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ORIGINAL ARTICLE

Investment, Uncertainty and Credit Market Imperfection in India

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Abstract The paper attempts to make a timely contribution to the debate on the status of business fixed investments in Indian private manufacturing firms. There are two key issues on which the debate hinges: lower presence of formal credit and, procedural and contractual rigidities. Lower presence of formal credit restricts or makes it costlier for a group of firms to incur investment expenditure that they would have incurred otherwise. Such firms predominantly rely on their internal funds for investment. Procedural and contractual rigidities, on the other hand, make almost all the investment projects undertaken, partially or completely, irreversible. Firms respond to such irreversibilities by aligning their investment to a relatively favorable time which, in turn, depends on the way firms process future uncertainty. The analytical exercise endogenously distinguishes between two investment regimes based on the access to external credit and uses a set of characteristics, along with different measures of uncertainty, to explain fluctuations in investment. The results provide three important observations. First, in the post-reform period there has been an adverse shift in the investment financing policy. Second, firms with inferior access to external credit are smaller, younger, pay less dividend, export less and belong to an industry with inferior demand than others. Such firms invest by running down their available cash flows and selling assets. Third, macroeconomic uncertainty depresses investment whereas microeconomic uncertainty has no impact on investment.

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Introduction

In the backdrop of the Indian economic reforms that began in June 1991, the subsequent policy debate on the role of business fixed investment (henceforth, investment) in GDP growth hinges on two key issues: extension of formal credit to the private sector and; procedural and contractual rigidities. Extension of formal credit to the private sector is contingent on the dealing of banks with non-performing assets (NPA) vis-à-vis their lending portfolio on the one hand and; listing process of firms in the stock exchanges on the other.[1] Banks, until mid-1980s, had discretion in extending credit which later got aligned to the international standards in a phased manner starting 1991. In 2001, the prudential standards required that a credit advance where interest and/or installments of principal remain overdue for a period of more than 90 days would qualify as NPA.[2] These norms on NPA led to an adverse shift in the bank credit portfolio for all kinds of firms. In the meantime, at the onset of the reforms, the Government of India had a priority sector lending program which included agricultural credit, credit to micro and small enterprises, export credit and advances to weaker section.[3] Banks were advised to lend these sectors to the level of 40 percent out of their adjusted net bank credit (ANBC).[4] Sub-targets were also specified for lending to agriculture and the weaker

[1] Besides the trade-off between non-performing assets (NPA) and lending portfolio of banks, the role of covenants and their violations are also important in extension of formal credit to the private sector. The presence of covenants in financial contracts is motivated by their ability to mitigate agency problems. Their violations, in general, lead to transfer of control rights which can impact investment (see, for example, Chava and Roberts 2008). Due to data unavailability on such covenants, we are unable to include them in our purview. Also note that non-banking financial companies (NBFC) alongside banks and stock markets also lend to the businesses. Due to lack of time series data on NBFC loan portfolio, we restrict out discussion to banks and stock markets only.

[2] In 1985, the first ever system of classification of assets for the Indian banking system was introduced on the recommendations of Ghosh Committee on final accounts called the 'Health Code System'. It involved classification of bank advances into eight categories ranging from 1 (satisfactory) to 8 (bad and doubtful debt). In 1991, the Narasimhan Committee on the financial system suggested that banks should classify their advances into four broad groups, viz. (i) standard assets; (ii) substandard assets; (iii) doubtful assets; (iv) loss assets. In 1998, the Narasimhan Committee on Banking Sector Reforms recommended a further tightening of prudential standards in order to bring them at par with the international best practices. As a consequence, a 90-days norm for classification of NPAs was introduced in 2001.

[3] Priority sector lending program started in early 1970s to disburse credit to those key sectors which were unable to get adequate institutional credit due to lower creditworthiness. Currently, besides the four sectors mentioned above, priority sectors also include medium scale enterprises, education, housing, social infrastructure and renewable energy. However, the share of priority sector still remains 40 percent of ANBC (defined in footnote 4). For further details See RBI circular on "Priority Sector Lending-Targets and Classification" dated April 23, 2015.

[4] ANBC is Bank Credit in India *minus* bills rediscounted with Reserve Bank of India (RBI) and other approved financial institutions *plus* investments eligible to be treated as priority sector *minus* exemptions on issuance of long-term bonds for infrastructure and affordable housing *minus* CRR/SLR exempted advances

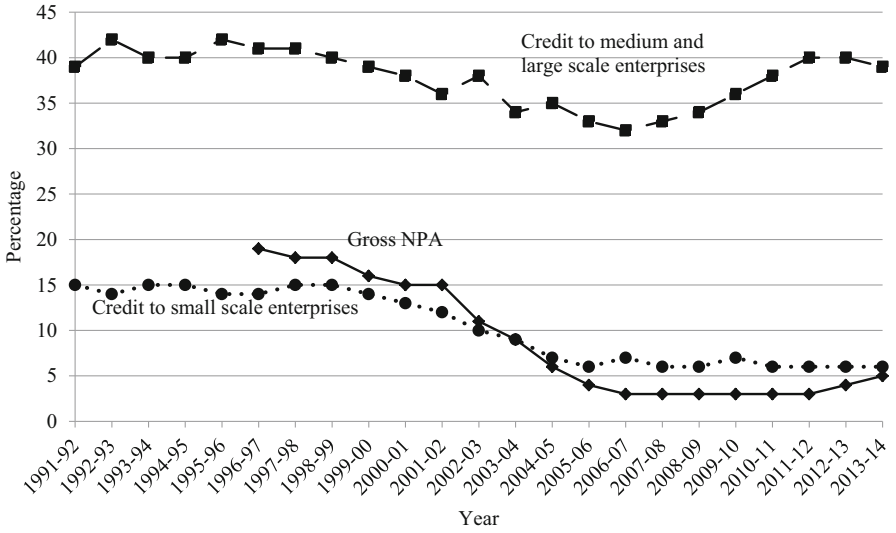

Fig. 1 Credit deployment to enterprises and NPA as a percentage of gross bank credit

sections, but there was no sub-target for the micro and small enterprises. The lack of specific sub-target affected smaller firms more adversely than medium and larger firms as such firms are generally considered to be less creditworthy. This pattern is largely evident in Fig. 1. We can see that out of the total deployment of gross bank credit, small scale firms received roughly 14.55 percent, on average, per annum in the period 1991–1992 to 2000–2001 (period 1).[5] This proportion dropped by more than half to settle at roughly 7.22 percent, on average, per annum in the period 2001–2002 to 2013–2014 (period 2).[6] The total deployment of gross bank credit to medium and large scale firms registered a fall of about 4.19 percent, i.e., on average, from 40.16 percent in the period 1 to 35.97 percent in period 2. More interestingly, the variability in the allocation of gross bank credit to small scale firms vis-à-vis medium and large scale firms shows a stark contrast in the two sub-periods. The coefficient of variation for allocation of gross bank credit to small scale firms (medium and large scale firms) changed from 0.05 (0.03) in period 1 to 0.26 (0.08) in period 2. Figure 1 also presents the pattern of NPA in the period 1996–1997 to 2013–2014. It is interesting to note that the correlation coefficient between NPA and gross bank credit to small scale firms is around 0.98 in the period 1996–1997 to 2013–2014. The correlation is lower at 0.55 with medium and large scale firms. These numbers seem to indicate that although credit allocation to all kinds of firms may result into NPA, it is more likely to be so if credit is allocated to the smaller firms.

Footnote 4 Continued
extended in India against the incremental foreign currency non-resident deposits to non-resident rupee account ratio.

5 Gross bank credit here does not include credit for food business and credit for exporting.

6 For further details see, RBI Master Circular on "Priority Sector Lending", July 01, 2014.

As far as listing of firms in stock exchanges is concerned, the prescribed eligibility criteria to raise funds through Initial Public Offerings (IPOs) and Follow-on Public Offerings (FPOs) are, similar to the bank credit channel, more averse to the smaller firms. For example, some of the eligibility criteria require the minimum post-issue paid-up capital to be Rs. 1 billion for IPOs and Rs. 0.3 billion for FPOs; the minimum issue size to be Rs. 1 billion and; the minimum market capitalization to be Rs. 2.5 billion. Moreover, stock exchanges are likely to affect the operation of management disciplinary devices—in particular, takeovers and proxy contests. Smaller firms are, in general, at receiving end in this context as they are less equipped to fight takeovers and proxy contests. Furthermore, if stock exchange rules encourage speculative trading more than the optimal, smaller firms are more likely to be vulnerable because on account of their growth needs they are less likely to have enough resources to hedge against any downside risk.

