

Asymmetric Information and Debt Financing: The Empirical Importance of Size and Balance Sheet Factors

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ABSTRACT *In an environment with asymmetric information regarding the outcome of investment activities, the premium on external funds is dependent upon a borrower's financial characteristics. Consequently, a borrower's need for funds and accessibility to the desired amount is interlinked. Using panel data over the 1970–89 period, this study finds that a firm's existing level of indebtedness reduces its current net issuance of long term debt. Bigger firm size, higher net worth and a lower sales to asset ratio alleviate this negative effect. The results suggest that the notion of a stronger balance sheet, which governs a firm's access to the capital market, should be extended to include the non-financial sales to asset ratio variable.*

Key words: Asymmetric information; Tobin's q ; Fixed effects; net worth; Liquidity; Balance sheet.

JEL classifications: D82, E22

1. Introduction

In a perfect capital market, a firm's investment decision is independent of its financial policy since external funds are a perfect substitute for internal funds. This perfect substitutability assumption suggests that under the neoclassical theory of investment, calculation of Tobin's marginal q is independent of the means of financing.¹ With the absence of any kind of external financing constraints, observed fluctuations in investment will be directly related to fluctuations in a firm's demand for investment. The supply side of the financial market is rendered irrelevant for investment fluctuations because in a perfect capital market both

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borrowers and lenders have access to the same level of information with respect to the outcome of the investment project. As a result, the market clears via a fully flexible rate of interest with no restrictions on the quantity or volume of loans supplied.

Alternatively, asymmetric information regarding the outcome of the investment process between borrowers and lenders gives rise to the problem of agency cost. Agency costs drive the price of external funds above internal ones, and furthermore, cause the premium on external funds to vary inversely with the level of internal funds. As a result, the perfectly substitutable nature of internal and external funds breaks down.² Now, both the quantity of credit desired and the quality of the balance sheet become important determinants for the rate of investment as the interest rate alone does not adequately reflect the links between the financial market and the rest of the economy. An important component of the external finance raised by firms is debt of long term maturity. This paper empirically analyzes this need for long term debt and the factors that affect the ability of a firm to obtain it.³ These two issues are interlinked as high levels of internal finance not only reduce the degree of reliance on external finance but are also helpful in obtaining the required amount of external funds. This is possible as higher levels of internal finance reduce the agency cost associated with issuing debt thereby improving a firm's access to the capital market.

Previous empirical studies, especially Fazzari, Hubbard and Peterson (1988), have focussed on the effect a firm's internal cash flow has on its investment activity. They find a differential effect of internal cash flow on investment activities when firms were grouped by their long run dividend payment or retention behavior. Investment opportunities are measured in their study by using Tobin's marginal q or its empirical equivalent average q .⁴ But under asymmetric information, calculation of Tobin's marginal q is itself dependent on the source of finance (external or internal). As Chirinko (1987) has demonstrated, the equivalence between the unobservable marginal q and the observable average q is broken when the agency cost of debt is modelled in a firm's objective function. Consequently, directly examining the investment activity will miss the channel by which the availability of internal finance affects it. On the other hand by focussing on external finance, especially debt of long term maturity, the agency cost problem associated with external finance can be captured. In addition, the role of financial factors and other firm-specific characteristics which are helpful in mitigating the problem of agency cost can then be analyzed. For example, heterogeneity among borrowers along the dimensions of size or collateralizable net worth can lead to a situation where certain borrowers end up being credit constrained which can then be examined empirically.

This study employs firm level panel data on publicly traded firms in the US stock market (COMPUSTAT data base) to examine the long term debt issuance behavior for approximately 6000 firms over the 1970 to 1989 period. The empirical analysis finds that after controlling for unobservable firm specific factors and measuring investment opportunities directly, instead of relying on an indirect measure such as average q , the amount of long term debt outstanding reduces the capacity of a firm to raise new debt finance. This negative effect differs in strength across different categories of firms when the firms are grouped by their observable characteristics: total assets, sales to asset ratio and net worth. One implication of the analysis is that the quality or strength of the balance sheet is a concept which,

apart from being related to the size of the firm and its liquidity level, is also related to the role played by unobservable firm-specific information characteristics in the production process. This relationship arises because asymmetric information resulting from unobservable firm specific variables distorts the input choice and, consequently, the output level in a production process (Gale and Hellwig, 1985; Bernanke and Gertler, 1989).⁵ Hence, this technological aspect of asymmetric information is reflected in a varying output to capital ratio among firms for a given level of firm size or liquidity.

