\ln\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right)$	0.2*** (6.5)	0.1*** (4.6)	0.1*** (4.4)	0.14*** (5.6)	0.1*** (3.9)	0.03 (1)
$\Delta\ln\left(\frac{Sales_{i,t}}{K_{i,t-1}}\right)$	0.44*** (5.7)	0.96*** (12)	0.96*** (12)	0.4*** (5.6)	0.9*** (11)	0.97*** (8.7)
$\Delta\ln\left(\frac{Sales_{i,t}}{K_{i,t-1}}\right)^2$			0.01 (0.3)			0.09** (2.1)
$\ln(Tobin's\ Q_{t-1})$	0.3*** (5.3)	0.18*** (3.1)	0.18*** (3.1)	0.36*** (5.4)	0.22*** (3.6)	0.23*** (3.1)
$\ln\left(\frac{Sales_{i,t-1}}{K_{i,t-2}}\right)$		0.94*** (12)	0.94*** (12)		0.9*** (11.2)	1.1*** (10)
$\delta_{I.,t}^{\sigma 1}$	-0.7*** (3.9)	-1.08*** (-6.3)	-1.08*** (-6.3)			
$\delta_{I.,t}^{\sigma 2}$	-0.72*** (-4)	-1.12*** (-6.4)	-1.12*** (-6.4)			
$\delta_{I.,t}^{\sigma 3}$	-0.8*** (-4.6)	-1.18*** (-7.2)	-1.19*** (-7.2)			
$\delta_{I.,t}^{\sigma 4}$	-0.96*** (-5.2)	-1.4*** (-7.3)	-1.4*** (-7.35)			
$\sigma_{i,t-1} \times \delta_{I.,t}^{\sigma 1}$				-36*** (-2.9)	-28.5** (-2.4)	-26* (-1.8)
$\sigma_{i,t-1} \times \delta_{I.,t}^{\sigma 2}$				-34** (-2.6)	-29.4** (-2.4)	-25* (-1.9)
$\sigma_{i,t-1} \times \delta_{I.,t}^{\sigma 3}$				-35.5*** (-2.9)	-30*** (-2.7)	-24.4* (-1.9)
$\sigma_{i,t-1} \times \delta_{I.,t}^{\sigma 4}$				-38.6*** (-3.3)	-36*** (-3.2)	-32** (-2.5)
No. of Observations	3224	3224	3224	3088	3088	3088
No. of Groups	412	412	412	391	391	391
Wald Statistic (p-val.)	0.00	0.00	0.00	0.00	0.00	0.00
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummy	Yes	Yes	Yes	Yes	Yes	Yes

Table 3 Ownership Concentration and Idiosyncratic Volatility.

Dependent Variable $\ln\left(\frac{I_{i,t}}{K_{i,t-1}}\right)$	Promoters' Equity Share <=0.5	Promoters' Equity Share >0.5	Promoters' Equity Share <=0.5	Promoters' Equity Share >0.5	Promoters' Equity Share <=0.5	Promoters' Equity Share >0.5	Promoters' Equity Share <=0.5	Promoters' Equity Share >0.5
$\ln\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right)$	0.08 (1.6)	0.05** (2)	0.01 (0.2)	-0.07 (-1.8)	0.04 (0.8)	-0.01 (-0.4)	0.01 (0.3)	-0.03 (-0.8)
$\sigma_{i,t-1}$	20 (1)	-16 (-1)	25 (1.3)	-26* (-1.75)	17 (1)	-36** (-2.6)	7 (0.3)	-52*** (-3.4)
$\ln\left(\frac{Sales_{i,t-1}}{K_{i,t-2}}\right)$			0.5*** (4)	0.9*** (7.5)	1*** (7.5)	1.4*** (12)	1*** (5)	1.4*** (11)
$\Delta\ln\left(\frac{Sales_{i,t}}{K_{i,t-1}}\right)$					1*** (6)	1.2*** (10)	0.9*** (5)	1.1*** (8.7)
$\Delta\ln\left(\frac{Sales_{i,t}}{K_{i,t-1}}\right)^2$					0.06 (0.7)	0.1*** (2.7)	0.07 (0.8)	0.09** (2.1)
$\ln(Tobin's\ Q_{t-1})$							0.3** (2)	0.06 (0.8)
No. of Obs.	941	1971	941	1965	941	1964	842	1694
No. of Groups	150	270	150	269	150	269	143	254
Wald Statistics (p-val.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4. Industry Characteristics and Idiosyncratic Volatility

