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Does debt diversification impact firm value? Evidence from India

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ABSTRACT

Corporate debt diversification (firms simultaneously utilizing multiple distinct debt sources) is a global phenomenon. However, how such financing affects firm value has not yet been examined. Using Indian firms, we investigate debt diversification's impact on monitoring effectiveness, agency costs, and financial constraints – which can all affect market value. Results reveal a negative impact of debt diversification on firm value, particularly among group-affiliated firms. This negative impact is attributed to free riding among lenders: evidence suggests that increased agency costs resulting from inferior monitoring contributes to worse firm accounting performance. Further, debt diversification does not appear to reduce financial constraints.

1. Introduction

Debt diversification is a common phenomenon among corporations across the globe. About 79% of firms in the U.S. use more than one source of debt financing (Johnson, 1997). Although it is an emerging market, about 78% of firms in India report a debt component on the balance sheet that utilizes more than one source of borrowing.[1] In spite of its international prevalence, the implications and impacts of the debt diversification phenomenon have yet to be fully examined. Prior research has concentrated on two aspects of diversification: the determinants of debt diversification (Colla, Ippolito, & Li, 2013; Rauh & Sufi, 2010) and the impact of debt diversification on certain firm-specific characteristics (Diamond, 1991; Huang & Ramirez, 2010; Rajan, 1992). However, the literature has not yet examined the impact of debt diversification on the value of firms. Thus, intriguing questions in this context are: (i) *Does* debt diversification affect firm value? and, if so, (ii) *why* does debt diversification impact value?

We examine Indian firms to investigate these questions because of the access to reliable and detailed information about the sources of debt for Indian corporations.[2] Additionally, the frequent affiliation of Indian firms into business groups – a phenomenon which is generally not observed in western economies – provides a unique setting to examine relationships between debt diversification and firm value.

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[1] Authors' calculation for Bombay Stock Exchange (BSE) listed firms.

[2] We utilize data from the well-known source CMIE-Prowess, which provides financial data for Indian corporate firms and is maintained by CMIE (Center for Monitoring Indian Economy). The Prowess database provides information about eleven distinct debt sources for Indian firms.

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After testing whether debt diversification affects firm value, we consider two hypotheses to explain why debt diversification would have such an effect. First, accessing multiple debt sources can reduce the financial constraints faced by firms in the presence of credit rationing by individual financial institutions (Diamond, 1991; Jaffee & Russell, 1976; Stiglitz & Weiss, 1981). Such rationing implies that firms intending to use large amounts of credit must diversify their credit sources in order to fund promising investment projects. This reasoning predicts a positive association between debt diversification and firm value. A positive value effect, therefore, may be predicated on the existence of financial constraints, such as those documented by Faulkender and Petersen (2006), who found that, in the U.S. context, firms with access to bond markets had substantially higher leverage compared to firms with no access. In our sample of Indian firms, we use the model of investment sensitivity to cash flow developed by Fazzari, Hubbard, Petersen, Blinder, and Poterba (1988) to test whether the firms with diversified debt sources are less financially constrained. Special attention is paid to smaller firms, since they are traditionally considered to be financially constrained because of higher levels of information asymmetry (Rajan & Zingales, 1995).

Next, one stream of agency literature suggests that debtholders decrease agency costs through their monitoring (Harris & Raviv, 1990; Rajan, 1992). Therefore, as the number of debt sources increases, monitoring becomes more effective, which can lower agency costs and increase the value of the firm (Nguyen, Locke, & Reddy, 2015). This agency cost argument predicts a positive relationship between debt diversification and firm value. However, a second stream of agency literature argues that the efficiency of monitoring decreases in the presence of multiple actors due to the free rider problem (Brunner & Krahnen, 2008; Carletti, Cerasi, & Daltung, 2007; Jadiyappa, Saikia, & Parikh, 2019; Krugman, 1988). Carletti et al. (2007) propose a model to explain the relationship between multiple banking relationships and monitoring efficiency based on the free rider problem. They posit that the incentive for debtholders to monitor firm activities increases with the amount lent to the firm. When firms engage in multiple banking relationships, the amount borrowed from individual banks decreases, in turn decreasing the bank's incentive to monitor firm activities. Their model predicts the highest monitoring efficiency when there is a single debtholder with considerable funds lent to the subject firm. We extend their insight and argue that when firms access debt from multiple sources, the efficiency of monitoring decreases, which should lead to a decrease in their values in capital markets. It is expected that the valuation penalties from poor monitoring will be most pronounced among firms with high levels of free cash flow, which are assumed to have the highest levels of potential agency costs (Jensen, 1986; Jiraporn, Kim, Kim, & Kitsabunnarat, 2012). To examine agency and free rider hypotheses, we classify our firms into high and low agency cost firms based on the average free cash flows. A positive relationship between debt diversification and firm value for high cash flow firms would provide support for the agency hypothesis. On the other hand, a negative impact of debt diversification on the value of firms with higher free cash flows would support the free rider hypothesis.

To measure debt diversification, we use the number of sources of debt from which firms have outstanding borrowings at financial year end.[3] Firm value is proxied by Tobin's Q, which is the ratio of the market value of the firm to its book assets.[4] Our analyses reveal a negative impact of debt diversification on firm value. Further, we observe that changes in debt diversification are accompanied by corresponding *inverse* changes in firm value. These results strongly support the free rider hypothesis. The investment sensitivity test reveals that debt diversification has an insignificant impact on the financial constraints of firms, even among smaller firms (which are traditionally considered to be financially constrained; Rajan & Zingales, 1995). This finding is inconsistent with the financial constraint hypothesis. In the free cash flow analysis, debt diversification has a negative impact on firm value, rejecting the argument that having more distinct sources of debt leads to better monitoring and providing evidence of free riding among lenders.

To test the robustness of the evidence supporting the free rider hypothesis, we classify our sample into group-owned firms and standalone firms. The free rider hypothesis predicts that the negative impact of debt diversification on firm value should be greater for firms which are prone to more agency costs. In India, group-affiliated firms are expected to have a greater level of the agency problems as they are exposed to conflicts of interest in two ways. The first source is the conflict between shareholders' and managers' interests, and the second source is between majority and minority shareholders (Singla, Veliyath, & George, 2014). Hence, for the group-affiliated subsample, we expect to observe a greater negative impact for debt diversification. As expected, the negative impact witnessed in the full sample analysis is driven primarily by its impact on group-affiliated firms; for standalone firms, the impact is insignificant. This analysis documents the robustness of our result and reinforces the empirical support for the free rider hypothesis.

Next we examine the economic channel of the impact on firm valuations. We expect the negative impact to be a result of firms' inferior operating performance. To examine this, we regress firm ROA on our measure of debt diversification. As predicted, debt diversification has a negative effect on the performance of the firm. We also investigate whether this negative performance reflects increased agency costs. In this test, we use the asset turnover ratio as an indirect measure of agency costs as suggested by Ang, Cole, and Lin (2000). They argue that the agency problem would ultimately affect the efficiency of asset employment, leading to lower asset turnover. Consistent with this prediction, our results reveal that firms with diversified sources of debt have a lower asset turnover ratio compared to firms with specialized debt sources.

Our study is closely related to that of Carletti et al. (2007), which examines the impact of debt from multiple banks on the value of Danish firms. However, the studies differ in two important aspects. The scope of Carletti et al. is limited to borrowing from multiple banks; however, our study extends this line of research by considering eleven broad categories of debt (including bank debt). More importantly, we examine the economic channel through which this negative relationship is established; that is, we provide evidence that

[3] Prior studies in the finance literature have used this measure. Colla et al. (2013) use this measure to study debt specialization (which is the opposite of debt diversification) in the U.S. context, and Orlvo and Harper (2016) use this measure to study debt complexity.

[4] Our results remain qualitatively and qualitatively similar and the conclusions drawn do not change if we use the market value of equity as our measure of firm value.

decreases in firm value are due to increased agency costs.