The paper is organized as follows. Section 2 reviews the broad themes in the asymmetric information literature and summarizes them in terms of general implications that outline the role of observable and unobservable firm-specific characteristics on a firm's ability to raise external finance. These implications form the basis for the regression analysis in Section 3. This section also discusses the notion of balance sheet quality when the effect of informational requirements on choice of input levels in the production process is taken into account. Section 3 presents the results of this regression analysis where panel data estimation techniques are employed to control for the effect of unobservable informational differences among the firms. In addition, the regression equation is estimated for different groupings of firms by asset size, net worth and sales to asset ratio. Conclusions are presented in Section 4.

2. Review of Asymmetric Information Literature

The focus of the asymmetric information literature is the nature of loan contracts that are written between parties who are differentially informed about the state of the world. The state of the world in the present context refers to the outcome of an investment project undertaken by a firm where the exact realization is part of the private information set of the firm and the outside lenders are unable to verify it costlessly.⁶ A crucial premise in this literature is that borrowers have limited access to collateral which leads to the incorporation of non-negativity constraints on contractual payments by the borrowers to the lenders. Under these conditions there is a deviation from the first best optimum that can be attained if the information regarding the investment project was perfect. The cost of this deviation is referred to as the agency cost of asymmetric information which translates into a premium on uncollateralized external funds in comparison to the price of internal funds. This can leave a firm or a borrower to be credit rationed either in the sense of not being funded at all, or to constrain it to choose less than the optimal choice of input levels. Consequently, this section contains a discussion of some of the models and their implications regarding the issue of external finance and the factors that affect the ability of a borrower to obtain it. The discussion is descriptive rather than mathematical as a common mathematical model is not feasible.⁷

Gertler (1992) develops a model which allows for ongoing borrower-lender relationships. A distinguishing feature of the model is that the borrowers output and financial capacity—the maximum overhang of the debt they may feasibly carry—are jointly determined. This feature is a result of the broader definition of collateral that not only includes a borrower's current financial assets but also its expected future income. This implies that the 'tightness' of credit constraints depends upon current cash flow and anticipated future profits. In this set-up, debt

rescheduling is not possible below a critical value of net worth. To state differently, above a certain value of outstanding debt it is difficult to refinance any portion of it. Hence, a borrower's access to new finance depends negatively on the amount the borrower already owes to lenders.

Bernanke and Gertler (1989) also emphasize the association of agency cost with the asymmetric nature of information, but from the investment demand perspective. Unlike Gertler's (1992) framework where investment levels are dependent on supply side credit constraints, Bernanke and Gertler emphasize that pessimism of investors, resulting from the higher cost of external funds, reduces the level of investment. Still, for both these frameworks, levels of net worth or working capital should show a positive relationship with investment. On the other hand, Calomiris and Hubbard (1990) emphasize the role borrower heterogeneity plays in determining the investment level. In their framework, where borrowers are indexed by their information intensity, depending upon the level of net worth, the outcome is either a symmetric information allocation where everyone receives funds, or a credit collapse where loans are denied to a certain proportion of the borrowers, as in Mankiw (1986). In a similar vein, Gertler and Gilchrist (1993) have suggested and provided evidence that small firms react more sharply and quickly to both movements in GNP and to conventional indicators of monetary policy. Their model illustrates how credit market imperfections may introduce a kind of risk-aversion on the part of firms even when they are risk neutral, making their behavior excessively sensitive to earnings flow and the interest rate, and more so for smaller firms.

Thus, given the diversity of arguments in the literature, a few general implications of this literature are stated which form the basis of the empirical analysis. These are:

Implication A. *Given a level of investment opportunity, the higher the level of collateral or the liquidity, the less is the agency cost associated with the project. Consequently, the chances of undertaking the given investment project are higher and external debt requirements lower.*

Implication B. *When undertaking an investment project, the higher the collateral or the liquidity, the lower is the amount of debt required. Hence, the possibility of being credit constrained is lower.*

Implication B differs from implication A in one crucial way. In implication A, non-utilization of an investment opportunity is the decision of the investor whereas in implication B the investor is unable to fully utilize the investment opportunities due to supply constraints.