Dependent Variable: $\ln\left(\frac{I_{i,t}}{K_{i,t-1}}\right)$	$\theta_i = DEP_i$			$\theta_i = LMP_i$			$\theta_i = ISTC_i$		
	Entire Sample	Promoters' Equity Share <=0.5	Promoters' Equity Share >0.5	Entire Sample	Promoters' Equity Share <=0.5	Promoters' Equity Share >0.5	Entire Sample	Promoters' Equity Share <=0.5	Promoters' Equity Share >0.5
$\sigma_{i,t-1}$	-27** (-2.5)	9 (0.4)	-52*** (-3.5)	-30*** (-2.7)	6 (0.3)	-55*** (-3.6)	-27** (-2.5)	8.9 (0.4)	-51*** (-3.4)
θ_i	-0.1*** (-4)	-0.15*** (-3.5)	-0.15*** (-4.3)	-0.6*** (-7)	-0.8*** (-3.8)	-0.7*** (-4)	-0.3*** (-5)	-0.3** (-2.1)	-0.3*** (-3.9)
$\sigma_{i,t-1} \times \theta_i$	-2.4* (-1.7)	-3.8 (-1.3)	-2.8 (-1.4)	-8 (-1.2)	-13 (-0.9)	-8.5 (-0.9)	-5 (-1.7)	-9 (-1.4)	-6.4 (-1.6)
No. of Obs.	3002	796	1668	3002	796	1668	3002	796	1668
No. of Groups	379	135	250	379	135	250	379	135	250
Wald Stat (p-val.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummy	No	No	No	No	No	No	No	No	No

Table 5 Institutional Ownership and Idiosyncratic Volatility

Dependent Variable $\ln\left(\frac{I_{i,t}}{K_{i,t-1}}\right)$	(1) Promoters' Equity Share <=0.5	(2) Promoters' Equity Share>0.5	(3) Promoters' Equity Share <=0.5	(4) Promoters' Equity Share >0.5	(5) Promoters' Equity Share <=0.5 (95% obs.)	(6) Promoters' Equity Share >0.5 (95% obs.)	(7) Indian Promoters share <=0.5	(8) Indian Promoters share >0.5
$\ln\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right)$	0.01 (0.3)	-0.03 (-0.8)	0.01 (0.2)	-0.03 (-0.9)	0.01 (0.3)	-0.02 (-0.7)	0.01 (0.2)	-0.04 (-1)
$\ln(Tobin's\ Q_{t-1})$	0.3** (2)	0.06 (0.8)	0.3** (2.1)	0.06 (0.9)	0.4** (2.2)	0.06 (0.7)	0.23* (1.7)	0.03 (0.3)
$\ln\left(\frac{Sales_{i,t-1}}{K_{i,t-2}}\right)$	1*** (5.2)	1.4*** (11)	1*** (5)	1.4*** (11)	0.9*** (5)	1.4*** (12)	1.2*** (7.3)	1.6*** (10)
$\Delta\ln\left(\frac{Sales_{i,t}}{K_{i,t-1}}\right)$	0.9*** (5)	1.1*** (8.7)	0.9*** (4.9)	1.1*** (8.7)	0.87*** (4.9)	1*** (8.5)	0.9*** (6.5)	1.3*** (8.7)
$\Delta\ln\left(\frac{Sales_{i,t}}{K_{i,t-1}}\right)^2$	0.07 (0.8)	0.09** (2.1)	0.06 (0.7)	0.09** (2.1)	0.07 (0.6)	0.1** (2.1)	0.09 (1.7)	0.08 (0.9)
$\sigma_{i,t-1}$	7 (0.3)	-52.6*** (-3.4)	8.4 (0.4)	-54*** (3.6)	11 (0.5)	-53*** (-3.6)	0.15 (0.01)	-56.6*** (-3.1)
$\delta_{I.,t}^{INST}$			0.5 (1.1)	-0.1 (-0.4)	0.7 (1.6)	-0.16 (-0.6)	0.5 (1.5)	-0.3 (-1)
$\sigma_{i,t-1} \times \delta_{I.,t}^{INST}$			-105* (-1.7)	5.9 (0.1)	-116** (-2.1)	9.5 (0.2)	-92** (-2.5)	50.6 (0.9)
No. of Obs.	842	1694	839	1687	839	1687	1092	1330
No. of Groups	143	254	143	253	143	253	181	208
Wald Stat. (p-val.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 6. Over investment in Low Ownership Concentration Firms