On the whole, owing to the pattern of the banking sector in credit lending, the listing criteria and incentives in stock exchanges, nearly 70–80 percent of firms, on average, are likely to find it difficult to tap the formal sources of credit.[7] On a similar note in Table 1, the aggregate pattern in the Indian context suggests that financing of capital formation is inadequately met through the formal sources of credit (rows 5-8).[8] But interestingly, the share of private sector gross fixed capital formation in India's GDP, on average, is quite high (row 4). The shortfall in formal credit is met by informal sources such as trade credit, borrowings from friends and relatives, etc. (Allen et al. 2012). A significant body of evidence also confirms that lack of external credit is a major bottleneck in undertaking investments among Indian firms (e.g., see Athey and Laumas 1994; Athey and Reeser 2000; Bhaduri 2005; Gautam and Vaidya 2013). Reluctance of formal sources to disburse credit to the private sector seem to be mainly on account of low informational coverage (rows 9–10) to which these sources respond by rationing credit. Such rationings take the form of either a reduction in credit limit or charging a premium over the opportunity cost of the credit. We discuss this point in detail in Sect. "Sample and Variables".

Procedural and contractual rigidities in terms of sunken time and monetary costs are among the highest in India (rows 11–14, Table 1). Such rigidities make almost all the investment projects undertaken, partially or completely, irreversible. Firms respond to such irreversibilities by processing future uncertainties and thereafter, aligning their investment to a relatively favorable time. For example, investments are seen to be more frequent during business upswings than downswings. In essence, the presence of irreversibility and thereby, uncertainty, induces firms to optimize their investment decision by treating it as a real option. A call option embodying investment gives firms a limited ability to extend the decision in future whereas a put option enables a possibility to resell capital (Abel et al. 1996).

In our context, the channel through which uncertainty may influence investment prompts a distinction between macroeconomic uncertainty and microeconomic uncertainty for two reasons. First, macroeconomic factors such as future interest, exchange

[7] The proportion is compiled from Love and Peria (2005), Allen et al. (2012) and the sample used in this study.

[8] Data for Table 1 is availed from World Bank.

Table 1 Average macroeconomic indicators for India, China, UK and USA

Indicators	India	China	UK	USA	Period
GDP growth (annual %)	6.78	10.23	2.13	2.61	1992–2013
GDP per capita growth (annual %)	5.11	9.40	1.62	1.57	1992–2013
Gross fixed capital formation (% of GDP)	29.21	40.86	17.52	20.90	1991–2013
Gross fixed capital formation, private sector (% of GDP)	20.72	NA	NA	17.08	1991–2013
Foreign direct investment, net inflows (% of GDP)	1.39	4.06	3.83	1.48	1991–2013
Domestic credit provided by financial sector (% of GDP)	56.97	123.36	146.81	199.22	1991–2013
Domestic credit to private sector (% of GDP)	34.45	110.18	139.50	165.26	1991–2013
Market capitalization of listed companies (% of GDP)	64.41	70.83	107.18	109.29	1991–2012
Credit depth of information index (0 = low to 8 = high)	4.10	3.40	6.20	6.20	2004–2013
Private credit bureau coverage (% of adults)	9.91	NA	92.31	100	2004–2013
Cost of business start-up procedures (% of GNI per capita)	57.15	8.22	0.73	0.95	2003–2013
Start-up procedures to register a business (number)	12	14	6	6	2003–2013
Time required to enforce a contract (days)	1420	411	409	318	2003–2013
Time required to start a business (days)	42	40	12	6	2003–2013

and inflation rates or shocks to regulatory policy regimes may influence investment by affecting the cost or availability of external credit and availability of a particular type of capital good for an industry or industries as a whole. Microeconomic factors, on the other hand, such as future product prices and input costs may influence investment by affecting the competitive behaviour and the relative efficiencies of firms. Second, microeconomic factors, by definition, present scope for strategic behaviour between firms within an industry. Such a scope is relatively limited in case of macroeconomic factors. These two issues, in a sample level study, are likely to show up in a very different manner. Macroeconomic uncertainty, more often than not, is likely to influence investment for a set of firms in a particular year in a unidirectional way as it influences an industry or all industries. Firms facing microeconomic uncertainty, in contrast, are faced with two opposing motives regarding investment. An investment, before the uncertainty unfolds, may lead to acquisition of a strategic growth option in terms of stronger ex post market share. However, the unfolded uncertainty might also disdain the undertaken investment as mere sunk cost without any potential advantage in near future.

In cases of limited extension of formal credit (credit market imperfection) and uncertainty due to procedural and contractual rigidities, the traditional models of corporate investment (e.g., the Jorgenson's model and the q model), which assume perfect market setup, are valid only in providing a benchmark rather than a more realistic picture. The basic prediction of the traditional models is that the measures of growth opportunities alone should explain the fluctuations in investment. In recent years, there is an overwhelming support for investment models that have augmented the traditional models with measures of uncertainty and credit market imperfection, independently.[9] In this paper, we examine the composite influence of uncertainty and credit market imperfection on investment for Indian private manufacturing firms. This is important for at least two reasons. First, since investment decisions are inter-temporally related as the current investment raises the future level of capital stock, fluctuations in investment, after controlling for growth opportunities, can be attributed to both, uncertainty and credit market imperfection. Second, if investment projects to be undertaken by firms are risky, they cater to it by endogenizing growth opportunities, future uncertainty and the potential of credit rationing as a result of credit market imperfection.

The empirical strategy for examining the composite influence of uncertainty and credit market imperfection is contingent on two key requirements. First, the econometric model should use a two-step setup wherein the first step should outline the propensity of firms to be credit constrained or unconstrained and the second step should endogenously distinguish between investment in the constrained and unconstrained regimes, respectively, based on firms' characteristics, uncertainty measures and other controls. The second key requirement pertains to allowing firms to change from constrained to unconstrained regime and vice-versa within the sample period. This is because a firm, depending on the dynamics of the internal and external environment, can be constrained in one period and unconstrained in the next. These requirements dictate the use of an endogenous regime switching model for our empirical exercise. We discuss the model in the next section.

The results give a clear indication that the post-2001 period has a relatively negative impact on investment of firms. This implies that even though the policy makers have been able to cut NPA by lowering the allocation of credit in post-2001 period, this has come at the cost of reduction in investment. In addition, we find that firms which are small and young; which pay lower dividend, export less and; cater to a product market with inferior demand than peers are likely to be credit constrained. Such firms, in our sample, are more likely to invest by selling assets in the previous period and running down their cash flows in the current period. The results also suggest that, among uncertainty measures, macroeconomic uncertainty depresses investment whereas microeconomic uncertainty has no significant influence on investment.

The outline of the paper is as follows: "Empirical Strategy" discusses the research methodology; "Sample and Variables" describes the dataset and the construction of variables; "Estimation Results" presents the econometric results; finally, "Conclusion" provides concluding remarks.

[9] For literature survey on investment under uncertainty see Carruth et al. (2000) and Lensink et al. (2001) and; for investment under credit market imperfection see Hubbard (1998), Lensink et al. (2001) and Calcagnini and Saltari (2010).

Empirical Strategy

Firms may either be credit constrained or unconstrained in a particular year depending on the access to external credit. Since the points of structural change between these two regimes are not observable, we use the following system of three equations that are estimated simultaneously:

$$I_{1it} = X_{it}\beta_1 + u_{1it} \tag{1}$$
$$I_{2it} = X_{it}\beta_2 + u_{2it} \tag{2}$$
$$y^*_{it} = Z_{it}\gamma + \varepsilon_{it} \tag{3}$$

Equations (1) and (2) are the structural equations that describe the investment behavior of firms in the alternative regimes. Equation (3) is the selection equation that determines firms' propensity to be in one or the other regime. X_{it} is the set of determinants of investment. y^*_{it} is latent variable measuring the likelihood of firm i to be in either of the regimes at time t. Z_{it} is the set of the determinants of y^*_{it}. β_1, β_2, and γ are vectors of parameters and u_{1it}, u_{2it}, and ε_{it} are residuals. We assume that u_{1it}, u_{2it}, and ε_{it} are jointly normally distributed with mean vector 0 and covariance matrix $\Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{1\varepsilon} \\ \sigma_{12} & \sigma_{22} & \sigma_{2\varepsilon} \\ \sigma_{1\varepsilon} & \sigma_{2\varepsilon} & 1 \end{bmatrix}$. This assumption permits a nonzero correlation between the shocks to investment and the shocks to firm's characteristics. Variance of ε_{it} is normalised to 1 because, in (8), we can estimate only $\gamma / \sigma_\varepsilon$, but not γ and σ_ε, individually.[10] Also, since σ_{12} does not appear in (8), it is not estimable. The observed investment, I_{it}, undertaken by a firm i at time t, is defined as

$$I_{it} = I_{1it} \quad iff\ y^*_{it} < 0 \tag{4}$$
$$I_{it} = I_{2it} \quad iff\ y^*_{it} \geq 0 \tag{5}$$

Though we cannot observe a firm being in one or the other investment regime, we can, however, calculate the probability with which each one of them occurs:

$$Prob\,(I_{1it}) = Prob\,(Z_{it}\gamma + \varepsilon_{it} < 0) = Prob\,(\varepsilon_{it} < -Z_{it}\gamma) = \Phi\,(-Z_{it}\gamma) \tag{6}$$
$$Prob\,(I_{2it}) = Prob\,(Z_{it}\gamma + \varepsilon_{it} \geq 0) = Prob\,(\varepsilon_{it} \geq -Z_{it}\gamma) = 1 - \Phi\,(-Z_{it}\gamma) \tag{7}$$

here $\Phi(.)$ is the cumulative distribution function. I_{it} is, thus, a weighted conditional density function of u_{1it} and u_{2it} with weights $\Phi\,(-Z_{it}\gamma)$ and $\left[1 - \Phi\,(-Z_{it}\gamma)\right]$, respectively.