Implication C. *Differentiating firms by their size and other observable characteristics has the implication that credit market distortions will depend inversely on the unobservable level of informational requirements. Thus, asymmetric information distorts the level of inputs chosen in a production framework.*

Implication C extends implications A and B to an explicit production framework. To be more substantive, consider the following argument. Assume that the output of a firm Y_{it} is produced via a well behaved production function f which employs two types of inputs: capital K_{it} and labor L_{it} . If firms are differentiated by their

information intensity i within an observable category η (net worth, size, etc.), then one can write the production function as:

$$\begin{aligned} Y_{it} &= f(K_{it}, L_{it} | \eta) \text{ where } i \in (a, b) \\ \text{s.t. } L_{it} &= L_t^*, K_{it} = K_t^*, \text{ if } i = a \\ \text{and } L_{it} &< L_t^*, K_{it} < K_t^*, \text{ if } a < i \leq b \end{aligned} \quad (1)$$

where there are no restrictions on the returns to scale. Here, the index i takes on values between a and b , where level a corresponds to the full or symmetric level of information and any value above it represents increasing degree of asymmetric information. K_t^* and L_t^* represent the optimal choice of input level in absence of any type of asymmetry in information. Thus, Equation (1) produces a different output to capital ratio (Y_{it}/K_{it}) within a given category η depending upon the index parameter i . This implies that the debt raising capacity of a firm will be linked to the unobservable output to capital ratio. However, the exact relationship will be dependent upon the properties of the generic production structure f . In absence of direct information about the properties of f , one is forced to rely upon data to define *ex-post* the nature of this relationship, an approach followed in this study. If one identifies capital with the total assets of the firm and sales with the total output, then the sales to asset ratio is equivalent to measuring output to capital ratio.⁸

To sum, the above three implications address the need for debt and the ability to finance it, thereby, impacting the current and future operations of a firm. This is captured by specifying a regression equation (Equation (2)) and estimating it using panel data estimation techniques. As need and ability seem to be intermixed, an attempt will be made to separate them by differentiating the sample on the basis of observable factors and estimating the regression equation separately for each subgroup.

3. Regression Analysis

3.1. Econometric Approach

Empirical work which focuses on the investment behavior of a firm has proceeded along two lines: reduced-form regressions of investment on cash flow, and tests of financial constraints using Euler equation methods.⁹ The Euler equation approach is not pursued in this study. In addition to the computational limitations in analyzing the relatively large panel data set used in this study, there is no common mathematical model available to make the Euler equation approach operational. The aim of this study is to explore the implications of cross-sectional heterogeneity among borrowers on the basis of both observable and unobservable characteristics on the debt raising capacity of a firm. It is precisely this heterogeneity which precludes any clear mathematical solution but can be made operational by utilizing panel data regression techniques. Hence, estimating the specified regression equation over the various groups and sub-groups is similar in spirit to the Euler equation estimation approach under different assumptions regarding the borrowing constraint. Consequently, the focus of this study is a reduced-form regression analysis of the net issuance of long term debt by an individual firm measured by the annual change in long term debt.

Reduced-form regression analysis has its own problems. First, use of cash flow as a proxy for internal funds has been criticized by Hayashi and Inoue (1991) since movements in current cash flow may be correlated with shocks to the underlying

production structure. Second, this proxy problem is compounded when controls for investment opportunities are attempted by using Tobin's q . The relationship between q theory and investment breaks down in the presence of asymmetric information. In general, expectations reflected in prices quoted on the centralized security markets do not reflect insiders or firms valuation of future investment projects under asymmetric information.¹⁰

In view of the above mentioned concerns, and given the objective of examining the factors which affect the need for debt and the ability of a firm to finance it, firm-specific unobservable heterogeneity and investment opportunities will be controlled for in a direct manner. Panel data estimation technique is employed to estimate the regression equation for different categories for firms: firm size, liquidity and strength of the balance sheet. A fixed effect is specified to control for firm-specific unobservables.¹¹ The dependent variable in the regression is the annual change in long term debt (CHD). The first set of explanatory variables is the lagged value of debt due in one year (DEBTYR), the lagged value of total long term debt (LTD) and the lagged value of cash flows (CF). The second set of explanatory variables is the expenditure on property, plant and equipment (PPECE), the amount spent on acquisition of interests in other companies (ACQ) and the net repurchase of firm's own equity (NETEQ). Annual data for the years 1970–1989 for these balance sheet variables was obtained from the COMPUSTAT database.