We use Indian financial data because detailed information on debt diversification is available from the Prowess database. Using Indian firms to test our hypotheses regarding the relationship between firm value and debt diversification may impact the generalizability of our results to other contexts. However, results from recent studies of U.S. firms suggest that our result may hold in the U.S. context. For example, Jadiyappa, Saikia, and Parikh (2018) find that firms with greater managerial stock ownership tend to have diversified sources of debt since it allows them to avoid monitoring by creditors, providing empirical support for the creditor free rider hypothesis. Our study is an extension of this insight in that we explore the implication of this finding for firm value. Further, the same authors conduct a preliminary examination of the impact of debt diversification on the value of U.S. firms with results similar to what our study reports in the Indian context.[5] Therefore, the generalizability of our results does not appear to be significantly constrained by the use of Indian financial data.

The rest of the paper is organized as follows. The hypotheses are presented in the second section and the data and methodology employed are discussed in the third section. Results are then presented and discussed. In the fifth section, we check for the robustness of our results against alternate measures of debt diversification and for endogeneity issues. Conclusions are drawn in the final section.

2. Hypothesis development

There are contradictory views in the agency theory literature about the possible impact of debt diversification on firm value. The first view is the efficient monitoring hypothesis, which predicts a positive association between debt diversification and firm value. There are two arguments for why a positive impact would be expected. Jensen (1986) posits that the debt reduces agency problems as it decreases the amount of free cash flow available for expropriation. Harris and Raviv (1990) argue that debt has an informational role in the event of default and hence has a disciplinary impact on the behavior of managers. Indeed, Jiraporn et al. (2012) find evidence that leverage can act as a substitute for corporate governance in mitigating agency conflicts. Rajan (1992) provides another channel through which this disciplinary impact becomes effective. He points out that debtholders, especially banks, have access to firms' checking accounts which gives them an informational advantage to monitor firm activities. Datta, Iskandar-Datta, and Raman (2005) highlight that every loan comes with a definite maturity period. Thus firms must visit the debt market frequently, exposing them to frequent scrutiny by market participants like financial institutions, underwriters, and rating agencies, which again has a disciplinary impact on the firm's activities. Therefore, when firms issue debt to multiple investors, and borrow from multiple sources, they are scrutinized by diverse creditor perspectives leading to lower agency costs that result in a positive impact on firm value.

However, a second view – the free rider hypothesis – predicts a negative association between debt diversification and firm value. Carletti et al. (2007) and Brunner and Krahnen (2008) argue that the monitoring of creditors would be less effective when firms borrow from multiple banks because of free rider problems that arise. These authors contend that when multiple banks have provided capital, each individual bank has lent less to the firm and therefore has less incentive to scrutinize firm behavior; this can motivate lenders to rely on other institutions to effectively monitor. If multiple creditors rely on others to monitor, the overall level of monitoring can decrease, increasing the potential for agency costs that are detrimental to firm value. We argue that the same intuition should hold true when firms use different sources of debt. Therefore, the free rider hypothesis predicts that firms with diversified debt sources should have lower market values compared to firms with less diversified debt. Which of these hypotheses – i.e., efficient monitoring or free rider arguments – holds true is an empirical question that we explore through the following hypotheses:

H1. Debt diversification impacts firm value.

H2. Marginal changes in debt diversification impact marginal changes in firm value.

We also examine whether diversified debt affects the financial constraints that may be imposed by lenders:

H3. Debt diversification impacts the financial constraints faced by firms.

Our final hypothesis predicts that agency costs will tend to amplify the effects of debt diversification. That is, firms with a greater potential for agency costs will experience a magnification of the impact on firm value of either improved monitoring, or of the free rider problem, associated with the diversification of debt:

H4. The impact of debt diversification is greater for firms which are exposed to higher potential of agency costs.

3. Data and methodology

3.1. Data

To test our hypotheses, data is collected from the Prowess database, provided by the Center for Monitoring Indian Economy (CMIE). Our sample consists of 3061 non-financial firms listed on the Bombay Stock Exchange (BSE) for a period of sixteen years, from 2001

[5] Jadiyappa et al. (2019): While the authors find a value affect and evidence of a free rider problem among multiple lenders, their study does not examine the channel through which debt diversification affects the value.

Table 1
Summary statistics.

Variable	N	Mean	SD	Min	Max
Tobin's_Q	33375	1.523	2.806	0.005	74.513
ROA	43653	0.073	0.106	−0.985	1.000
Debt_Div	44062	2.764	1.470	1.000	11.000
Firm_Size	38949	6.741	1.994	2.303	15.205
Tangibility	42909	0.310	0.206	0.001	0.900
Dividends	44062	0.005	0.017	0.000	0.576
Growth	39723	0.128	0.301	−0.993	2.000
R_D_Ratio	44062	0.002	0.013	0.000	0.693
MLev	32006	0.416	0.282	0.001	0.900

Note: This table reports the summary statistics for key variables among our sample firms across the entire sample period (2001–2016). Variable definitions: *Tobin's_Q* is the ratio of the market value of the firm to its book value, *ROA* is return on assets (calculated as earnings before interest and taxes divided by total assets), *Debt_Div* is the number of distinct types of debt sources against which a firm had an outstanding balance at the financial year end (note that we exclude zero-debt firms from our sample, hence the minimum value for *Debt_Div* is one), *Firm_Size* is the log of firm sales, *Tangibility* is the ratio of net fixed assets to total assets, *Dividends* is the ratio of dividends paid to total assets, *Growth* is the annual growth rate in total assets, *R_D_Ratio* is the ratio of research and development expenditures to total assets, and *MLev* is the lagged market leverage (calculated as the prior year's ratio of the book value of debt to the sum of the market value of the firm's equity and the book value of its debts).

through 2016. We exclude from our sample all financial and zero-debt firms along with small firms having sales less than 10 million Rupees.[6] Summary statistics for our sample are displayed in Table 1.

The firms in our sample average 2.764 debt sources with a maximum of eleven sources and a minimum of one source.[7] The average return on assets for our sample firms is 7.3% and the average market value is 1.523 times the book value. The average size (log of sales) of our sample firms is 6.74 and around 31% of firm assets are fixed assets. The firms in our sample paid dividends equal to approximately 0.5% their assets. The average growth rate of total assets for the sample firms during the study period is 12.8%, and Research and Development expenditure as a ratio of total assets is 0.2% on average. Lastly, firms in our sample have a market debt ratio averaging 41.6%.

The correlations among these variables are presented in Table 2. Though the correlation among some of the independent variables is relatively high, untabulated Variance Inflation Factor (VIF) analysis, conducted for our baseline model, did not indicate any multi-collinearity issues.

3.2. Model specification

We use Equation (1) as our baseline model to test the hypotheses.

$$Y_{it} = \alpha_i + \beta_1\ \text{Debt\_Div}_{it} + \beta_2\ \text{Firm\_Size}_{it} + \beta_3\ \text{Dividends}_{it} + \beta_4\ \text{Growth}_{it} + \beta_5\ \text{R\_D\_Ratio}_{it} + \beta_6\ MLev_{it-1} + \varepsilon_{it} \quad (1)$$

Where Y_{it} is the dependent variable, which is Tobin's Q (*Tobin's_Q*, the ratio of the market value of the firm to its book assets).[8] *Debt_Div* is our measure of debt diversification, calculated as the number of debt sources that a firm has utilized. We consider eleven distinct debt sources: bank debt, promoter debt, foreign debt, bond debt, government debt, debt from non-bank financial institutions, fixed deposits from the general public, commercial paper, leasing and hire obligations, deferred debt, and inter-company loans. Appendix 1 describes these sources, which are extracted from the Prowess database. Firm-specific control variables include firm size (*Firm_Size,* the log of sales), scaled dividends (*Dividends*, the ratio of dividends paid to total assets), growth (*Growth*, measured as the annual growth rate of total assets), the research and development ratio (*R_D_Ratio*, the ratio of research and development expenses to total assets), and the lagged value of market leverage (*MLev*, the prior year's ratio of the book value of debt to the sum of the market value of the firm's equity and the book value of its debts). Based on the Hausman test,[9] we use the fixed effects estimator – which controls for firm-specific time-invariant factors – to estimate the coefficients. Any year-specific effects are controlled by the inclusion of year dummy variables.