[10] The selection equation in (3) is akin to a probit model where variance of ε_{it} is normalised to 1 to identify the model.

$$I_{it} = \phi(u_{1it}|\varepsilon_{it} < -Z_{it}\gamma)\Phi(-Z_{it}\gamma) + \phi(u_{2it}|\varepsilon_{it} \geq -Z_{it}\gamma)\left[1 - \Phi(-Z_{it}\gamma)\right]$$
$$= \phi(u_{1it}, \sigma_{11})\,\Phi\left[\frac{-Z_{it}\gamma - \frac{\sigma_{1\varepsilon}}{\sigma_{11}}u_{1it}}{\sqrt{1 - \frac{\sigma_{1\varepsilon}^2}{\sigma_{11}}}}\right]$$
$$+ \phi(u_{2it}, \sigma_{22})\left[1 - \Phi\left(\frac{-Z_{it}\gamma - \frac{\sigma_{2\varepsilon}}{\sigma_{22}}u_{2it}}{\sqrt{1 - \frac{\sigma_{2\varepsilon}^2}{\sigma_{22}}}}\right)\right] \tag{8}$$

here ϕ (.) denotes the normal density function; $\phi\left(u_{jit}|.\right)$ denotes conditional density function and $\phi\left(u_{jit}, \sigma_{jj}\right)$ denotes the marginal density function for j={1, 2}.[11] For the panel of N firms with T_i observations for firm i, the log likelihood function is given by

$$L = \sum_{i=1}^{N}\sum_{t=1}^{T_i} log\,(I_{it}) \tag{9}$$

β_1, β_2 and $\gamma/\sigma_\varepsilon$ can be estimated by maximising the log-likelihood function.

In the endogenous regime switching model, as discussed in Equations (1)–(9), firms are allowed to change regime over time. This implies that the unit of analysis is firm-year and the structure of the data is cross-sectional. This setup poses two key challenges. First, fixed firm effects would remain. Second, the estimate of lagged investment would be biased due to its correlation with the fixed effects if it is an important variable in explaining current investment. The fixed effects can be removed by mean-differencing the variables. But, the dynamic panel bias (due to correlation of lagged dependent variable with fixed effects) still remains. Following Nickell (1981), we know that this bias would be negative if the coefficient of lagged dependent variable is positive. Thus, in a cross-sectional regression, a positive coefficient associated with lagged investment would imply that our results are valid with even greater force. We keep these aspects in hindsight while discussing our results.

Two additional challenges are faced in identifying the investment equation from the selection equation and the investment equation in the first regime from the second regime. We tackle the first challenge by ensuring that there is at least one variable in the investment equation which is excluded from the selection equation (Maddala 1983). To this end, we characterize investment equation from the sources of funds side along with the proxies for growth opportunities and uncertainty. On the other hand, we characterize the selection equation by all the potential variables having information on the creditworthiness of the firms. This, as discussed below, results in exclusion of several variables from the selection equation which are present in the investment equation. In tackling the second challenge, i.e., in identifying the investment equation

[11] The second equality represents joint density as the product of conditional density and marginal density. For details see Maddala (1983).

in the first regime from the second regime, under the restriction that the coefficients of the two investment regimes are equal; the parameters of the selection equation are not identified. It is, therefore, difficult to calculate the degrees of freedom. We resolve this issue by following Goldfeld and Quandt (1976) who, suggest that the χ^2 distribution can be used to conduct a likelihood ratio test by defining the degrees of freedom as the sum of the number of constraints and the number of unidentified parameters.

The observable empirical model for the investments equation in (1) and (2), can be specified as:

$$I_{it} = f\left(I_{it-1,} growth\ opportunity, credit\ market\ imperfection, uncertainty, controls\right) + \gamma_i + \tau_t + \epsilon_{it} \tag{10}$$

The observable empirical model for the selection equation in (3), can be specified as:

$$D = g\left(creditworthiness\right) + \gamma_i + \tau_t + v_{it} \tag{11}$$

In Eqs. (10) and (11), I_{it} is investment by firm i at time t. $I_{it-1,}$ is lagged investment. γ_i and τ_t are fixed firm and year effects, respectively. ϵ_{it} and v_{it} follow the structure noted before. D is a qualitative variable taking values one and zero in alternative investment regimes. To arrive at this initial grouping we use k-means cluster analysis using all the variables characterizing creditworthiness.[12] These variables along with the regressors in Eq. (10) are discussed in the next section following an outline of the sample.

Sample and Variables

We use data from the PROWESS, corporate data directory of the Center for Monitoring Indian Economy (CMIE), to construct firm-level variables. It is the most comprehensive database containing detailed information on over 20,000 Indian firms for around 3000 items. We use data from Reserve Bank of India (RBI) to construct gross bank credit and NPA (used in Fig. 1); and to construct *replacement value of capital stock* (capital, henceforth) which is used as a deflator.[13] The use of capital to transform variables from levels to ratios yields a trend-stationary series and controls for heterogeneity. It also helps in adjusting for different depreciation provisions across firms which is noted to be a significant determinant of fluctuations in investment (Athey and Laumas 1994). Finally, we take the data on gold prices in Mumbai (used to construct one of the measures of uncertainty) from Reuters Datastream and data on macro-economic aggregates (used in Table 1) from the World Bank.

Among the variables, *investment* is defined as the change in capital stock. The characterization of *growth opportunities*, *credit market imperfection*, *creditworthiness*,

[12] The dummy specification of D is overwritten in estimating endogenous regime switching model based on a numerical maximisation technique.

[13] Following Salinger and Summers (1983), we use perpetual inventory stock method for constructing the replacement value of capital stock.

uncertainty and *controls in investment equation*, as outlined in Eqs. (10) and (11), is discussed below.

Characterization of Growth Opportunities

Accelerator and *Tobin's q* are expected to positively affect firm investment as the proxies for growth opportunities. Tobin's q is forward looking measure, but its use restricts the sample to firms that are listed in the stock exchanges. The accelerator, unlike Tobin's q, is backward looking, but it is not susceptible to omission of firms which are not listed. Since we have many unlisted firms in our sample, we use accelerator in our main exercise. For a smaller sub-sample of firms that are listed in the Bombay Stock Exchange (BSE), we reiterate the results by including the Tobin's q. Accelerator is defined as the difference in sales of a firm in two consecutive years. Tobin's q is defined as the ratio of market value of a firm to its book value of assets. Market value is calculated by adding market value of equity to book value of debt.

Characterization of Credit Market Imperfection

The literature commonly uses investment-cash flow sensitivity (ICFS) as the measure to investigate the presence of credit constraint in firms.[14] It is argued that for credit constrained firms, investment is contingent on their ability to generate internal liquidity, represented by cash flows. Credit unconstrained firms, in contrast, would not display a systematic propensity to invest out of cash flows as the cost of external credit, relative to its opportunity cost, is likely to be small. The ICFS, therefore, should be positive for the constrained firms and insignificant for the unconstrained firms. The usual practice to examine credit constraint in firms is to sort the sample of firms into groups based on their creditworthiness by using variables such as dividend payout, size, age, etc. The group having significantly greater investment-internal funds sensitivity, after controlling for the effect of growth opportunities and other confounding variables, is interpreted as credit constrained in comparison to the other group.