The first two variables DEBTYR and LTD are in the spirit of Gertler's (1992) analysis and account for the flow and stock version of the maximum overhang of debt hypothesis. Lagged value of cash flow (CF) is used to control for shocks to working capital.¹² These three variables empirically reflect the notion of balance sheet liquidity that form the basis of implications A and B. The variables PPECE and ACQ control for investment opportunities available to the firm within its own operations as well as opportunities available outside the firm. NETEQ is meant to represent management's desire to make use of tax advantages and cash payments made by corporations to shareholders.¹³

Availability of this type of detailed data at the firm-specific level obviates the need to use average q to control for investment opportunities indirectly as has been done in most of the previous research. Consequently, the investment opportunities are directly controlled for here. Also, the variable DEBTYR captures the differences in the maturity composition of long term debt among different firms. The time profile of debt maturity could be different among firms even if the total outstanding long term debt is the same. This implies that a high level of debt maturing in the near future puts a strain on firms' cash flows thereby reducing the amount of internal financing available for investment. As a result, the need for external financing increases with an accompanying increase in agency cost which then affects the issuance of new debt and reduces the amount of investment undertaken. This reasoning reflects the effect of asymmetric information on the supply of external funds.

A regression equation of the following form is estimated for the period 1970–1989 where all variables at the estimation stage are normalized by total firm assets in a given year so as to convert the data into per-capita (real) terms.¹⁴ The equation to be estimated is:

$$\begin{aligned} (\text{CHD} | K)_{it} = & \alpha_i + \beta_1 (\text{DEBTYR} | K)_{it-1} + \beta_2 (\text{LTD} | K)_{it-1} + \beta_3 (\text{CF} | K)_{it-1} \\ & + \beta_4 (\text{PPECE} | K)_{it} + \beta_5 (\text{ACQ} | K)_{it} + \beta_6 (\text{NETEQ} | K)_{it} + \varepsilon_{it}, \end{aligned} \quad (2)$$

$i = 1, \dots, N, t = 1, \dots, T.$

The coefficient α_i captures the unobservable firm specific factors.¹⁵ Consequently, it controls for differences in management style, efficiency and policies across firms. An example of firm-specific policy would be that a firm's management has a targeted debt to equity ratio to reflect the concern of its creditors. This concern is a direct consequence of the nature of the debt contract where the risk of default directly affects the creditors rather than the equity owners. As a result, managers may forego some investment opportunities with a positive net present value and accept others with a high risk and even a negative net present value. The managers also have the incentive to issue new debt in order to raise the riskiness of the existing debt, thereby, lowering the value of the existing debt. Hence, creditors often demand covenants which stipulate targeted debt to equity ratios.

Another example of firm specific differences arises when managers are concerned with who they borrow from (private or public) in addition to caring about the type of funds: retained earnings, private debt, new shares, corporate bonds (Mackie-Mason, 1990). One implication of this reasoning is that if firms care about who provides the funds, then credit market conditions are likely to have an effect on many economic activities including investment.

Equation (2) was estimated using ordinary least squares under the assumption of fixed effects.¹⁶ This was implemented by using a dummy variable for each firm. To control for diversity among firms on the basis of observable factors, net worth normalized by total assets of the firm, sales to assets ratio and total asset size, the regression equation is estimated separately for different groups and sub-groups. That is, the β_i 's are allowed to be different between groupings but constant within a group.

Firms are differentiated into two distinct groups given any observable characteristic. The number of groups (two) is arbitrary and is motivated solely by the consideration of computational tractability. Total assets of a firm are used to measure firm size, net worth is used to measure liquidity, and the sales to asset ratio is used to measure the importance of informational requirements in the production process. The dividing point for the sales to asset ratio category is a value of one. This number is arbitrary but is chosen as it approximates the median value of sales to asset ratio in the data.