3.3. Investment cash flow sensitivity model

To test the financial constraints hypothesis, we use the investment sensitivity model from Fazzari et al. (1988). The basic intuition of this model is that investment by firms with financial constraints is largely dependent upon internal cash flows. We add to their model our debt diversification measure and an interaction term (i.e., the product of the debt diversification variable and the measure of internal cash flow). If the financial constraints hypothesis holds, then the positive relationship between debt diversification and firm value

[6] One U.S. dollar equals 70 Indian Rupees as of July, 2018.
[7] We exclude zero-debt firms from the sample.
[8] As mentioned in footnote 4, our results remain qualitatively and qualitatively the same if we use the market value of equity as our measure of firm value.
[9] Our Hausman test results rejected the null at the 1% level.

Table 2
Correlation matrix.

Tobin's_Q	1								
ROA	0.172	1							
Debt_Div	−0.092	−0.030	1						
Firm_Size	0.126	0.288	0.299	1					
Tangibility	−0.077	−0.041	0.167	−0.008	1				
Dividends	0.352	0.483	−0.118	0.227	−0.040	1			
Growth	0.088	0.223	0.024	0.130	−0.130	0.065	1		
R_D_Ratio	0.101	0.042	−0.002	0.044	−0.002	0.059	0.010	1	
MLev	−0.325	−0.267	0.371	0.013	0.216	−0.360	−0.107	−0.099	1

Note: Table 2 displays the correlations among key variables; untabulated Variance Inflation Factor (VIF) analysis indicated there are no multicollinearity issues. Variable definitions: *Tobin's_Q* is the ratio of the market value of the firm to its book value, *ROA* is return on assets (calculated as earnings before interest and taxes divided by total assets), *Debt_Div* is the number of distinct types of debt sources against which a firm had an outstanding balance at the financial year end, *Firm_Size* is the log of firm sales, *Tangibility* is the ratio of net fixed assets to total assets, *Dividends* is the ratio of dividends paid to total assets, *Growth* is the annual growth rate in total assets, *R_D_Ratio* is the ratio of research and development expenditures to total assets, and *MLev* is the lagged market leverage (calculated as the prior year's ratio of the book value of debt to the sum of the market value of the firm's equity and the book value of its debts).

should correspond to a negative impact of debt diversification on the sensitivity of the firm's investments to their cash flows. Therefore, we expect the sign of the interaction's coefficient to be negative and statistically significant. The empirical model is presented in Equation (2).

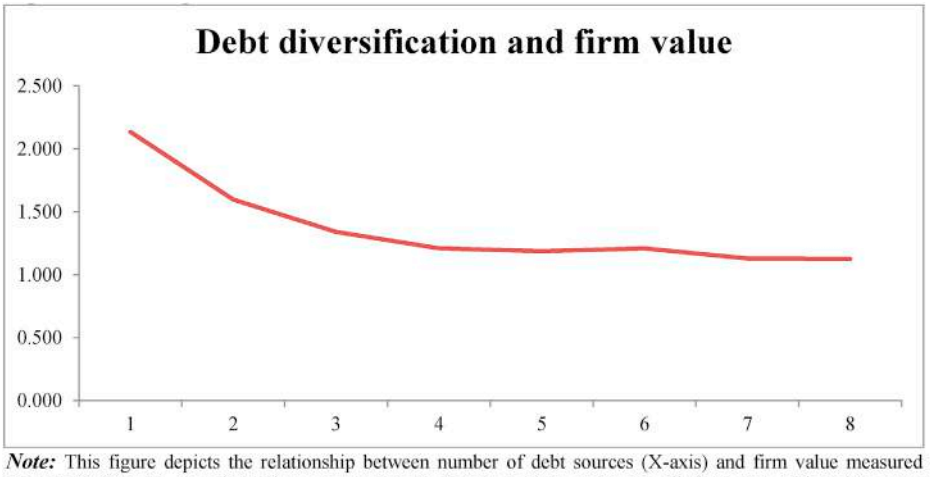
$$\text{Investment\_Ratio}_{it} = \alpha_i + \beta_1\ \text{Tobin's\_Q}_{it} + \beta_2\ \text{Cash\_Flow}_{it} + \beta_3\ \text{Debt\_Div}_{it} + \beta_4\ (\text{Cash\_Flow}^*\text{Debt\_Div})_{it} + \varepsilon_{it} \quad (2)$$

Where *Investment_Ratio* is the ratio of gross investments made in the fixed assets divided by the period's beginning net fixed assets. Gross investments are calculated as depreciation plus the change in net fixed assets. *Tobin's_Q* is measured by the market-to-book ratio, which captures a firm's investment opportunities. *Cash_Flow* is our measure of internal free cash flow and is calculated by subtracting interest, taxes and dividends from EBITDA (to arrive at free cash flow), and then dividing by beginning of the period net fixed assets. *Debt_Div* is our measure of diversification. The interaction variable ($Cash\_Flow^*Debt\_Div_{it}$) is the main variable of interest.

4. Results and discussion

The relationship between firm value and debt diversification is depicted in Fig. 1. Here, the number of debt sources used by the firms is measured by the X-axis and the market value (Tobin's Q) is reported on the Y-axis. From this graph we observe that as debt diversification increases, firm value decreases – i.e., a negative relationship is apparent. The most dramatic reduction in the firm value is observed in the early stages of debt diversification, while beyond four debt sources, the impact is nearly insignificant. The same information is tabulated in Table 3.

Next, we classified companies into eight groups based on the number of debt sources utilized. These groups form the columns in



Note: This figure depicts the relationship between number of debt sources (X-axis) and firm value measured by Tobin's Q (Y-axis). For simplicity, we truncate the X-axis at eight and graph all firms that utilize eight *or more* distinct debt sources at this truncated final point on the X-axis.

Fig. 1. Relationship between debt diversification and firm value
Note: This figure depicts the relationship between number of debt sources (X-axis) and firm value measured by Tobin's Q (Y-axis). For simplicity, we truncate the X-axis at eight and graph all firms that utilize eight *or more* distinct debt sources at this truncated final point on the X-axis.

Table 3, beginning with the group of firms that only had one debt source in the first column of the table and continuing to the final group of firms which used eight or more distinct debt sources in the far righthand column. Statistical tests (t-tests) were used to compare the differences in the mean firm value (Tobin's Q, displayed in the bottom row of Table 3) across these eight groups. The test results (untabulated) indicate that the difference between the average firm value within a given group compared to the group immediately preceding it (which contained firms utilizing one less debt source) is significant for the first five groups. In other words, the mean firm value for the group of firms utilizing two debt sources differs significantly from the mean firm value within the group of firms that utilize three debt sources, and so forth, up until the comparison of the groups with six versus five debt sources, at which point the difference in firm value are no longer significant. Moreover, the mean firm value for the groups of firms with one, two, and three debt sources each differs significantly from the mean firm value of the groups of firms utilizing seven and eight or more debt sources. These univariate results suggest that a negative relation exists between firm value and debt diversification, with the negative effect diminishing once firms have accessed five debt sources – consistent with the inferences drawn from Fig. 1.

Incremental analysis was conducted to examine how firm value changes with changes in the level of debt diversification. The results are presented visually in Fig. 2 and tabulated in Table 4. The X-axis of Fig. 2 and the first column of Table 4 record the change in debt diversification (i.e., the change in the number of debt sources utilized) year-over-year. A zero value indicates no change in the number of debt sources used in the current year relative to the previous year. Positive values denote an increase in the number of debt sources year-over-year and negative values denote a year-over-year decrease. The Y-axis of Fig. 2 and the far-right column of Table 4 record the mean change in firm value (measured by Tobin's Q) for a given change in debt diversification (The middle column of Table 4 reports the number of firms experiencing a given change in the level of debt sources utilized.). In both the figure and the table, negative changes in debt diversification are associated with positive changes in firm value, and vice-versa. Untabulated t-tests indicate that all of the changes in firm value associated with a change in debt diversification are statistically significantly different from zero. These results support the earlier evidence of a negative relationship presented in Table 3 and Fig. 1.

Though these preliminary results provide support for the free rider hypothesis, the impact of other variables on firm value has not been controlled for in these tests. Therefore, we conduct multivariate regression analysis to examine the marginal impact of debt diversification on firm value.

4.1. Debt diversification and firm value

The financial constraints and the agency costs arguments predict a positive impact of debt diversification on firm value, while the free rider hypothesis predicts a negative relationship. To examine these conflicting hypotheses, we regress firm value on *Debt_Div* while incorporating controls in the analysis. Table 5 presents the results.