In such examinations, the use of cash flows as the proxy for internal liquidity poses an important concern. It is argued that cash flows also contain information on the growth opportunities of firms, even when they are credit unconstrained. For example, cash flows, besides being easily accessible, also offer more control than external sources of funds. Therefore, firms may opt for financing investment out of cash flow for reasons independent of credit constraint (Kaplan and Zingales 1997). Moreover, it is noted that value of a firm, even when unconstrained, responds to the shocks to cash flows (Gilchrist and Himmelberg 1995; Hovakimian and Titman 2006). To check these criticisms associated with the use of cash flows are valid or not, we constructed firm level ICFS scores using a random coefficient model and then sorted the scores into insignificant and positive groups. We expected that if the commonly used interpretations with these groups (i.e., unconstrained and constrained, respectively)

[14] The use of ICFS to identify financially constrained firms was first suggested by Fazzari et al. (1988).

is justified then the same must be reflected in the firm characteristics associated with them. Using a logistic regression we find that our dataset does not yield firms' grouping which can be unambiguously interpreted on the basis of their characteristics.[15]

We consider asset sales as an alternate proxy for internal liquidity of firms following Hovakimian and Titman (2006). It is defined as the proceeds from sale of fixed assets. Empirical validity for the use of asset sales requires that it is mainly used for obtaining requisite finance for investment and not so for other motives such as efficient deployment of assets to other firms (Hite et al. 1987), focusing on core operations (John and Ofek 1995), smoothing earnings (Bartov 1993), etc. In an investigation of the determinants of asset sales and the annual statements of 100 randomly chosen firms selling assets in the sample period, we found significant evidence that healthy (non-distressed) firms, that are likely to find difficulty in raising external finance, sell assets mainly for financing investment.[16] This implies that credit constrained firms use asset sales because it involves a privately negotiated transaction and represents less costly means of raising credit than public issues of debt and equity. It also implies that for a pool of healthy firms, asset sales are unlikely to contain information on the growth opportunities, unless they are credit constrained. It is important to note that the use of proceeds from asset sales for investment purpose involves a significant lag. This is because firms are required to re-evaluate their growth opportunities in the light that the market has received new information on the transaction and several management issues (Gautam and Vaidya 2013).

Characterization of Creditworthiness

Creditworthiness of firms is a multi-faceted characteristic based on the profile of several variables (Kaplan and Zingales 1997; Hu and Schiantarelli 1998). For example, banks assess several aspects of a borrower before extending credit. Investors in stock markets also investigate several aspects of a firm before buying shares. In a similar vein, we choose the following variables to proxy creditworthiness of firms size, age, tangibility, liquidity, leverage, dividend payout, growth opportunities, export sensitivity, group affiliation and industry sales growth.

We use log of sales to represent size of firms. Bigger firms command more resources and get more analyst coverage than smaller firms. Hence, they are less likely to be credit constrained (Hovakimian and Titman 2006). Log of age is used to represent maturity of firms where age is taken as the number of years from the incorporation of the firms. Mature firms, apart from having more analyst coverage, also signal more stability. Therefore, they are less likely to face problems in raising external credit. Along with size and age, tangibility also assesses firms' ability to obtain external funds as it increases the pledgeable value that can be captured by creditors in default (Almeida and Campello 2007). Tangibility is defined as the ratio of gross fixed assets to capital stock.

[15] These results are omitted to save space. They can be furnished on request.

[16] These results are omitted to save space. They can be furnished on request.

Asset sales, cash flows (which also contain information on growth opportunities) and interest coverage are taken as the flow measures of liquidity. Asset sale is defined as proceeds from the sale of fixed assets. Cash flow is defined as the sum of retained profits and depreciation. Firms are likely to sell assets if they find it difficult to tap external sources of credit, as discussed in the previous sub-section. Cash flows, on the other hand, by increasing the resource pool, increase the creditworthiness of firms. But, since cash flows are cheaper source of funds than credit from banks and stock market, firms commanding healthy stream of cash flows are less likely to opt for external credit. Interest coverage is defined as the ratio of interest accrued to profits before depreciation, interest, taxes and amortization (PBDITA). Firms with high interest coverage are heavily indebted and, thus, they are more prone to default. Such firms are likely to find it difficult to tap in external sources of credit (Myers 1977). We also use slack as a stock measure of liquidity. It is defined as the sum of cash and marketable securities. Those firms which anticipate shortage of external credit in the near future, maintain high level of slack (Fazzari and Petersen 1993).

We use two measures of firms' leverage as short term debt and long term debt. Short term debt is defined as the loan taken from all sources for a period of less than 12 months and; long term debt is defined as the loan taken from all sources for a period of more than 12 months. Jensen and Meckling (1976) suggest that firms with high debt are prone to default during business downturn. Therefore, they may face higher hurdles in accessing external credit. However, Lensink et al. (2001) suggest that small debt helps in avoiding agency problem between stock holders and managers of the firm by disciplining the later. So, for a small debt, firms are likely to be more creditworthy whereas for a larger debt their creditworthiness is likely to fall.

Among the other variables, dividend payout is defined as the sum of common and preference dividends. Since dividends and investments are competing uses of funds, firms facing hurdles in obtaining external credit should choose low dividend payout (Fazzari et al. 1988). Firms with high growth opportunities, as defined in the previous sub-section, indicate further scope for profitable investments. So, it is less likely they would face problems in raising external credit (Hovakimian and Titman 2006). Export sensitivity is defined as the ratio of export of goods to sales. Firms which export more are more capable of surviving and doing well. Such firms are less likely to be credit constrained (Ganesh-Kumar et al. 2001). Group affiliation is a dummy which takes value one for a firm belonging to a group and zero otherwise. Hoshi et al. (1991) suggest that group firms have their own internal credit market which acts as an additional source of funds. In contrast, Bertrand et al. (2002) argue that some business groups mainly exist for the benefit of small number of investors who control the group. This may lead to the expropriation of minority share holders. Such a structure of business groups may lead to severe agency conflicts and thereby reduce creditworthiness. Industry sales growth is defined as the difference between the average sales growth of an industry over two consecutive years and the average sales growth across all other industries over the same period. Firms with positive industry sales growth are those which perform better than their peers in other industries. Such firms are less likely to be credit constrained (Bates 2005; Denis and Shome 2005).

Characterization of Uncertainty

The methods for the characterization of macroeconomic uncertainty may be grouped into four broad classes-the unconditional variance of the unpredicted part of a stochastic process (method 1); the variance of geometric Brownian motion (method 2); the conditional variance of the unpredicted part of a stochastic process (method 3) and; risk premium embedded in the term structure of interest rates (method 4). Method 1 requires the unconditional variance to be constant over time, i.e., the unpredicted part of the stochastic process must have a stationary distribution. Method 2 requires continuous data on the stochastic process. However, in practice the stochastic process is observed only discretely over time. Method 3 is very sensitive to model specification. A common issue with the methods 1–3 is that they all produce a backward looking measure of uncertainty. Finally, method 4 yields a forward looking measure of uncertainty through commercial forecast surveys. However, this method assumes that subjective probability distribution is identical to objective probability distribution of the term structure. For the purpose in hand, we exclude method 1 because if the data is non-stationary, the volatility would be unstable. Moreover, in dealing with a sequence of unconditional homoscedastic random variables, it is possible to observe conditional heteroscedasticity, but the opposite does not hold. We exclude method 2 for lack of continuous data. We exclude method 4 also because of data limitation.[17] We focus on method 3 by using volatility in real gold prices to represent macroeconomic uncertainty. Real gold prices are derived by deflating rupee gold prices in Mumbai by GDP deflator. There are several advantages associated with gold prompting this choice. First, gold is a low-risk hedge and movements in its price is ought to reveal important information about market sentiment vis-à-vis other asset returns (Carruth et al. 2000). Second, investors take confidence from its high liquidity as it can be easily resold without loss of time. Third, gold prices at a location are closely inter-linked to international gold prices and thereby, they contain important information about several other key variables such as international commodity prices, dollar exchange rate and equity prices (Mishra and Mohan 2012). Finally, movement in gold prices, besides having cultural and social importance, is closely followed by the stock prices in India (Ray and Prabhu 2013).

The conditional volatility in gold prices using daily data is computed in the following way: first, we construct the return series as the change in the log of gold price from the previous trading date. Second, we check for stationarity and structural break in the return data. We find it to be stationary and without any structural break. Third, we regress week days on the return series to check if they have an influence. We find no significant influence of the week days. Fourth, we choose lag length based on various information criteria (Akaike, Bayesian and Schwarz criteria) and check for the best fit among the various models in the ARCH-family. We find Asymmetric Power ARCH

[17] The Government of India, in a phased way, started replacement of automatic deficit financing role of ad-hoc treasury bills with a system of ways and means advances only from 1997–1998. Moreover, high and compulsory SLR (Statutory Liquidity Ratio) holding requirement by Indian banks also ensured a captive market for such securities. For instance, in 1997–1998, banks had invested in excess of 25 % in such securities (Darbha et al. 2003). Since our sample period starts from 1994, method 4 is of limited use.