A small firm is defined as one having \$25 million or less in total assets, using the average level of assets of the firm over its life span where the asset values are measured in 1982 dollars.¹⁷ This level is selected since Gertler and Gilchrist (1993) suggest that firms that are liquidity constrained when making investment decisions are concentrated in the vicinity of this level of assets or below. Liquidity is measured as the net worth of a firm divided by its total assets. Compared to the absolute value of net worth, this relative measure of liquidity distinguishes between two firms selling identical products but having a different capital structure due to different degrees of vertical integration. A normalized net worth of less than 0.40 over a firm's entire life span categorizes the firm as having low net worth and conversely for a high net worth type. Again, the dividing line of 0.40 is arbitrary but is motivated by the desire to have a fair proportion of the sample in each category to facilitate consistent estimates.

Table 1. Summary statistics of variables used in the regression analysis

Variable	Mean	SD	Median	Min	Max
CHD K	0.0076	0.1329	0.0000	- 3.784	4.677
DEBTYR K	0.0211	0.1047	0.0006	0.0000	4.993
LTD K	0.1887	0.2309	0.1390	0.0000	4.818
CF K	0.0298	0.2740	0.0728	- 4.998	4.492
PPECE K	0.0537	0.0971	0.0124	0.0000	1.933
ACQ K	0.0134	0.0651	0.0000	0.0000	5.534
NETEQ K	- 0.0541	0.2152	0.0000	- 4.996	2.101

Note: All variables have been normalized by the value of total assets.

3.2. Results

Table 1 presents the summary statistics of the variables used in the regression analysis. The estimated equation for the entire sample where the firm dummies are not reported for convenience is:

$$\begin{aligned}
 (\text{CHD}|K)_{it-1} = & \\
 & - 0.0098 (\text{DEBTYR}|K)_{it} - 0.240 (\text{LTD}|K)_{it-1} - 0.033 (\text{CF}|K)_{it-1} \\
 & \quad \quad \quad (- 1.55) \quad \quad \quad (- 76.50) \quad \quad \quad (- 11.82) \\
 & + 0.342 (\text{PPECE}|K)_{it} + 0.181 (\text{ACQ}|K)_{it} + 0.116 (\text{NETEQ}|K)_{it} \\
 & \quad \quad \quad (39.06) \quad \quad \quad (18.00) \quad \quad \quad (31.41) \\
 \bar{R}^2 = & 0.348
 \end{aligned}$$

Numbers in brackets are the t values of the estimated coefficients. The negative sign of β_2 , the coefficient of $(\text{LTD}|K)_{it-1}$ in the regression equation, implies that a higher level of existing debt tends to reduce the net issuance of debt in the current period. β_3 , the coefficient of $(\text{CF}|K)_{it-1}$, is negative in accordance with the theory that positive shocks to working capital will reduce the need for costly external finance. β_1 , the coefficient for $(\text{DEBTYR}|K)_{it-1}$, is negative but barely significant at the 10% level of significance, indicating that the currently maturing proportion of long term debt is not an important factor, at least not for the overall sample. The coefficients for the investment variables and equity repurchase activity are all positive. The joint sum of coefficients for $(\text{PPECE}|K)_{it}$ and $(\text{ACQ}|K)_{it}$ can be interpreted to mean that for every dollar of investment activity, close to 26% is financed by issuing long term debt.

An added concern is the endogeneity of investment variables in the empirical analysis. To this effect the equation was estimated using instrumental variables (one period lagged value of $(\text{PPECE}|K)$) to reflect that investment within the firm is endogenous but the investment in outside opportunities is not. Estimates for the overall sample showed no change in sign or significance level except that the coefficient for $(\text{DEBTYR}|K)_{it-1}$ became positive but significant at the 5% level of significance. Hence, subsequent estimation for different groupings of the data is undertaken using only simple OLS. These results are presented in Table 2 where, because of the unbalanced nature of the panel, both the number of firms as well as the total number of sample points are reported.