In column (1) of Table 5, which reports the full sample analysis, the coefficient of debt diversification (*Debt_Div*) is negative and significant at the 1% level. This indicates that as the number of debt sources increases, there is a reduction in firm value, supporting free rider hypothesis. Columns (2) and (3) present results for the same regression conducted separately for large and small firm subsamples, which were created via a median split based on each sample year's median value of firm size. We again observe a significant, negative effect of debt diversification on firm value among both large and small firms. These results support H1, which predicts that debt diversification impacts firm value, and are consistent with the free rider argument.

If there is a consistent negative relationship between debt diversification and firm value, then the same association should be observed on an incremental basis as well, as predicted in H2. Thus, a change in the *Debt_Div* is expected to be accompanied with a corresponding, but opposite change in firm value. To test this, we conduct incremental regression analysis, regressing changes in firm value on the changes in the number of debt sources. The results are presented in Table 6.

Consistent with the results presented in Table 5, the coefficient of *Delta_Debt_Div* is negative and significant for the full sample (column (1) of Table 6), as well as for the small and large firm subsamples in columns (2) and (3). These results suggest that the negative association is observed not only in the cross-section but also in the time dimension. Therefore, when firms access debt from an additional, distinct source, firm value declines. This finding supports H2 and provides further evidence consistent with the notion of a free rider effect.

While the findings thus far support the free rider hypothesis, to reject the financial constraints and agency hypotheses conclusively, we perform additional analyses as reported in the following sections.

4.1.1. Investment cash flow sensitivity

Though the results presented in Tables 5 and 6 do not appear to support the financial constraints hypothesis, they are insufficient to confidently reject the hypothesis. Debt diversification might decrease the financial constraints faced by firms; however, such a positive

Table 3
Mean firm value among debt diversification groups.

Groups based on *Debt_Div*	1	2	3	4	5	6	7	8+
N	6663	8552	7830	5477	2909	1260	474	146
Mean *Tobin's_Q*	2.134	1.597	1.340	1.209	1.187	1.209	1.128	1.126

Note: For this table, we classified firms into eight groups based on the number of debt sources utilized (that is, based on the *Debt_Div* variable); we combined firms with eight or more distinct debt sources into one group, labelled "8+." The number of firms in each group and the mean *Tobin's_Q* (the ratio of the market value of the firm to its book value) for each group are reported.

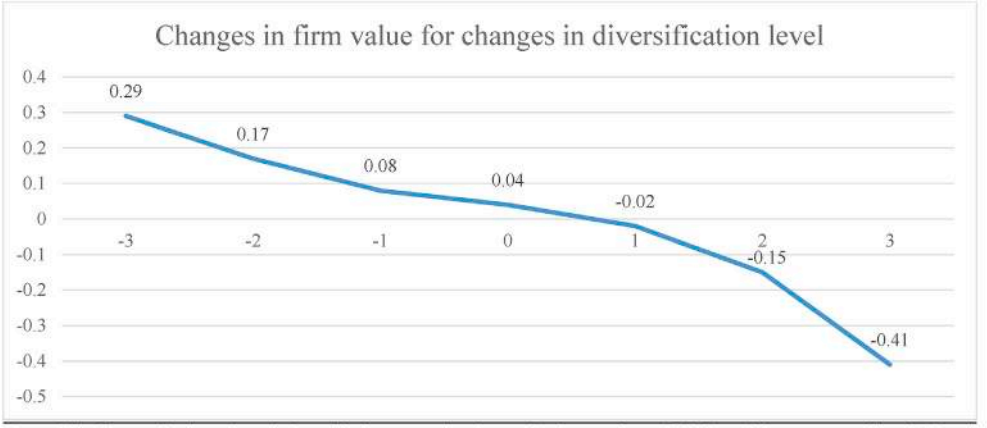


Fig. 2. Change in firm value for a given change in debt diversification.
Note: This figure displays the relationship between the change in the number of distinct debt sources utilized (X-axis) and the corresponding mean change in firm value (Y-axis; measured by Tobin's Q).

Table 4
Changes in debt diversification and firm value.

Change in *Debt_Div*	N	Mean Change in *Tobin's_Q*
−3	133	0.29***
−2	912	0.17***
−1	5212	0.08***
0	17281	0.04***
1	4369	−0.02***
2	667	−0.15***
3	73	−0.41***

Note: This table displays information related to the year-on-year change in the number of distinct types of debt sources utilized by a firm (in the far-left column) and the corresponding mean change in firm value (in the far-right column). Observations are classified depending on the firm's year-on-year change in *Debt_Div* (that is, depending on the increase or decrease in how many distinct debt sources a firm utilized in the current year relative to the prior year). The number of observations classified into a particular change in *Debt_Div* group is reported under "N" in the middle column, and the average change in *Tobin's_Q* for these groups is also displayed in the far-right column. Variable definitions: *Tobin's_Q* is the ratio of the market value of the firm to its book value, and *Debt_Div* is the number of distinct types of debt sources against which a firm had an outstanding balance at the financial year end.

effect could be overshadowed by the negative impact of the free rider problem. Therefore, we cannot conclusively reject the financial constraints hypothesis based solely on the results presented in Tables 5 and 6 Hence, we test the financial constraints hypothesis (H3) using the investment cash flow sensitivity model as suggested by Fazzari et al. (1988). An insignificant impact of debt diversification on the financial constraints faced by firms, especially small companies, would provide the additional evidence needed to reject the hypothesis.

Fazzari et al. (1988) argue that firm investments are sensitive to their internal cash flows if firms experience constraints in accessing external financing. The financial constraints argument predicts that firms with diversified sources of debt should experience less funding constraints and, therefore, the sensitivity of these firms' investments to their internal cash flow should be lower than for firms without diversified debt. We introduce into our model an interaction term between the cash flow variable and the debt diversification variable ($Cash\_Flow*Debt\_Div_{it}$), which estimates a differential slope coefficient. Observing a negative coefficient for this interaction term would provide support for the financial constraints hypothesis. To probe further, we divide our sample into small and large firm subsamples based on the yearly median firm size. If firms face significant financial constraints and debt diversification reduces these constraints, then the interaction's coefficient should be negative at least for small firms as they are traditionally considered to be more financially constrained (Rajan & Zingales, 1995). Table 7 reports the results.

The debt diversification variable (*Debt_Div*) has a positive coefficient for the full sample as well as for the large and small firm subsamples in Table 7, implying that the investment ratio increases with debt diversification; however, their significance is statistically weak. The cash flow coefficient is positive and significant, which is in keeping with the results of Fazzari et al. (1988). The variable of interest in this analysis is the interaction term ($Cash\_Flow*Debt\_Div_{it}$); its coefficient is statistically insignificant in all of the regressions, including that for small firms. Thus, debt diversification does not have a significant impact on the financial constraints faced by the

Table 5
Impact of debt diversification on Tobin's Q.

Variables	Full Sample	Small Firms	Large Firms
	Tobin's_Q	*Tobin's_Q*	*Tobin's_Q*
	(1)	(2)	(3)
Debt_Div	−0.045***	−0.060*	−0.041***
	(-3.116)	(-1.807)	(-2.685)
Firm_Size	0.080***	0.065	0.092***
	(2.783)	(1.328)	(2.763)
Dividends	27.913***	15.381***	31.739***
	(6.561)	(3.893)	(5.951)
Growth	0.176***	0.127	0.219***
	(2.822)	(0.961)	(3.690)
R_D_Ratio	10.852**	2.324	22.100***
	(2.442)	(1.072)	(3.282)
MLev	−0.552***	−0.663***	−0.475***
	(-5.182)	(-3.841)	(-3.505)
Constant	0.609***	0.918***	0.369
	(3.142)	(3.341)	(1.469)
No. of Observations	27,043	9087	17,956
R-squared	0.087	0.028	0.154
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes

Note: This table reports the multivariate regression results testing the impact of debt diversification on firm value for the full sample, as well as for small and large firm subsamples. Dependent variable: *Tobin's_Q*, which is the ratio of the market value of the firm to its book value. Independent variables: *Debt_Div* is the number of distinct types of debt sources against which a firm had an outstanding balance at the financial year end, *Firm_Size* is the log of firm sales, *Dividends* is the ratio of dividends paid to total assets, *Growth* is the annual growth rate in total assets, *R_D_Ratio* is the ratio of research and development expenditures to total assets, and *MLev* is the lagged market leverage (calculated as the prior year's ratio of the book value of debt to the sum of the market value of the firm's equity and the book value of its debts). The coefficients are estimated using the fixed effects estimator. The t-values calculated from heteroscedasticity-adjusted robust standard errors are given in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 6
Incremental analysis of the relationship between debt diversification and firm value.