Dependent Variable: Overinvestment Dummy	Ownership Conc.: High	Ownership Concentration: Low						
	(1)	(2)	(3)	(4)	(5)	(6)	(7) Low Leverage	(8) No Debt Growth
$\sigma_{i,t-1}$	-9.7** (-2.2)	6.3 (1.4)	8* (1.8)	7.1 (1.4)	6.7 (1.4)	9* (1.9)	11** (2.1)	18.5** (2.4)
$\delta_{I.,t}^{INST}$	-0.1 (-1.5)	0.02 (0.3)	0.2* (1.9)	0.2 (1.3)	0.2 (1.6)	0.2 (1.5)	0.2 (1.5)	0.3* (1.8)
$\sigma_{i,t-1} \times \delta_{I.,t}^{INST}$			-33** (-2)	-32* (-1.7)	-44** (-2.5)	-41** (-2.4)	-46** (-2.1)	-69*** (-3.4)
$\ln(Tobin's\ Q_{t-1})$				0.06* (1.9)	0.1*** (3.4)	0.09*** (2.9)	0.07** (2.3)	0.15*** (2.7)
$\ln\left(\frac{Sales_{i,t-1}}{K_{i,t-2}}\right)$					-0.2*** (-8)	-0.3*** (-9)	-0.3*** (-9)	-0.3*** (-6)
$\ln\left(\frac{Cash\ Flow_{i,t-1}}{K_{i,t-2}}\right)$						0.08*** (3.6)	0.08*** (2.8)	0.1** (2.4)
No. of Obs.	1743	977	977	879	879	879	644	366
No. of groups	301	188	188	180	180	180	140	125
Log-likelihood	-1106	-521	-519	-477	-449	-443	-321	-188
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 7. Large Outsider Block holders and Over Investment

Dependent Variable: Overinvestment Dummy	(1)	(2)	(3)	(4)	(5)[10]	(6)
	Low Ownership Concentration					High Ownership Concentration
$\sigma_{i,t-1}$	19*** (3.4)	19*** (3.4)	19*** (3.2)	19.3*** (2.9)	38** (2.1)	-8.4* (-1.7)
$\delta_{I.,t}^{LBH}$	0.3*** (3.5)	0.26*** (3.5)	0.23*** (3.2)	0.2*** (-\2.8)	0.3 (1.2)	0.05 (0.8)
$\sigma_{i,t-1} \times \delta_{I.,t}^{LBH}$	-21*** (-2.7)	-21*** (-2.7)	-20*** (-2.6)	-21** (-2.4)	-33* (-1.8)	11.7 (1.5)
$\ln\left(\frac{Cash\ Flow_{i,t-1}}{K_{i,t-2}}\right)$		-0.009 (-0.5)	0.08*** (3.9)	0.08*** (3)	0.07*** (3.3)	0.05*** (2.8)
$\ln\left(\frac{Sales_{i,t-1}}{K_{i,t-2}}\right)$			-0.2*** (-8)	-0.2*** (-7.6)	-0.2*** (-7.9)	0.16*** (4.9)
$\ln(Tobin's\ Q_{t-1})$				0.07*** (2.7)	0.08*** (3)	-0.08*** (-3)
No. of Obs.	951	951	951	857	857	1645
No. of groups	184	184	184	177	177	293
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes

Appendix A. Key Variables

Variable	**Definition**	**Mean**	**Median**	**Standard Deviation**
$\frac{I_{i,t}}{K_{i,t-1}}$	Change in Gross Fixed Assets divided by lagged level of Gross Fixed Assets	0.2	0.076	0.3
$\frac{Sales_{i,t}}{K_{i,t-1}}$	Total sales divided by Gross Fixed Assets	3.7	2.2	4.1
$\Delta\ln(Sales_{i,t})$	Growth rate in Total Sales	0.09	0.094	0.6
$Tobin's\ Q_t$	(Market value of equity+ Book value of debt)/(Book value of Total Assets)	1.2	0.83	1.2
$\frac{Cash\ Flow_{i,t}}{K_{i,t-1}}$	Cash flow (defined as profit before depreciation, interest, tax and amortization) divided by lagged level of Gross Fixed Assets	0.63	0.28	0.9
Leverage	Total debt divided by equity	0.89	2.2	5.5
Promoters Equity Share	Equity shares held by the promoters (and PAC) divided by the total number of equity shares outstanding	0.499	0.52	0.21

[10] Large block holders defined as those holding greater than one percent of the shares outstanding.