(1, 1) or APARCH (1, 1) to be a better fit than the competing models.[18] Finally, we compute the annual volatility by taking the mean of the predicted variance over each year and dividing it by the square root of the number of observations in the respective year. The division is performed to annualize the series.

We represent microeconomic uncertainty using top four-firm market share dispersion where market share is defined as the ratio of sales by a firm to sales by all the firms in that industry.[19] The use of top four-firm market share dispersion is justified on the following grounds: firstly, if firms have similar advertising expenses, retail availability and product characteristics, dispersion in market share will reflect dispersion in product prices of firms (Weiss 1968). We consider the dispersion in the market share of top four-firms in each industry at five-digit National Industrial Classification (NIC) level to control for these factors.[20] Secondly, dispersion in market share is also likely to reflect cost considerations. This is because if cost changes indicate technological diversity, as in the standard Nash-Cournot approach, they will indicate uncertainty with respect to future demand (Driver et al. 1996). Dispersion in market share, therefore, is the outcome of the interaction of competitive behaviour and the relative efficiencies of the firms, capturing information on any turbulence in the microeconomic domain (Hay and Liu 1997).[21]

Controls in the Investment Equation

In the investment equation, in addition to the accelerator, Tobin's q, lagged asset sales and uncertainty measures, we use the following explanatory variables as controls: cash flow and its lag; current asset sales; slack and its lag and; interest coverage and its lag.[22] In addition, we also use a low credit allocation dummy which takes value one for the period starting 2001 and zero otherwise. This dummy, as noted in "Introduction", would capture the fall in credit allocation by banks since 2001 with the 90-day prudential norms on NPA.

We expect growth in cash flows to influence investment positively as it is a cheaper and easily available source of funds. So, current cash flows should be positive and

[18] We evaluate 300 one-step-ahead forecasts using a rolling window of 1000 observations for the mean and the variance equation. The forecasts we obtain are evaluated using five different measures: mean squared error, median squared error, mean absolute error, adjusted mean absolute percentage error and Theil's inequality coefficient. Our model is consistent with several other works that find support for APARCH model and its ability to capture properties like, fat-tails, persistence in volatility, asymmetry and leverage effect (e.g., Laurent 2004).

[19] The use of stock prices is also a potential candidate for constructing a measure of microeconomic uncertainty. However, a large number of firms are unlisted in our sample restricting the use of stock prices for our purpose.

[20] Choice of top four-firm market share dispersion is ad-hoc. We also used top three-firm and top five-firm market share dispersion in alternative setups. The results remain consistent.

[21] These arguments can be contested if firms face different credit availability conditions. However, we control for such conditions in our analysis.

[22] The variables are chosen to qualify investment from sources (of funds) side. We are not using funds mobilised from stock market to avoid multicollinearity. The econometric model is similar to Hovakimian and Titman (2006).

lagged cash flows should be negative in the investment regression. Current asset sales should influence investment negatively. This is because when firms are constrained by funds for investment, they can replenish it by accumulating funds acquired from the sale of fixed assets. Such funds can be used for a better-suited investment purpose in the next period after updating growth opportunities in the light that market has received new information on the sale of fixed assets. Slack and its lag should also correspond negatively with investment. This is because firms add to slack if they anticipate shortage of liquidity in the near future and one hassle-free way to do this is by cutting on investment expenditure. Interest coverage and its lag should also influence investment negatively because funds, in case of higher interest burden, are more likely to be diverted from investment purpose to servicing debt. Finally, low credit allocation dummy should also affect investment negatively as the stringent NPA rules post-2001, contracted the allocation of credit to the corporate sector.

Sample Composition

Sample composition is a critical issue to impart comparability with the previous studies as there are instances of contradictory results on account of this issue. Allayannis and Mozumdar (2004), for example, point out that Kaplan and Zingales (1997) and Cleary (1999) have different results from Fazzari et al. (1988) because their studies have extreme observations and negative cash flow observations, respectively. Gilchrist and Himmelberg (1995) and Gomes (2001) point out a number of sample irregularities in the existing literature (for example, restructuring of firms; outliers; unreasonable numbers in capital stock, cash flows, investment, etc.). Taking this aspect into consideration, we choose firms based on the following criteria: First, we consider only private sector firms. Public sector enterprises and foreign firms are excluded as investments by such firms are directly controlled by the Ministry of Industry and a foreign parent company, respectively. Second, to ensure that the firms are mainly into manufacturing business (i.e., firms have not substantially diversified into non-manufacturing activities), we require sale of manufactured goods to contribute at least 75 % in the total sales for at least two-third of the sample period. Third, we drop firms undergoing major restructuring. We identify restructuring firms as those that report unreasonable jump in manufactured sales and the ratio of asset sales to net fixed assets in excess of 75 %.[23] Fourth, we exclude distressed firms from the sample.[24] This is because if a firm is in financial distress, marginal rupee is more likely to be paid back to the creditors than

[23] We allow up to a ten-fold jump if the manufactured sales is up to Rs. (Indian Rupees) 10 million; five-fold if the manufactured sales is between Rs. 10 million and Rs. 50 million; four-fold if the manufactured sales is between Rs. 50 million and Rs. 100 million; three-fold if the manufactured sales is between Rs. 100 million and Rs. 250 million and; two-fold if the manufactured sales is above Rs. 250 million. These cutoffs are chosen to include maximum possible number of observations in the sample and yet putting a restriction on the restructuring firms.

[24] Distressed firms are those firms whose claims to the creditors are broken or honored with difficulty. Treatment of distressed firms draws importance over the contradictory findings of Fazzari et al. (1988) and Kaplan and Zingales (1997). Fazzari et al. (2000) show that the results obtained by Kaplan and Zingales (1997) are erroneous as they have distressed firm observations in their sample.

Table 2 Summary statistics of key variables

Variable	Mean	Median	SD
Log sales	3.9301	3.942	1.6256
Log age	3.3878	3.2966	0.5153
Investment/K	0.1141	0.0731	0.1711
Accelerator/K	0.5687	0.2354	1.5423
Micro dispersion	0.0807	0.0726	0.0591
Macro dispersion	0.1322	0.1242	0.0523
Short term debt/K	0.5276	0.3387	0.6517
Long term debt/K	0.5303	0.3905	0.6096
Cash flow/K	0.2013	0.1301	0.3127
Slack/K	0.2344	0.0657	0.5636
Tangibility/K	1.7028	1.4314	0.9769
Asset sale/K	0.0106	0.0001	0.0371
Interest coverage/K	0.0457	0.0000	0.1251
Export sensitivity	0.1351	0.0157	0.2286

This table reports the summary statistics of key variables discussed in Sect. "Sample and variables". The number of observations is 20,881 from 2363 firms in the period 1994–2013

invested thereby weakening the relationship between investment and marginal rupee generated. A firm is defined as distressed in a year if its PBDITA is less than 80 percent of interest accrued in the current year or PBDITA is less than interest accrued in the current year and the year before. Fifth, we consider only those firms that have sold fixed assets at least once in the sample period as we intend to examine the relationship between asset sales and investment. Sixth, we require each industry at five-digit NIC level to have at least 10 firms. This is to ensure that the market share of top four firms does not exhaust the industry sales significantly. Seventh, we require firms to have at least 4 years of continuous data. This requirement is to facilitate our econometric specification and construction of variables. Finally, we avoid the influence of outliers by winsorizing extreme one percent observations for each variable. Meeting these conditions, we get an unbalanced sample of 2363 firms with 20,881 observations. Our sample covers the period 1994–2013. In fact, we attempted to use data from 1992, the first year after the structural reforms of 1991, but the initial two years of data is lost in constructing variables and performing regressions. The summary statistics of the key variables is in Table 2. It suggests that the sample firms come from a wide range of distributions for firm size, age, investment, cash flow and other variables.