Variables	Full Sample	Small Firms	Large Firms
	Delta_Tobin's_Q	*Delta_Tobin's_Q*	*Delta_Tobin's_Q*
	(1)	(2)	(3)
Delta_Debt_Div	−0.038***	−0.023*	−0.043***
	(-3.983)	(-1.672)	(-3.686)
Delta_Firm_Size	0.068***	0.009	0.118***
	(2.969)	(0.264)	(3.798)
Delta_Dividends	13.588***	14.348***	13.091***
	(6.385)	(3.271)	(5.509)
Delta_Growth	−0.049	−0.052	−0.050
	(-1.615)	(-0.919)	(-1.423)
Delta_R_D_Ratio	2.335	−1.552	10.544
	(0.603)	(-0.434)	(1.528)
Delta_MLev	0.095	0.034	0.102
	(1.541)	(0.287)	(1.468)
Constant	−0.069	−0.094**	−0.068
	(-1.585)	(-2.261)	(-1.159)
No. of Observations	23,361	7349	16,012
R-squared	0.094	0.058	0.117
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes

Note: Table 6 displays the regression results testing the impact of incremental changes in debt diversification on the change in firm value among the full sample, as well as among small and large firm subsamples. All variables are in the year-over-year change (delta) format. *Tobin's_Q*, is the ratio of the market value of the firm to its book value. *Debt_Div* is the number of distinct types of debt sources against which a firm had an outstanding balance at the financial year end, *Firm_Size* is the log of firm sales, *Dividends* is the ratio of dividends paid to total assets, *Growth* is the annual growth rate in total assets, *R_D_Ratio* is the ratio of research and development expenditures to total assets, and *MLev* is the lagged market leverage (calculated as the prior year's ratio of the book value of debt to the sum of the market value of the firm's equity and the book value of its debts). The coefficients are estimated using the fixed effects estimator. The t-values calculated from heteroscedasticity-adjusted robust standard errors are given in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

firms, and H3 (the financial constraints hypothesis) is rejected.

4.1.2. Free cash flow analysis

Again, the results presented in Tables 5 and 6 are, on their own, insufficient to reject the efficient monitoring hypothesis conclusively because of the confounding impact of agency costs. Therefore, in this section, we examine debt diversification's effect while considering Jensen's (1986) concept of the free cash flow problem. Jensen (1986) argues that firms with higher free cash flows face a higher degree of agency problems compared to firms with lower free cash flows. If debt diversification has a negative impact on agency costs, then that negative impact should be especially apparent in firms that are expected to have greater agency problems (i.e., firms with greater free cash flows). Therefore, the monitoring hypothesis predicts that for firms with higher cash flows, debt diversification should have a positive impact on firm value.

To test this hypothesis, we divide our sample into high and low agency cost firm subsamples based on the yearly median value of free cash flows. Observations with free cash flows greater than the median free cash flow for the corresponding year are classified as belonging to the high agency cost firm subsample; similarly, observations with less than the corresponding year's median free cash flow are grouped into the low agency cost firm subsample. We then estimate the coefficients separately for low and high agency cost firm subsamples. The monitoring hypothesis predicts a positive sign for the *Debt_Div* coefficient, at least for high agency cost firms. The results are presented in Table 8.

Contrary to the prediction of the monitoring hypothesis, the coefficient of *Debt_Div* is negative and significant for the full sample and, importantly, for the high cash flow firm subsample. The negative effect of debt diversification on the firm value of high free cash flow firms in column (3) leads us to conclusively reject the monitoring hypothesis. Never-the-less, we provide additional evidence in support of the free rider hypothesis in the following section.

4.1.3. Group affiliation analysis

To provide further evidence for the free rider hypothesis, we categorize our sample firms into group-affiliated firms and standalone firms. The free rider hypothesis predicts that the negative impact of debt diversification on the firm value should be greater for firms with greater agency problems. In the Indian context, group-affiliated firms are exposed to principal-principal agency costs in addition to principal-agent agency costs (Singla et al., 2014). Therefore, the agency problem is greater for the group-affiliated firms relative to standalone firms, which are exposed only to the principal-agent type of agency conflicts. We exploit this difference to conduct further tests of our hypotheses. While the free rider hypothesis predicts that the *negative* impact of debt diversification on firm value should be *greater* for group-affiliated firms, the efficient monitoring hypothesis predicts a *greater positive* impact on the group firms. To examine this, we estimate the coefficients of Equation (1) separately for group and standalone firms, as shown in Table 9.

The results for the analysis of the group-affiliated firms are presented in column (2) while that of standalone firms are presented in column (3). The *Debt_Div* coefficient is negative and significant for group firms and is insignificant for standalone firms. Therefore, the

Table 7
Investment cash flow sensitivity analysis.

Variables	Full Sample	Small Firms	Large Firms
	Investment_Ratio	*Investment_Ratio*	*Investment_Ratio*
	(1)	(2)	(3)
Tobin's_Q	0.003	0.001	0.003
	(0.002)	(0.003)	(0.002)
Debt_Div	0.007*	0.012*	0.007*
	(0.004)	(0.007)	(0.004)
Cash_Flow	0.164***	0.149***	0.209***
	(0.018)	(0.029)	(0.026)
*Cash_Flow*Debt_Div*$_{it}$	0.005	−0.006	0.001
	(0.007)	(0.013)	(0.008)
Intercept	0.151***	0.108***	0.158***
	(0.016)	(0.027)	(0.020)
No. of Observations	29,803	10,808	18,995
R-squared	0.075	0.052	0.086
F-statistic	44.910	10.780	39.320
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes

Note: In this table, results are presented for the test of the financial constraints hypothesis (H3) using the investment cash flow sensitivity model of Fazzari et al. (1988). The model is estimated for the full sample, as well as for small and large firm subsamples. Dependent variable: *Investment_Ratio,* which is the gross investment ratio (calculated as the change in net fixed assets plus depreciation divided by the beginning period net fixed assets). Independent variables: *Tobin's_Q* is the ratio of the market value of the firm to its book value, *Debt_Div* is the number of distinct types of debt sources against which a firm had an outstanding balance at the financial year end, *Cash_Flow* is calculated by subtracting interest, taxes and dividends from EBITDA (to arrive at free cash flow) and then dividing by the beginning of the period net fixed assets, and *Cash_Flow*Debt_Div* is the product of the *Debt_Div* and the *Cash_Flow* variables. The coefficients are estimated using the fixed effects estimator. The t-values calculated from heteroscedasticity-adjusted robust standard errors are given in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 8
Free cash flow analysis.

Variables	Full Sample	High Agency Cost Firm Subsample	Low Agency Cost Firm Subsample
	Tobin's_Q	*Tobin's_Q*	*Tobin's_Q*
	(1)	(2)	(3)
Debt_Div	−0.045***	−0.092***	0.020
	(-3.116)	(-3.949)	(1.230)
Firm_Size	0.080***	0.193***	−0.095**
	(2.783)	(3.160)	(-2.564)
Dividends	27.913***	30.829***	23.910***
	(6.561)	(4.775)	(4.319)
Growth	0.176***	0.270***	−0.212***
	(2.822)	(3.063)	(-2.685)
R_D_Ratio	10.852**	8.294	5.247
	(2.442)	(1.411)	(0.688)
MLev	−0.552***	−0.530***	−0.314**
	(-5.182)	(-3.337)	(-2.111)
Constant	0.609***	0.003	1.317***
	(3.142)	(0.010)	(6.196)
No. of Observations	27,043	14,419	12,624
R-squared	0.087	0.127	0.036
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes

Note: In this table, we examine the efficient monitoring hypothesis by we testing debt diversification's effect on firm value among firms that are predicted to have high versus low agency costs (Jensen, 1986). Firm-year observations with greater than the sample's median value of free cash flow (which is profit after tax plus depreciation minus dividends scaled by the total assets) for a given year are included in the high agency cost subsample, while those with less than the yearly median value of free cash flow classified as belonging to the low agency cost firm subsample. Dependent variable: *Tobin's_Q*, which is the ratio of the market value of the firm to its book value. Independent variables: *Debt_Div* is the number of distinct types of debt sources against which a firm had an outstanding balance at the financial year end, *Firm_Size* is the log of firm sales, *Dividends* is the ratio of dividends paid to total assets, *Growth* is the annual growth rate in total assets, *R_D_Ratio* is the ratio of research and development expenditures to total assets, and *MLev* is the lagged market leverage (calculated as the prior year's ratio of the book value of debt to the sum of the market value of the firm's equity and the book value of its debts). The t-values calculated from heteroscedasticity-adjusted robust standard errors are given in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

negative impact of debt diversification on firm value observed in Table 5 is driven primarily by its impact on group-affiliated firms. This result provides additional support for the free rider hypothesis, which posits that when firms use diversified debt sources, the efficiency of monitoring declines and this results in greater agency costs and decreased firm value.