The regression coefficient β_2 for the different groups is always negative (and significant) but varies in magnitude across these different groupings of firms.¹⁸ For large firms this coefficient is almost one-third smaller in value and the sum of

Table 2. Regression results of change in long term debt for general categories: 1970–89

Explanatory variables	All firms	Large firms	Small firms	NW high	NW low	S/A low	S/A high
$(DEBTYR K)_{it-1}$	-0.001 (-1.6)	-0.171 ^a (-18.3)	0.039 ^a (3.9)	-0.210 ^a (-20.3)	0.026 ^a (2.6)	-0.006 (-0.8)	-0.003 (-0.3)
$(LTD K)_{it-1}$	-0.241 ^a (-76.5)	-0.177 ^a (-53.5)	-0.293 ^a (-49.2)	-0.211 ^a (-56.9)	-0.249 ^a (-45.9)	-0.217 ^a (-58.4)	-0.277 ^a (-49.1)
$(CF K)_{it-1}$	-0.033 ^a (-11.8)	-0.032 ^a (-6.6)	-0.036 ^a (-8.3)	-0.007 ^a (-2.6)	-0.051 ^a (-9.9)	-0.031 ^a (-8.7)	-0.038 ^a (-8.3)
$(PPECE K)_{it}$	0.343 ^a (39.0)	0.382 ^a (34.5)	0.323 ^a (21.9)	0.272 ^a (35.9)	0.418 ^a (22.6)	0.309 ^a (30.2)	0.387 ^a (24.4)
$(ACQ K)_{it}$	0.181 ^a (18.0)	0.203 ^a (24.1)	0.159 ^a (6.2)	0.164 ^a (19.3)	0.199 ^a (9.3)	0.069 ^a (6.2)	0.410 ^a (20.9)
$(NETEQ K)_{it}$	0.116 ^a (31.4)	0.124 ^a (20.7)	0.111 ^a (19.4)	0.083 ^a (24.8)	0.145 ^a (19.6)	0.177 ^a (27.3)	0.107 ^a (16.0)
R^2	0.348	0.356	0.356	0.368	0.349	0.339	0.373
Total observations	47063	30410	16653	30455	16608	30575	16488
Number of firms	6048	3369	2679	3666	2382	3817	2231

Note: The figures in parentheses beneath the parameter estimates are t statistics. S/A is the sales to assets ratio and NW denotes net worth. ^aDenotes significant at the 0.01 confidence level.

coefficients on the investment activities is bigger. To be precise, the sum of the coefficients corresponding to $(ACQ|K)_i$ and $(PPECE|K)_i$ is 0.583 for the larger firms versus 0.481 for the smaller firms, implying that larger firms not only suffer less from the burden of existing level of debt but also rely more on external finance. This evidence conforms with Gertler and Gilchrist's (1993) analysis that size alleviates the agency cost problem associated with debt finance.¹⁹

When firms are categorized by their relative net worth, the coefficient β_2 is smaller and the sum of investment coefficients is also smaller for firms with higher net worth in comparison to firms with low net worth. This conforms to the expectations that low net worth increases the need for external debt while concomitant high accompanying agency costs restrict them from obtaining the required funds (implication B). Table 2 also reports results for groupings of firms by their sales to assets ratio. Here, firms with a low sales to asset ratio suffer less from the existing level of debt and finance a lower proportion of their investment through debt. If financial factors weren't important in the production function then differentiating firms by their sales to asset ratio would not have been informative. It appears that there is an inverse relationship between information intensity and the sales to asset ratio.²⁰

Comparing the coefficient β_3 for lagged cash flow across the various categories, which is negative, it is evident that larger size, higher net worth and lower sales to asset ratio makes changes in debt to be less sensitive to cash flow. This is reflected in the smaller absolute value of this coefficient for these categories. These results are complementary to the preceding results in that this 'excess' sensitivity to cash flow is alleviated by larger size and a stronger balance sheet. The coefficient for $(DEBTYR|K)_i$ is negative and significant for firms which suffer less from the previous level of debt burden (large firms and firms with higher liquidity) whereas the coefficient is significant and positive for firms suffering more from the negative effect of previous level of indebtedness (small firms and firms with lower liquidity). This is contrary to what is expected and is indicative of the fact that there is something more to a firms' desire to improve its balance sheet by paying off the currently maturing portion of the debt. An example would be the activity of inventory management which correlates very well with macroeconomic fluctuations in the short run, and is most likely to be independent of long term growth and investment strategies of the firm (Carpenter, Fazzari and Peterson, 1993).