Estimation Results

Estimates Using Endogenous Regime Switching Model for the Full Sample

Table 3 reports the results of the endogenous regime switching model. Panel A reports the estimates for the investment equation and Panel B reports the estimates for the selection equation. We first need to test for the existence of two distinct investment regimes as discussed in Sect. "Empirical strategy". We follow Goldfeld and Quandt

Table 3 Endogenous regime switching regression

Panel A: The investment equation			
Dependent variable: Investment/K	Regime 1 coefficient	Regime 2 coefficient	p value for difference in coefficients
L. Investment/K	−0.0046 (1.55)	0.0064*** (5.98)	0.0000
L. Accelerator/K	−0.0002 (0.95)	−0.0004 (1.30)	0.0000
Accelerator/K	0.0135*** (3.84)	0.0627*** (11.56)	0.0000
Market share dispersion	−0.8801 (1.02)	−0.3230 (1.05)	0.0000
Gold price volatility	−1.4642*** (9.14)	−2.2375** (2.85)	0.0000
L. Cash flow/K	−0.0004 (1.47)	−0.0014*** (7.71)	0.0000
Cash flow/K	0.0392*** (4.46)	0.0478*** (9.11)	0.7473
L. Asset sale/K	0.0087*** (4.94)	−0.0058 (1.70)	0.0000
Asset sale/K	−0.8325*** (3.90)	−0.1089*** (3.79)	0.0000
L. Slack/K	0.0003 (1.20)	0.0003 (0.41)	0.0000
Slack/K	−0.0403 (1.73)	−0.0315*** (4.03)	0.0000
L. Interest coverage/K	0.0001 (1.34)	0.0001 (1.30)	0.7148
Interest coverage/K	0.0244 (0.47)	−0.0277** (3.10)	0.0000
Low credit allocation dummy	−0.7733** (2.84)	−0.3719*** (9.05)	0.0000
Prob. > F	0.0000	0.0000	
R^2	0.1488	0.2027	

Panel B: The selection equation	
Dependent variable: regime dummy	Coefficient
Log sales	−0.1183*** (33.59)
Log age	−0.1015*** (9.83)
Dividend payout/K	−0.0416* (2.12)
Slack/K	0.0161*** (5.51)
Tangibility	−0.0138*** (5.17)
Accelerator/K	−0.0017*** (3.95)
Short term debt/K	−0.0107*** (5.77)
Long term debt/K	0.0090*** (5.28)
Export sensitivity	−0.0926*** (9.88)
Group affiliation	0.0172 (1.46)
Industry sale growth	−1.1556*** (29.95)
Prob> F	0.0000
R^2	0.2700

Variables are defined in Sect. "Sample and variables". In the selection equation, the dependent variable is coded 1 for the first investment regime and 0 for the second investment regime.
L. is lag operator.
Estimation is done after controlling for fixed firm and year effects. Absolute t-statistics are in parentheses. *, ** and *** represent level of significance at 5, 1 and 0.1 %, respectively. The number of observations for the regression is 18,052

(1976) to conduct a likelihood ratio test by defining the degrees of freedom as the sum of the number of constraints and the number of unidentified parameters. The calculation yields 50 degrees of freedom. Given the critical value for the χ^2 distribution with 50 degrees of freedom, we reject the possibility of a single investment regime at all the conventional levels. Next, we interpret the regimes by looking at the coefficients associated with lagged asset sales which should be significantly greater for the credit constrained regime than the unconstrained one. We find it to be significantly greater in the first regime.

In Panel A, five variables turn out to be significant in explaining investment in both the regimes: current accelerator and current cash flows with positive sign and; gold price volatility, current asset sales and low credit allocation dummy with negative sign. Following inferences can be drawn from these. First, firms invest more when they experience growth in sales and internal liquidity. Second, macroeconomic uncertainty depresses investment. Third, firms respond to lower investment by accumulating funds acquired from the sale of fixed assets. Finally, lower credit allocation to firms in the post-2001 period, in response to the policy makers' stance to restrict NPA, also resulted in a reduction in investment.

Several variables assume significance only in the second regime. Lagged investment is positive implying that firms, when unconstrained by credit, tend to persist with their investment expenditure over time. Lagged cash flow appears with a negative sign suggesting that unconstrained firms are likely to respond to growth in cash flows (after controlling for current cash flows, its growth can only be ensured by a fall in its lagged value). Current slack and current interest coverage also turn out to be negative. This implies that unconstrained firms are likely to build their cash and marketable securities reserve and; service their debt, respectively, by cutting down their investment. As both these aspects are directly related to potential downside risk, such approaches keeps management of the firms focused.

Lagged asset sale is the only variable which is significant only in the first regime. A positive sign with this variable suggests that proceeds from the sale of fixed assets in the previous period are an important source of funds for investment by constrained firms. It draws its importance by being a privately negotiated transaction and being cheaper than issues of debt and equity.

Market share dispersion, which is a key variable in our exercise, is insignificant. This could mean that with an increase in microeconomic uncertainty firms are inclined to stick to their market position and thereby refrain from making any adjustments in investment pattern. This is plausible if firms relatively underweight acquisition of a strategic growth option in terms of stronger ex post market share compared to the fear of having their investment as mere sunk cost when uncertainty unfolds.

The estimates of the selection equation, in Panel B, reveal that all the selection characteristics, except group affiliation, play important role in determining the likelihood of a firm to be credit constrained or unconstrained. Specifically, firms with smaller size, lesser maturity, lower dividend payout, lower tangibility, smaller growth opportunities, smaller short term debt, lower export sensitivity and lower industry sale growth are more likely to be credit constrained. Also, firms with greater slack and long term debt are more likely to be constrained. The results with rest of the variables are consistent

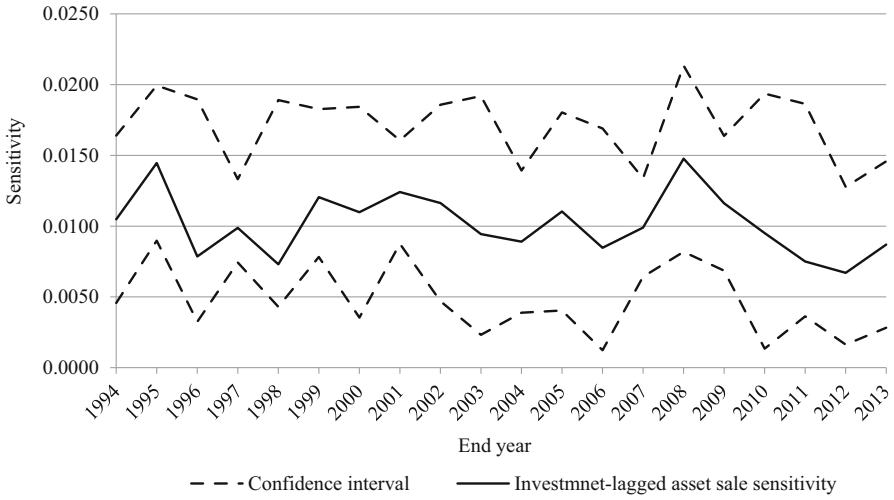

Fig. 2 Stability of investment-lagged asset sale sensitivity (constrained regime)

with their rationale discussed in the Sect. "Characterization of creditworthiness". The coefficients of the debt variables provide two interesting inferences. First, firms which rely more on short term debt are more likely to be creditworthy as such debts keep the agency issue at bay by providing the creditors with the option of credit liquidation if the project goes awry. Second, firms that rely primarily on long term debt, in contrast, do not entrust an option of early liquidation with the creditors. Severe agency conflicts may arise as a result. Such debts, therefore, are more likely to make a firm credit constrained.

Stability of Investment Sensitivity to Lagged Asset Sales and Uncertainty Measures

We check the stability in signs and significance of investment sensitivity to lagged asset sales and uncertainty measures by using the sample from the year 1994 to 2000 as the base and then adding one year in subsequent steps. Figure 2 portrays investment-lagged asset sales sensitivities; Fig. 3 portrays investment-gold price volatility sensitivities and; Fig. 4 portrays investment-market share dispersion sensitivities—all for the credit constrained regimes.[25] In the figures, investment-lagged asset sales sensitivities and investment-gold price volatility sensitivities remain significant throughout with positive and negative sign, respectively. Investment-market share dispersion sensitivities remain insignificant throughout. These patterns are consistent with the main results in Table 3.

[25] Figures for the unconstrained regime also show a pattern consistent with the results in Table 3. They are omitted to save space.