4.2. Debt diversification and agency costs and firm performance

The above analyses are based on the implicit assumption that the free rider problem associated with debt diversification increases agency costs due to less effective monitoring, resulting in lower firm values. In the following section, we test this assumption using the asset turnover ratio (*ATR*[10]) as an indirect measure of agency costs as suggested by Ang et al. (2000). Since this ratio is negatively associated with agency costs, firms with diversified debt sources are expected to have a lower turnover ratio compared to that of firms with fewer debt sources. To examine this, we regress the asset turnover ratio on *Debt_Div* and expect a negative coefficient. Further, to check the robustness of the results, we divide our sample into various subgroups based on firm size and group affiliation and re-estimate the coefficients. If the negative association observed between debt diversification, firm value, and performance is due to the free rider problem, then we should observe a negative relationship between asset turnover ratio and debt diversification for all firms irrespective of their size and affiliation. The results are presented in Table 10.

Consistent with our expectation, the *Debt_Div* coefficient in the full sample analysis, presented in column (1), is negative and significant, implying that firms with diversified debt sources turn their assets over at a lower rate than the firms with fewer debt sources. This result is observed for all firms irrespective of their size and group affiliation (see columns (2) through (5) of Table 10). Thus, the analysis supports the argument that debt diversification indeed has a positive, dampening impact on the agency costs of firms. From this, we may conclude that the negative impact of debt diversification on firm value flows from the free rider problem inherent in accessing multiple debt sources.

In the above analysis, we examined the response of markets to debt diversification, as reflected in Tobin's Q. Market responses should be closely correlated with the accounting performance of the firm. If the free rider hypothesis holds true for our sample, then the increasing agency costs should be detrimental to the accounting performance of the firms in the absence of effective monitoring. Therefore, we also examine the impact of debt diversification on an accounting measure of performance – return on assets (*ROA*). We

[10] The asset turnover ratio, *ATR*, equals sales divided by total assets.

Table 9
Impact of debt diversification on the value of group-affiliated firms.

Variables	Full Sample	Group-affiliated Firms	Standalone Firms
	Tobin's_Q	Tobin's_Q	Tobin's_Q
	(1)	(2)	(3)
Debt_Div	−0.045***	−0.062***	−0.027
	(-3.116)	(-2.740)	(-1.551)
Firm_Size	0.080***	0.105**	0.058
	(2.783)	(2.228)	(1.586)
Dividends	27.913***	28.746***	27.290***
	(6.561)	(3.987)	(5.949)
Growth	0.176***	0.176*	0.191**
	(2.822)	(1.679)	(2.477)
R_D_Ratio	10.852**	25.252***	4.198
	(2.442)	(3.133)	(1.350)
MLev	−0.552***	−0.346*	−0.683***
	(-5.182)	(-1.755)	(-5.745)
Constant	0.609***	0.356	0.747***
	(3.142)	(0.957)	(3.454)
No. of Observations	27,043	11,178	15,865
R-squared	0.087	0.111	0.073
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes

Note: Table 9 reports the results for estimating Equation (1) separately for standalone firms versus firms affiliated with business groups. Group-affiliated firms face greater potential agency problems than standalone firms (Singla et al., 2014). Thus, this division permits further examination of H1 since the efficient monitoring hypothesis predicts a *greater positive* impact of debt diversification on firm value among group-affiliated firms, while the free rider hypothesis predicts a *greater negative* impact among group firms. Dependent variable: *Tobin's_Q*, which is the ratio of the market value of the firm to its book value. Independent variables: *Debt_Div* is the number of distinct types of debt sources against which a firm had an outstanding balance at the financial year end, *Firm_Size* is the log of firm sales, *Dividends* is the ratio of dividends paid to total assets, *Growth* is the annual growth rate in total assets, *R_D_Ratio* is the ratio of research and development expenditures to total assets, and *MLev* is the lagged market leverage (calculated as the prior year's ratio of the book value of debt to the sum of the market value of the firm's equity and the book value of its debts). The coefficients are estimated using the fixed effects estimator. The t-values calculated from heteroscedasticity-adjusted robust standard errors are given in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 10
Impact of debt diversification on the asset turnover ratio.

Variables	Full Sample	Small firms	Large firms	Group-affiliated firms	Standalone firms
	ATR	*ATR*	*ATR*	*ATR*	*ATR*
	(1)	(2)	(3)	(4)	(5)
Debt_Div	−0.050***	−0.048***	−0.057***	−0.055**	−0.047***
	(-4.145)	(-6.140)	(-3.295)	(-2.269)	(-7.846)
Firm_Size	0.357***	0.405***	0.349***	0.380***	0.344***
	(9.129)	(10.607)	(5.481)	(3.966)	(12.729)
Dividends	3.514***	2.085***	3.586***	3.577***	3.340***
	(6.381)	(2.985)	(5.645)	(3.642)	(6.154)
Growth	−0.184***	−0.232***	−0.188***	−0.167***	−0.191***
	(-9.066)	(-6.197)	(-8.062)	(-6.684)	(-6.962)
R_D_Ratio	1.244**	0.339	2.714**	1.548	1.024*
	(2.103)	(0.592)	(2.279)	(0.948)	(1.930)
MLev	−0.123***	−0.069	−0.157***	−0.187***	−0.086**
	(-4.328)	(-1.615)	(-4.116)	(-4.093)	(-2.391)
Constant	−1.051***	−0.996***	−1.110***	−1.527**	−0.752***
	(-4.712)	(-5.469)	(-2.671)	(-2.438)	(-4.778)
No. of Observations	27,639	9536	18,103	11,338	16,301
R-squared	0.125	0.264	0.096	0.088	0.189
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes

Note: This table presents regression results testing the impact of debt diversification on the asset turnover ratio (which is negatively related to agency costs) among the full sample, as well as among small firms, large firms, group-affiliated firms, and standalone firms. Dependent variable: *ATR* is the asset turnover ratio, calculated as sales divided by total assets. Independent variables: *Debt_Div* is the number of distinct types of debt sources against which a firm had an outstanding balance at the financial year end, *Firm_Size* is the log of firm sales, *Dividends* is the ratio of dividends paid to total assets, *Growth* is the annual growth rate in total assets, *R_D_Ratio* is the ratio of research and development expenditures to total assets, and *MLev* is the lagged market leverage (calculated as the prior year's ratio of the book value of debt to the sum of the market value of the firm's equity and the book value of its debts). The coefficients are estimated using the fixed effects estimator. The t-values calculated from heteroscedasticity-adjusted robust standard errors are given in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

regress ROA against *Debt_Div* along with other control variables. Table 11 displays the results.

Consistent with the prediction of the free rider hypothesis, the coefficient of *Debt_Div* in the full sample analysis (column (1) of Table 11) is negative and significant at the 1% level. This implies that the negative impact of debt diversification on market value reflects its negative impact on firm accounting performance. In columns (2) and (3), the results for small and large firms are presented (observations were grouped according the yearly median firm size). Again, as expected, the impact is negative for all firms irrespective of their size. These results provide additional support for the free rider problem when multiple lenders are accessed by borrowing firms.