Table 3 presents the results for sub-categories of net worth by the sales to asset ratio and total asset size. A stronger balance sheet can now be defined, given the arguments in Section 2 and the empirical results above, as a comparatively lower sales to asset ratio within a given net worth category. Stronger firms by this definition have less trouble in raising debt—lower negative coefficient β_2 —and is even valid for the low sales to asset ratio sub-category within the high net worth group.²¹ Another measure of the strength of a balance sheet is to sub-divide the net worth category by the asset size of the firm. Here, one finds that within the net worth categories large firms are less constrained in raising long term debt as they show a smaller negative (absolute) value of β_2 .

4. Conclusions

The empirical analysis in this paper finds that the level of outstanding debt has a detrimental effect on the capacity of a firm to raise new debt finance, after **Table 3.** Regression results of change in long term debt for sub-categories of net worth: 1970–89

Explanatory variables	NW high & S/A low	NW high & S/A high	NW low & S/A low	NW low & S/A high	NW high & large	NW high & small	NW low & large	NW low & small
$(DEBTYR K)_{it-1}$	-0.206 ^a (-19.6)	-0.186 ^a (-7.2)	0.047 ^a (3.6)	0.009 (0.6)	-0.533 ^a (-31.8)	-0.118 ^a (-7.6)	-0.121 ^a (-8.4)	0.070 (4.4)
$(LTD K)_{it-1}$	-0.163 ^a (-41.0)	-0.326 ^a (-41.6)	-0.238 ^a (-34.8)	-0.262 ^a (-29.9)	-0.090 ^a (-25.7)	-0.361 ^a (-47.8)	-0.217 ^a (-36.9)	-0.269 (-27.1)
$(CF K)_{it-1}$	-0.013 ^a (-4.2)	-0.005 (-1.0)	-0.046 ^a (-6.4)	-0.054 ^a (-7.3)	-0.010 ^b (-2.1)	-0.009 ^b (-2.3)	-0.047 ^a (-5.1)	-0.054 (-6.9)
$(PPECE K)_{it}$	0.263 ^a (31.0)	0.271 ^a (18.8)	0.366 ^a (15.8)	0.480 ^a (15.8)	0.274 ^a (26.7)	0.264 ^a (21.9)	0.464 ^a (21.5)	0.389 (11.9)
$(ACQ K)_{it}$	0.055 ^a (6.0)	0.461 ^a (25.2)	0.093 ^a (3.6)	0.260 ^a (9.8)	0.225 ^a (29.6)	0.088 ^a (4.6)	0.191 ^a (11.1)	0.278 (4.3)
$(NETEQ K)_{it}$	0.082 ^a (22.7)	0.086 ^a (12.3)	0.159 ^a (16.6)	0.125 ^a (10.8)	0.084 ^a (17.8)	0.079 ^a (15.2)	0.188 ^a (13.3)	0.135 (12.2)
\bar{R}^2	0.349	0.438	0.347	0.358	0.381	0.413	0.368	0.346
Total observations	20573	9882	10002	6606	19658	10797	10752	5856
Number of firms	2418	1253	1404	983	1984	1687	1390	997

Notes: The figures in parentheses beneath the parameter estimates are *t* statistics. S/A is the sales to assets ratio and NW denotes net worth. ^aDenotes significant at the 0.01 confidence level. ^bDenotes significant at the 0.05 confidence level.

controlling for unobservable firm-specific factors and investment opportunities. This effect varies in strength across different categories of firms when they are segregated by their observable characteristics. The use of total assets to measure firm size, net worth to measure liquidity and the sales to asset ratio, by itself as well as in conjunction with net worth, to measure the quality of the balance sheet produces the result that large firms and firms with stronger balance sheets can alleviate the negative effects of existing levels of debt on their access to the capital market. These results support the implications of the asymmetric literature that were outlined in Section 2. Use of the sales to asset ratio as a financial criterion is an implication of the effect of unobservable informational requirements on the choice of input levels in the production process. The empirical analysis suggests that the notion of a stronger balance sheet, which governs a firm's access to the capital market, should be extended to include the non-financial sales to asset ratio variable.