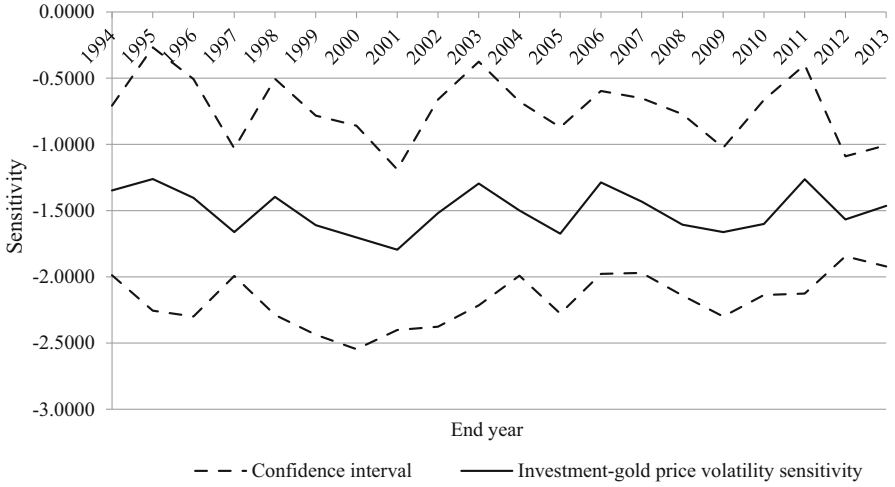

Fig. 3 Stability of investment-gold price volatility sensitivity (constrained regime)

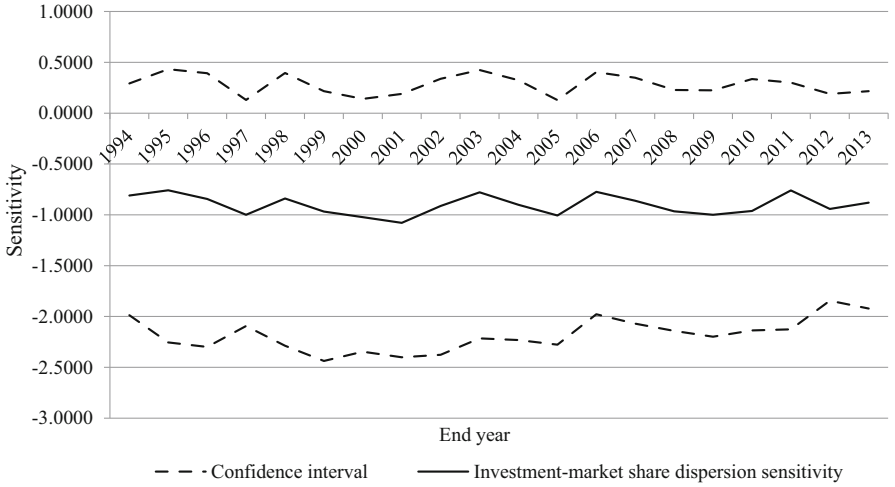

Fig. 4 Stability of investment-market share dispersion sensitivity (constrained regime)

Estimates Using Endogenous Regime Switching Model for Listed Firms

In Table 3, we have used accelerator to represent the growth opportunities of firms as we have many unlisted firms in the sample. A sample of only listed firms would allow us to introduce Tobin's q as an additional measure of growth opportunities which is extensively used in the literature. We, therefore, present the endogenous regime switching model estimates for a sub-sample of 673 firms that are listed in the BSE. Analysis of this sub-sample, in addition, also helps in shedding further light on market share dispersion in investment model, a key variable that is insignificant in Table 3. It can be argued that market share dispersion could be insignificant due to prominent

representation of unlisted firms in the sample as such firms, owing to their resource limitations to hedge against downside risks, are more likely to forego any growth potential for the fear of sunk cost.

The results of the endogenous regime switching regression for the listed firms are in Table 4. Panel A reports the estimates for the investment equation and Panel B reports the estimates for the selection equation. We first perform χ^2 test, as done before, which rejects of similar investment behavior by the two regimes at all conventional significance level. We then look at the coefficients associated with lagged asset sales in the two investment regimes and find it to be significantly greater in the first regime. Hence, we consider the first regime as credit constrained and the second regime as unconstrained.

In Panel A, the coefficients associated with the variables show a great deal of similarity in sign and significance with the main results in Table 3. Among the variables which show difference, current accelerator was significant earlier with a positive sign in the first regime; it turns out to be insignificant. However, Tobin's q, which is an additional measure of growth opportunities, is significant with a positive sign. This implies that firms in the first (credit constrained) regime have limited resources for investment which they align to stock market driven signals rather than signals from growth in sales. This is plausible as stock market performance gives unconfounded signal about own performance whereas deduction from product market requires distinction between industry-wide sales growth and sales growth due to own fundamentals, which may be costly to investigate. This argument also finds support for the credit unconstrained firms—these firms step up their investment with an increase in both, accelerator and Tobin's q, as they do not lack in financing resources.

The coefficient associated with lagged slack was insignificant earlier in the second regime; it is positive and significant now. This, along with negative and significant current slack, implies that such firms increase their investment by running down their cash and marketable securities. Finally, current interest coverage was negative and significant earlier; it turns out to be insignificant now. This implies that investment and debt servicing are stronger substitutes when firms have no stock market presence. Such a substitution is of a limited relevance when stock market offers an additional source of credit. The coefficient of market share dispersion remains insignificant. This gives an additional indication that firms in our sample are more likely to forego any growth potential that microeconomic uncertainty offers for the fear of sunk cost.

In Panel B, except slack, long term debt and accelerator, all other variables retain their sign and significance. The coefficients of slack and long term debt, which were positive earlier, are insignificant now and; the coefficient of accelerator changes from negative and significant to insignificant. These imply the following. First, for a sample with a dominant presence of unlisted firms, cash is the major component of slack. Firms anticipating credit constraint are likely to stack it as a precautionary measure. For listed firms, marketable securities replace cash as the major component of slack. It is likely that most of the information contained in marketable securities is already embedded in Tobin's q. Second, for listed firms, fluctuations in stock prices conveniently capture most of the information about their chances of default. Such information, for unlisted firms, is deduced from long term debt. Third, with firms listed in the stock market, it is very likely Tobin's q captures most of the information contained in the accelerator. We

Table 4 Endogenous regime switching regression (listed firms)

Panel A: The investment equation			
Dependent variable: Investment/K	Regime 1 coefficient	Regime 2 coefficient	p value for difference in coefficients
L. Investment/K	0.0081 (0.61)	0.1068*** (8.68)	0.0000
L. Accelerator/K	−0.0041 (1.25)	0.0131 (1.38)	0.0000
Accelerator/K	0.0078 (0.47)	0.0238*** (7.11)	0.0000
L. Tobin's q	−0.0057 (0.93)	0.0040 (0.32)	0.2603
Tobin's q	0.0082* (2.45)	0.0184** (3.01)	0.0000
Market share dispersion	−0.1478 (1.23)	0.1434 (1.26)	0.0000
Gold price volatility	−3.7943*** (4.71)	4.4409*** (6.56)	0.0000
L. Cash flow/K	0.0097 (0.11)	−0.0145*** (7.96)	0.0000
Cash flow/K	0.0250** (3.05)	0.0334*** (3.58)	0.1014
L. Asset sale/K	0.1798*** (6.71)	−0.2184 (1.39)	0.0000
Asset sale/K	−0.3327*** (5.48)	0.2129*** (3.55)	0.0000
L. Slack/K	−0.0052 (1.41)	0.0173*** (4.50)	0.0000
Slack/K	−0. 0085 (1.13)	0. 1648* (2.50)	0.0000
L. Interest coverage/K	0.0401 (0.90)	0.0029 (0.69)	0.0000
Interest coverage/K	0.1146 (0.69)	0.0098 (0.81)	0.0000
Low credit allocation dummy	−0.1873*** (4.66)	0.0779*** (4.96)	0.0000
Prob. > F	0.0000	0.0000	
R^2	0.4240	0.7756	

Panel B: The Selection Equation	
Dependent variable: regime dummy	Coefficient
Log sales	−0.0882*** (6.20)
Log age	−0.1736*** (3.59)
Dividend payout/K	0.2172** (2.63)
Slack/K	0.0183 (1.50)
Tangibility	0.0210* (2.09)
Accelerator/K	0.0039 (1.76)
Tobin's q	0.2010*** (4.71)
Short term debt/K	0.0294** (3.60)
Long term debt/K	0.0092 (1.37)
Export sensitivity	0.1711*** (4.72)
Group affiliation	0.0281 (0.67)
Industry sale shock	2.6658*** (17.64)
Prob> F	0.0000
R^2	0.3441

Variables are defined in Sect. "Sample and variables". In the selection equation, the dependent variable is coded 1 for the first investment regime and 0 for the second investment regime.
L. is lag operator.
Estimation is done after controlling for fixed firm and year effects. Absolute t-statistics are in parentheses. *, ** and *** represent level of significance at 5, 1 and 0.1 %, respectively. The number of observations for the regression is 3334

can see that Tobin's q assumes a similar sign and significance in Table 4 as accelerator in Table 3.