5. Robustness checks

5.1. Alternate measure of debt diversification

The *Debt_Div* measure is a tally of the number of distinct debt sources from which firms have borrowed. However, it does not account for the relative importance of each source of debt in each firm's overall capital structure; in other words, it does not account for the dispersion of debt diversification. To account for the relative importance of debt sources, therefore, we use a normalized variation of the Herfindahl-Hirschman Index[11] (*HHI*). We construct this measure as follows.

First, the sum of the squared shares of total borrowing represented by each of the individual debt components[12] is obtained by using Equation (3). Then by using Equation (4) we normalize our measure.

$$SS_{it} = \sum X^2{}_{it} \tag{3}$$

Where X^2_{it} is the squared proportion of each type of debt in a firm's total borrowing.

$$\text{HHI-Score}_{it} = \{SS_{it} - (1/11)\} / \{1 - (1/11)\} \tag{4}$$

Finally, for interpretational ease, we subtract the value obtained in Equation (4) from one so that the results resemble the *Debt_Div*

Table 11
Impact of debt diversification on ROA.

Variables	Full Sample	Small firms	Large firms
	ROA	*ROA*	*ROA*
	(1)	(2)	(3)
Debt_Div	−0.005***	−0.008***	−0.004***
	(-8.341)	(-5.498)	(-6.610)
Firm_Size	0.027***	0.029***	0.027***
	(18.319)	(13.495)	(13.208)
Dividends	2.096***	2.007***	2.106***
	(12.969)	(6.758)	(11.171)
Growth	0.043***	0.055***	0.034***
	(13.990)	(10.275)	(9.277)
R_D_Ratio	0.065	−0.271	0.477***
	(0.237)	(-0.773)	(2.844)
MLev	0.004	0.024***	−0.009
	(0.870)	(3.040)	(-1.542)
Constant	−0.095***	−0.085***	−0.099***
	(-9.548)	(-7.035)	(-6.679)
No. of Observations	27,596	9507	18,089
R-squared	0.196	0.159	0.230
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes

Note: Table 11 reports regression results testing the impact of debt diversification on an accounting measure of performance – return on assets – for the full sample, as well as for small and large firm subsamples. Dependent variable: *ROA* is return on assets, calculated as the ratio of EBIT (earnings before interest and taxes) to total assets. Independent variables: *Debt_Div* is the number of distinct types of debt sources against which a firm had an outstanding balance at the financial year end, *Firm_Size* is the log of firm sales, *Dividends* is the ratio of dividends paid to total assets, *Growth* is the annual growth rate in total assets, *R_D_Ratio* is the ratio of research and development expenditures to total assets, and *MLev* is the lagged market leverage (calculated as the prior year's ratio of the book value of debt to the sum of the market value of the firm's equity and the book value of its debts). The coefficients are estimated using the fixed effects estimator. The t-values calculated from heteroscedasticity-adjusted robust standard errors are given in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

[11] We calculate the Herfindahl-Hirschman Index for dispersion of borrowing rather than the traditional Index, which is found using squared market shares within an industry as a measure of market concentration in anti-trust assessments.

[12] Total borrowing is obtained by summing debt amounts from the eleven possible sources.

measure in that higher values represent greater debt diversification. The resulting measure (which we label *HHI*) has a range between 0 and 1 and is positively correlated with the *Debt_Div* variable. Zero represents the lowest level of debt diversification, meaning all of the firm's borrowing is from a single type of debt source. One represents the maximum level of diversification, with a firm borrowing equally across all eleven types of lenders. We re-estimate all the models presented previously in different tables using this measure. However, to conserve space we present only the results of the full sample analyses in Table 12.

In the regressions, coefficients may be interpreted similarly to previous tables, with a negative value indicating lower a valuation effect (when the dependent variable is Tobin's Q or the change in Tobin's Q), greater agency costs (when examining *ATR*, an inverse measure of agency costs), or lower accounting performance (when assessing *ROA*). The results utilizing the *HHI* alternative measure are qualitatively similar to those which were obtained by using the *Debt_Div* variable: greater diversification leads to (i) lower valuations (in Models I and II), consistent with free riding; (ii) lower asset turnover rates and thus greater implied agency costs (in Model III); and (iii) lower accounting performance (in Model IV). The untabulated results for the analyses of large and small firms, as well as of group-affiliated and standalone firms, remain qualitatively the same when using the *HHI* measure. Therefore, we conclude that the study's findings are robust to the use of an alternate measure of debt diversification.

5.2. Omitted variables and endogeneity

There is a possibility that our results are driven by omitted variables that are related to both the agency problem and debt diversification.[13] To examine the impact of any such omitted variables, we employ the methodology suggested by Oster (2017). Her key insight is that the covariance structure of the known control variables can be used to examine the impact of omitted variables on the coefficient estimate of the main independent variable. Using this logic, she provides a procedure to estimate the impact of omitted variables on the coefficient of interest. Using Oster's technique, we test whether any omitted variables make the impact of debt diversification on firm value insignificant or whether they change the direction of the impact.

The procedure involves comparing the change in the beta coefficient relative to changes in the R-squared value of the uncontrolled and controlled models. Using these as inputs, it calculates the bias-adjusted beta with the assumption that control variables and potential omitted variables can explain 100% of the variation in the dependent variable (i.e., the $R_{max} = 1$ assumption), and that omitted variables are at least as important as that of control variables (i.e., delta = 1). The values corresponding to this analysis are presented in Table 13. The model delta (0.035) suggests that omitted variables are positively correlated with the control variables. For these values, the estimated bias-adjusted coefficient is −1.09.

The difference in the magnitude of the controlled and bias-adjusted coefficients suggests that the omitted variables indeed have a significant impact on the magnitude of the coefficient estimate of *Debt_Div*. However, to check whether the bias makes the impact zero or not, Oster (2017) constructs an identified set of values for controlled beta and bias-adjusted beta and argues that if this identified set excludes zero from its range, then we may conclude that though the coefficient estimate is biased, the impact is still significant. Based on this procedure, we find that our identified set (−0.028 to −1.09) excludes zero from its range. These results suggest that:

1. The coefficient estimate of *Debt_Div* is biased because of omitted variables.
2. However, the bias only affects the magnitude of the coefficient and not the direction of the impact as both the controlled and bias-adjusted coefficients have the same sign.
3. Since the identified set excludes zero from its range, the null that the impact of *Debt_Div* is zero is rejected.

Additionally, Hener, Rainer, and Siedler (2016) and Oster (2017) argue that forming an identified set with $R_{max} = 1$ assumes that our model, with both included and omitted variables, is able to explain 100% of the variation in the dependent variable. Yet measurement errors make it impossible to satisfy this assumption in the empirical world. Therefore, they suggest using a new identified set, formed by (controlled β, β* ($R_{max} = 2.2R$, 1)), and checking whether it excludes zero from its range. The adjusted β for $R_{max} = 2.2R$ is −2.45. Following this approach, the identified set (−0.028, −2.45) continues to exclude zero from its range and yields exclusively negative coefficients. Therefore, from our analyses, we may conclude that though the omitted variables are biasing the coefficient estimate of the debt diversification variable, neither its significance nor its direction has been affected.

To address the omitted variable bias in the coefficient estimate and the potential for endogeneity issues, we use the instrumental variable two-stage least squares (2SLS) estimation. The main issue with this approach is that it is very difficult to find exogenous instrumental variables that are not directly related to firm value. The results of this analysis have to be interpreted keeping this limitation in mind. Drawing on the finance literature, we select firm tangibility (the ratio of net fixed assets to total assets) and non-debt tax shield (NDTS, the ratio of depreciation to profit before depreciation, interest, and taxes) as the instrumental variables as these are important determinants of a firm's debt policy (Rajan & Zingales, 1995; Titman & Wessels, 1988). In order to check for any relationship between tangibility or NDTS with firm value, we regress firm value on these variables along with other control variables and test the null that impact is zero. We find that the coefficients of both the tangibility and NDTS variables are not statistically significant in any of the models.[14] This confirms that the instrumental variables are not directly related to firm value.

To examine the relevance and validity of the instrumental variables and the appropriateness of the 2SLS procedure, we conduct three tests. The Durbin–Wu–Hausman specification test examines the appropriateness of the 2SLS estimator against OLS. The null of this test is

[13] We thank an anonymous referee for suggesting this robustness check.
[14] Results not reported for brevity.

Table 12
Results using the alternative *HHI* debt diversification measure.