Notes

1. As the opportunity cost of internal funds is equal to that of external funds, the market valuation of an additional unit of capital is the same for both outsiders (lenders) and insiders (owners).
2. Additionally, information problems in the financial market shape both financial market institutions and debt instruments. Under asymmetric information, financial institutions (banks, insurance companies and brokers) play the role of information gatherers on behalf of depositors, in addition to intermediating between savers and investors (Diamond, 1984; Williamson, 1986).
3. After internal sources of finance, such as retained earnings, long term debt is the next most important source of external funds for firms. The average debt to asset ratio during the 1970 to 1989 period is close to 0.25 for the surviving firms in the COMPUSTAT data base used in this study. For the firms which failed during this period, this average is close to 0.33.
4. Hayashi (1982) has derived the conditions under which the unobservable marginal q is equivalent to observable average q which is the ratio of the market value of existing capital to its replacement cost.
5. Examples of these unobservables would be management style and efficiency, targeted goals, goodwill with customers and distributors. These factors are typically part of the private information set of managers (insiders or owners), while outsiders (banks, stock-holders) must infer these characteristics indirectly and imperfectly.
6. This particular scenario stresses upon the *ex-post* costly observation of states in the world. An alternative scenario in this literature is that of lenders not being able to verify, *ex-ante*, either the viability of the project or the entrepreneur type (good or bad), which then leads to the problem of moral hazard. However, both these scenarios lead to the same qualitative conclusion regarding the emergence of credit constraints or rationing (Jaffe and Stiglitz, 1990).
7. For a detailed survey of the asymmetric information literature, one can refer to Gertler (1988) and Jaffe and Stiglitz's (1990) comprehensive surveys.
8. A better measure of output is value added by a firm but data considerations limit the use of this measure. The cost of goods item needs to be adjusted as it contains the wages and salaries of workers which are an important component of value added. As this is a supplementary items of the balance sheet in the COMPUSTAT data, it suffers from non-reporting problem. Consequently, only a small proportion (15%) of the firms in the sample have enough data to calculate value added.
9. A list of papers in the reduced-form estimation tradition are Fazzari, Hubbard and Peterson (1988), Gertler and Hubbard (1988), Devereux and Schiantarelli (1990), Gilchrist (1990), Himmelberg (1990), Hoshi, Kashyap and Scharfstein (1991), Oliner and Rudebusch (1992), Whited (1992), and Worthington (1995). On the other side, Hubbard and Kashyap (1992) and Gertler, Hubbard and Kashyap (1991) use Euler equation approach to test for the significance of borrowing constraints.
10. Additionally, an empirical proxy for marginal q may be a poor proxy because of imperfect competition in the product market and non-constant returns to scale at the production level.

11. The assumption that firm effects are random was rejected using a Hausman's misspecification test. Additionally, the absence of serial correlation in the error term was confirmed using the modified Durbin-Watson test for panel data as proposed by Bhargava, Franzini and Narendranathan (1982).
12. DEBTYR, LTD and CF are obtained from the end of the year balance sheet. In contrast, the theory postulates that the value at the beginning of the period matters for these variables. Lagging the variables by one period reconciles this timing issue.
13. Bernanke and Campbell (1988) have documented the changing nature of net equity repurchases. These were in the small negative range for most of the 1970s and early 1980s but have been on the high positive side since then.
14. This also controls for the potential heteroscedasticity effects in the error term.
15. The fixed effects α_i 's were estimated by the least squares dummy variable technique described in Hsiao (1986).
16. Bernanke and Campbell (1988) have also estimated a similar type of regression equation where they control for industry effects but not for firm-specific effects. This analysis goes further by analyzing the debt issuing capacity for various categories of firms.
17. Durable goods price deflator was used to deflate the asset series.
18. For all the equations estimated in Table 2, the null hypothesis of similar coefficients across different categories was always rejected.
19. Although not reported in the table, similar results were obtained when size was measured with respect to the level of assets of the firm when it first appears in the sample, as well as using the Small Business Administration's definition of defining small firm as one having 500 employees or less.
20. This also provides indirect evidence for the fact that the underlying production structure for these publicly traded firms exhibits decreasing returns to scale as opposed to increasing returns. In case of increasing returns this relationship between sales to asset ratio and information intensity would have been positive.
21. The coefficient β_2 is much smaller in absolute value for the high net worth and low sales to asset ratio sub-group in comparison to the low net worth and high sales to asset sub-group, which it clearly dominates by both the net worth and sales to asset ratio criterion. The same cannot be said of the remaining two cases—high net worth and high sales to asset ratio versus low net worth and low sales to asset ratio—as they cannot be pareto ranked in terms of the observables. This argument is also valid for sub-dividing the net worth category by firm size.

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