Conclusion

In this paper we investigate how finance constraints and uncertainty affect investment by using a sample of 2363 Indian private manufacturing firms in the period 1994–2013. We identify financially constrained firms by relying on investment-lagged asset sale sensitivity whereas uncertainty is represented using volatility in gold prices (macroeconomic uncertainty) and top four-firms market share dispersion (microeconomic uncertainty). Using an endogenous regime switching model, our results make three significant observations. First, in the post-reform period there has been an adverse shift in the investment financing policy. The focus of the policy makers, however, does not seem to restrict investment but to restrict NPA. Athey and Reeser (2000) for a relatively early period (1981–1986) also suggest that the policy issues are a major bottleneck in investment financing in India. They focus mainly on the targeted credit program of government which adversely affected investments of those firms that are not covered in the program. The second important observation pertains to firms' credit constraint in our sample. The results suggest that firms with inferior access to external credit are smaller, younger, pay less dividend, export less and belong to an industry with inferior demand than others. Such firms invest by running down their available cash flows and selling assets in the previous period. The third important observation pertains to sensitivity of uncertainty to investment in our sample. We note that macroeconomic uncertainty depresses investment whereas microeconomic uncertainty has no impact on investment. The result on macroeconomic uncertainty is fairly consistent with the literature[26] but, to the best of our knowledge, we do not find any direct parallel to compare the result on microeconomic uncertainty. We argue that firms in our sample, on average, are more likely to forego any growth potential that microeconomic uncertainty offers for the fear of sunk cost. Such a behavior is commonly noted as loss aversion in the literature (Kahneman and Tversky 1979). We leave experimental evidence on this for future research.

References

Abel, A., A. Dixit, J. Eberly, and R. Pindyck. 1996. Options, the value of capital, and investment. *Quarterly Journal of Economics* 111: 753–777.

Allayannis, G., and A. Mozumdar. 2004. The impact of negative cash flow and influential observations on investment-cash flow sensitivity estimates. *Journal of Banking and Finance* 28: 901–930.

Allen, F., R. Chakrabarti, S. De, J. Qian, and M. Qian. 2012. Financing firms in India. *Journal of Financial Intermediation* 21: 409–445.

Almeida, H., and M. Campello. 2007. Financial constraints, asset tangibility, and corporate investment. *Review of Financial Studies* 20: 1429–1460.

Athey, M., and P. Laumas. 1994. Internal funds and corporate investment in India. *Journal of Development Economics* 45: 287–303.

[26] See Carruth et al. (2000) for a survey of results.

Athey, M., and W. Reeser. 2000. Asymmetric information, industrial policy, and corporate investment in India. *Oxford Bulletin of Economics and Statistics* 62: 267–292.
Bates, T. 2005. Asset sales, investment opportunities and the use of proceeds. *Journal of Finance* 60: 105–135.
Bartov, E. 1993. The timing of asset sales and earnings manipulation. *Accounting Review* 68: 840–855.
Bertrand, M., P. Mehta, and S. Mullainathan. 2002. Ferreting out tunneling: an application to Indian business groups. *Quarterly Journal of Economics* 117: 121–148.
Bhaduri, S. 2005. Investment, financial constraints and financial liberalization: some stylized facts from a developing economy, India. *Journal of Asian Economics* 16: 704–718.
Calcagnini, G., and E. Saltari. 2010. *The economics of imperfect markets: the effects of market imperfection on economic decision making*. Berlin, Heidelberg: Springer.
Carruth, A., A. Dickerson, and A. Henley. 2000. What do we know about investment under uncertainty? *Journal of Economic Surveys* 14: 119–153.
Chava, S., and M. Roberts. 2008. How does financing impact investment? The role of debt covenants. *Journal of Finance* 63: 2085–2121.
Cleary, S. 1999. The relationship between firm investment and financial status. *Journal of Finance* 54: 673–692.
Darbha, G., S. Roy, and V. Pawaskar. 2003. Term structure of interest rates in India: Issues in estimation and pricing. *Indian Economic Review* 38: 1–19.
Denis, D., and D. Shome. 2005. An empirical investigation of corporate asset downsizing. *Journal of Corporate Finance* 11: 427–448.
Driver, C., P. Yip, and N. Dakhil. 1996. Large company capital formation and effects of market share turbulence: Micro data evidence from the PIMS database. *Applied Economics* 28: 641–651.
Fazzari, S., and B. Petersen. 1993. Working capital and fixed investment: New evidence on financing constraints. *Rand Journal of Economics* 24: 328–341.
Fazzari, S., G. Hubbard, and B. Petersen. 1988. Financing constraints and corporate investment. *Brookings Papers on Economic Activity* 1988: 141–195.
Fazzari, S., G. Hubbard, and B. Petersen. 2000. Investment-cash flow sensitivities are useful: a comment on Kaplan and Zingales. *Quarterly Journal of Economics* 115: 695–705.
Ganesh-Kumar, A., K. Sen, and R. Vaidya. 2001. Outward orientation, investment and finance constraints: A study of Indian firms. *Journal of Development Studies* 37: 133–149.
Gautam, V., and R. Vaidya. 2013. Firm investment, finance constraint and voluntary asset sales: The evidence from Indian manufacturing firms. *Macroeconomics and Finance in Emerging Market Economies* 6: 114–130.
Gilchrist, S., and C. Himmelberg. 1995. Evidence on the role of cash flow for investment. *Journal of Monetary Economics* 36: 541–572.
Goldfeld, S., and R. Quandt. 1976. Techniques for estimating switching regressions. In *Studies in non-linear estimation*, ed. S. Goldfeld, and R. Quandt, 3–36. Cambridge: Ballinger Press.
Gomes, J. 2001. Financing Investment. *American Economic Review* 91: 1263–1285.
Hay, D., and G. Liu. 1997. The efficiency of firms: What difference does competition make? *Economic Journal* 107: 597–617.
Hite, G., J. Owers, and R. Rogers. 1987. The market for inter-firm asset sales: Partial sell-offs and total liquidations. *Journal of Financial Economics* 18: 229–252.
Hoshi, T., A. Kashyap, and D. Scharfstein. 1991. Corporate structure, liquidity, and investment: Evidence from Japanese industrial groups. *Quarterly Journal of Economics* 106: 33–60.
Hovakimian, G., and S. Titman. 2006. Corporate investment with financial constraint: Sensitivity of investment to funds from voluntary asset sales. *Journal of Money, Credit and Banking* 38: 357–374.
Hu, X., and F. Schiantarelli. 1998. Investment and capital market imperfections: A switching regression approach using US Firm panel data. *Review of Economics and Statistics* 80: 466–479.
Hubbard, G. 1998. Capital-market imperfections and investment. *Journal of Economic Literature* 36: 193–225.
Jensen, M., and W. Meckling. 1976. Theory of the firm: Managerial behavior, agency costs, and ownership structure. *Journal of Financial Economics* 3: 305–360.
John, K., and E. Ofek. 1995. Asset sales and increase in focus. *Journal of Financial Economics* 37: 105–126.
Kahneman, D., and A. Tversky. 1979. Prospect theory: An analysis of decision under risk. *Econometrica* 47: 263–291.

Kaplan, S., and L. Zingales. 1997. Do finance constraints explain why investment is correlated with cash flow? *Quarterly Journal of Economics* 112: 169–215.

Laurent, S. 2004. Analytical derivates of the APARCH model. *Computational Economics* 24: 51–57.

Lensink, R., H. Bo, and E. Sterken. 2001. *Investment, capital market imperfections, and uncertainty: Theory and empirical results*. Cheltenham: Edward Elgar Publication.

Love, I., and M. Peria. 2005. Firm financing in India: Recent trends and patterns. *World Bank Policy Research Working Paper* 3476. http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2005/02/07/000090341_20050207113952/Rendered/PDF/wps3476.pdf. Accessed 24 June 2015.

Maddala, G. 1983. *Limited-dependent and qualitative variables in econometrics*. Cambridge: Cambridge University Press.

Mishra, R., and G. Mohan. 2012. Gold prices and financial stability in India. *RBI Occasional Working Paper* 14015. https://www.rbi.org.in/scripts/PublicationsView.aspx?id=14015. Accessed 24 June 2015.

Myers, S. 1977. Determinants of corporate borrowing. *Journal of Financial Economics* 5: 147–175.

Nickell, S. 1981. Biases in dynamic models with fixed effects. *Econometrica* 49: 1417–1426.

Ray, P., and E. Prabhu. 2013. Financial development and monetary policy transmission across financial markets: What do daily data tell for India? *RBI Working Paper* 14985. https://www.rbi.org.in/scripts/PublicationsView.aspx?id=14985. Accessed 26 June 2015.

RBI circular. 2015. Priority Sector Lending-Targets and Classification. https://www.rbi.org.in/scripts/NotificationUser.aspx?Id=9688&Mode=0. Accessed 24 June 2015.

RBI Master Circular. 2014. Priority Sector Lending-Targets and Classification. https://rbi.org.in/Scripts/BS_ViewMasCirculardetails.aspx?id=9046. Accessed 24 June 2015

Salinger, M., and L. Summers. 1983. Tax reform and corporate investment: A microeconomic simulation study. In *Behavioral simulation methods in tax policy analysis*, ed. M. Feldstein, 247–288. Chicago: University of Chicago Press.

Weiss, D. 1968. Determinants of market share. *Journal of Marketing Research* 5: 290–295.