Variables	Model I	Model II	Model III	Model IV
	Tobin's_Q	*Delta_Tobin's_Q*	*ATR*	*ROA*
HHI	−0.147**		−0.082***	−0.002*
	(-2.251)		(-3.706)	(-1.761)
Delta_HHI		−0.079*		
		(-1.694)		
Firm_Size	0.074**	−0.061***	0.312***	0.026***
	(2.548)	(-3.957)	(16.750)	(18.044)
Dividends	27.311***	16.719***	3.835***	2.155***
	(6.623)	(7.004)	(6.937)	(12.757)
Growth	0.179***	−0.124**	−0.182***	0.039***
	(2.856)	(-2.520)	(-9.437)	(13.451)
R_D_Ratio	12.011***	6.847**	1.518***	0.362***
	(2.823)	(2.434)	(2.777)	(2.904)
MLev	−0.599***	0.711***	−0.165***	−0.003
	(-5.779)	(11.242)	(-5.697)	(-0.776)
Constant	0.570***	−0.171	−0.887***	−0.102***
	(2.919)	(-1.600)	(-7.248)	(-10.501)
No. of Observations	26,755	26,451	27,338	27,271
R-squared	0.091	0.092	0.189	0.203
No. of Firms	2981	2959	3056	3050
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes

Note: Table 12 presents the full sample regression results testing the impact of debt diversification on firm value (Model I), on the asset turnover ratio (Model III), and on return on assets (Model IV), as well as the impact of incremental changes in debt diversification on the change in firm value (Model II) – all utilizing the alternative *HHI* measure of debt diversification. Dependent variables: *Tobin's_Q* is the ratio of the market value of the firm to its book value, *Delta_Tobin's_Q* is the year-on-year change in Tobin's Q, *ATR* is the asset turnover ratio (calculated as total sales divided by total assets), and *ROA* is return on assets (calculated as earnings before interest and taxes divided by total assets). Independent variables: *HHI* is the dispersion-adjusted measure of debt diversification computed by subtracting the *HHI-Score* (calculated following Eq. (4)) from one, *Firm_Size* is the log of firm sales, *Dividends* is the ratio of dividends paid to total assets, *Growth* is the annual growth rate in total assets, *R_D_Ratio* is the ratio of research and development expenditures to total assets, and *MLev* is the lagged market leverage (calculated as the prior year's ratio of the book value of debt to the sum of the market value of the firm's equity and the book value of its debts). For Model II, all independent variables are in delta format. The coefficients are estimated using the fixed effects estimator. The t-values calculated from heteroscedasticity-adjusted robust standard errors are given in parenthesis. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 13
Model inputs for omitted variables test.

Model Type	Coefficient	R-Squared
Uncontrolled	−0.160	0.010
Controlled	−0.028	0.168
Model Delta	0.035	

Note: This table presents the analysis investigating the effect of potential omitted variables. The uncontrolled model does not include any control variables, while the controlled model includes the control variables listed in Equation (1). The Oster (2017) procedure involves comparing the beta coefficients and R-squared values of the controlled and uncontrolled models to make a prediction about the impact of omitted variables on the relationship between the dependent variable and the main independent variable.

that OLS produces consistent estimates. Our data rejected this null at the 1% level, suggesting that 2SLS is appropriate. The correlation between endogenous variables and the instrumental variables (i.e., the relevance of the instruments) is tested using the Cragg-Donald Wald F-statistic and is compared with the Stock-Yogo weak ID test critical values. Lastly, we use the Sargan statistic to test the validity of the instrumental variables used. The values of these statistics and the corresponding critical values or probabilities are displayed in the bottom rows of Table 14.

In both of the models presented in Table 14, the tests support the relevancy and validity of the instrumental variables. Therefore, we proceed to use tangibility and NDTS as the instrumental variables. Therefore, we proceed to use tangibility and NDTS as instrumental variables, and re-estimate the coefficients for our model using the 2SLS procedure. In the first stage, we calculate predicted values of *Deb_Div* or *HHI* by regressing them on all of the control variables as well as tangibility and NDTS. In the second stage, we use the estimated values of debt diversification from the first stage as the main independent variable and run Equation (1); results from this second stage are presented in Table 14. The coefficients of the *Debt_Div/HHI* instrument remains negative and significant, thus confirming the negative impact of debt diversification on firm value observed in the previous analysis. Similar results (untabulated) were also observed for all other hypotheses and subsample analyses. Therefore, we may conclude that our results remain robust after

Table 14
IV-2SLS endogeneity analysis.

Variables	Model I	Model II
	Tobin's_Q	*Tobin's_Q*
Debt_Div	−0.346**	
	(-2.568)	
HHI		−2.436***
		(-3.040)
Firm_Size	0.147***	0.137***
	(4.172)	(5.581)
Dividends	38.054***	36.905***
	(25.840)	(30.887)
Growth	0.246***	0.167***
	(4.236)	(3.036)
R_D_Ratio	0.000***	0.000***
	(6.762)	(7.420)
MLev	−0.683***	−0.894***
	(-2.929)	(-6.977)
Constant	1.323***	1.283***
	(8.771)	(9.619)
No. of Observations	26,906	26,635
R-squared	0.151	0.122
Year Fixed Effects	Yes	Yes
Cragg-Donald Wald F-statistic	82.550	63.320
Stock-Yogo weak ID test critical value (10%)	19.930	19.930
Sargan Statistic	0.569	0.251
Probability of Sargan test	0.450	0.610

Note: Table 14 seeks to address the omitted variable bias in the coefficient estimate and the potential for endogeneity issues. Dependent variable: *Tobin's_Q* is the ratio of the market value of the firm to its book value. Independent variables: *Debt_Div* is the estimated number of distinct types of debt sources calculated in the first stage of the 2SLS procedure, *HHI* is the estimated dispersion-adjusted measure of debt diversification calculated in the first stage of the 2SLS procedure, *Firm_Size* is the log of firm sales, *Dividends* is the ratio of dividends paid to total assets, *Growth* is the annual growth rate in total assets, *R_D_Ratio* is the ratio of research and development expenditures to total assets, and *MLev* is the lagged market leverage (calculated as the prior year's ratio of the book value of debt to the sum of the market value of the firm's equity and the book value of its debts). The coefficients are estimated using the fixed effects estimator. The t-values calculated from heteroscedasticity-adjusted robust standard errors are given in parenthesis. ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

accounting for potential endogeneity issues.

6. Conclusions

Diversification of debt sources is prevalent among corporations worldwide. However, the impact of debt diversification on firm value has not been investigated in the extant literature. Our results reveal that such diversification practices actually decrease the value of firms due to less efficient monitoring by the creditors. While prior finance literature finds a positive role of debt in minimizing the agency costs of firms, we present evidence to the contrary: when firms have diversified debt sources, our analysis implies that agency costs increase, particularly among group-affiliated firms. Further, our findings suggest that diversification of debt does not appear to reduce firms' financial constraints, but instead results in a free rider problem among lenders that affects the agency costs of firms and their accounting performance. Clearly, more research is needed to understand the negative impact of debt on firm value, especially for different economic and institutional settings such as those found in emerging markets (Chen & Huang, 2014). Additionally, our study uses the agency framework to understand the relationship between debt diversification and firm value, but there can be other channels, such as potential cost of debt effects, through which diversification could affect value.

This study has an important implication for the policymakers: efforts to increase access to debt markets may not reduce firms' financial constraints – even among small firms – and could actually lead to erosion of firms' market values, especially that of group-affiliated firms. Therefore, policies which try to increase access to different debt sources should be evaluated carefully prior to their implementation. Finally, previous studies have shown a positive stock market response to new debt announcements; yet, in contrast, our incremental analysis documents the opposite valuation effect as new sources of borrowing are utilized by firms. Further research is needed to understand whether the positive response to additional borrowing remains true if the debt is raised through a new debt source that a firm has not previously accessed.

CRediT authorship contribution statement

Nemiraja Jadiyappa: Conceptualization, Formal analysis, Writing - original draft. **L. Emily Hickman:** Writing - review & editing. **Pavana Jyothi:** Writing - review & editing. **Narender Vunyale:** Methodology, Investigation. **Bhanu Sireesha:** Data curation,

Validation.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.iref.2020.02.002.

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