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CAPITAL STRUCTURE AND CORPORATE DIVERSIFICATION:

IS DEBT A PANACEA FOR THE DIVERSIFICATION DISCOUNT?

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Abstract

This study investigates the role of debt as an internal governance mechanism that can be employed by companies to curb agency conflicts and discourage managers from value-destroying diversification. Using a panel of U.S. firms, we find that leverage positively moderates the effect of diversification on a firm's value. We confirm that such an effect stems from the monitoring role of debt, which fosters efficiency in investments across segments and discourages cross-subsidization. Our investigation goes a step further by delving into the disciplinary role of debt and rationalizing certain scenarios that determine whether the effect of debt on the diversification-value relationship is stronger or weaker. We find such a moderating effect proves more beneficial for unrelated diversified companies and for firms with lower investment opportunities. However, the benefits of debt weaken in the presence of an alternative monitoring device (concentrated ownership), and when debt allocation becomes discretionary in highly diversified companies.

JEL classification: C36, D22, G32, L25

Keywords: corporate diversification, capital structure, agency theory, overinvestment, firm value.

1. INTRODUCTION

This study investigates the role played by debt in the relationship between diversification and value. Many prior studies furnish evidence of a value discount in diversified firms relative to their unisegment counterparts (Berger and Ofek, 1995; Servaes, 1996; Denis, Denis and Yost, 2002; Hoechle *et al.*, 2012; Kuppuswamy and Villalonga, 2016).[1] The extant research associates the diversification discount with managerial agency costs (Denis, Denis and Sarin, 1997; Amihud and Lev, 1999; Jiraporn *et al.*, 2006; Hoechle *et al.*, 2012; Fuente and Velasco, 2015) because even in the absence of any value-enhancing effect, this strategy may still appeal to managers who wish to pursue their own self-interests.

By expanding the firm's number of businesses, managers obtain 'empire-building' benefits and decrease their employment risk (Amihud and Lev, 1981; Jensen, 1986; Stulz, 1990), amplify their power in terms of increased amounts of free cash flows for discretionary use (Jensen, 1986; Stulz, 1990), gain access to higher compensation (Murphy, 1999), and increase their prestige and visibility in the labour market (Denis *et al.*, 1997). As a result of these potential private benefits, managers could be tempted to overinvest in additional businesses, which is the driving force behind strategies that perform poorly. This problem becomes particularly acute in the case of diversified companies, since certain mechanisms such as cross-subsidization between divisions or the coinsurance effect increase the availability of funding, which can exacerbate this inefficient investment behaviour.

Some prior studies have analysed the role of corporate governance in shaping a firm's ability to deal with agency costs such as these that are embedded in corporate diversification.

[1] The diversification discount is by no means free from controversy. For instance, Campa and Kedia (2002) and Villalonga (2004a) present counterevidence reporting a diversification premium; Palich, Cardinal, and Miller (2000) find a nonlinear effect of diversification on a firm's value; and Villalonga (2004b) reports that there is no statistically significant relationship. This mix of conflicting evidence has served to highlight the complexity of this strategy and focus the analysis on a number of contextual factors that may result in diversification impacting each firm's performance differently (e.g. Fauver, Houston, and Naranjo, 2003; Santaló and Becerra, 2008).

However, most research has focused on the impact of ownership structure and the board of directors (e.g. Denis *et al.*, 1997; Amihud and Lev, 1999; Chen and Chen, 2006; Jiraporn *et al.*, 2006; and Hoechle *et al.*, 2012). Far less attention has been paid to examining the governance role of debt (O'Brien *et al.*, 2014), a gap we aim to help bridge. In particular, our investigation adopts an agency-based view to focus on how debt might serve as a corporate governance mechanism that affects the value outcomes of diversification.

Debt is seen to curb potential agency conflicts, since interest and principal payments reduce the free cash flow available to managers for discretionary spending (Jensen, 1986), and help discipline managers (Sutton and Callahan, 1987) as well as reduce information asymmetries (Ross, 1977). Prior evidence such as Duan and Li (2006) suggests the diversification discount might be explained by the different distribution of diversified firms relative to focused firms over leverage. However, to the best of our knowledge, only two earlier works (Ruland and Zhou, 2005; Park and Jang, 2013) provide evidence concerning the monitoring role of debt in diversification. Park and Jang (2013) focus on diversification in a single sector, the restaurant industry. They find that a greater amount of debt reduces free cash flow and that the latter has a negative impact on performance. As a result, debt may indirectly improve a firm's performance. Ruland and Zhou (2005) test for the moderating influence of debt in the effect of diversification on a firm's excess value and report that the value of diversified companies increases with leverage.[2]

[2] Another stream of literature has shed light on the relationship between debt and the value of diversification from the perspective of the leverage effect on a firm's equity risk (the risk-reducing hypothesis). Drawing on the equity-call model (Black and Scholes, 1973), studies such as Mansi and Reeb (2002), Glaser and Müller (2010), and Ammann, Hoechle, and Schmid (2012) contend that diversification decreases a firm's equity value by transferring wealth from shareholders to bondholders. By lowering the risk of a firm's portfolio of assets, diversification decreases its equity value, even if it does not modify a firm's total value. Despite its widely acknowledged contribution, this analysis leaves open two issues that might benefit from further research. First, while the risk-reducing hypothesis is understandable for highly leveraged firms, it is not so obvious for low and moderately leveraged firms for whom default is unlikely. Therefore, debt is less sensitive to further risk reductions from diversification. Second, it only considers the conflict of interest between shareholders and bondholders, while neglecting important issues related to the conflict between shareholders and managers.

Our research differs from those previous studies and contributes to prior literature on several fronts. First, after confirming that leverage reduces the diversification discount, our study extends prior research by further describing the firm diversification contextual factors under which the disciplining effect of debt might prove more powerful. Our results reveal that debt improves a firm's diversification performance to a greater extent in unrelated diversified firms and companies with low growth opportunities, which is consistent with the idea that the agency costs of free cash flow such as overinvestment, are more acute in those companies.

Second, we investigate in depth whether the relationship between leverage and the diversification discount is due to the disciplinary role of debt. Since one manifestation of agency costs in diversified firms is cross-subsidization from profitable segments to poorly performing ones, we examine whether leverage reduces such inefficient investments. Based on Rajan, Servaes, and Zingales' (2000) methodology, our results confirm that debt fosters efficiency in investments across segments, increasing (reducing) them in better (worse) performing ones. Furthermore, we find that the beneficial role of debt on the diversification-value relationship weakens in the presence of an alternative monitoring device such as concentrated ownership. Such evidence supports the idea that one channel through which debt improves the value of diversification is by alleviating managerial agency costs.

Third, we help reconcile the conflicting evidence in prior literature regarding the sign of the effect of the interaction between leverage and diversification on a firm's excess value. Ahn, Denis, and Denis (2006) analyse investment decisions within diversified firms and find that although the disciplinary role of debt can be valuable in firms with poor growth opportunities, managerial discretion in allocating debt service among segments in highly diversified companies can offset part of this value. Based on this, we examine whether the association between leverage and the diversification discount changes depending on the extent of diversification. We find that the positive moderating effect of leverage is stronger (weaker) for less (more) diversified firms. This finding supports the notion that leverage shapes the diversification-value relationship in a heterogeneous way across firms, thereby identifying one possible source of the prior mixed evidence.

Fourth, additional contributions emerge from our empirical strategy. We provide evidence on a post-1998 U.S. sample, when SFAS 131 was implemented. This is particularly insightful given our research purposes related to the agency costs of diversification. SFAS 131 enhances stock price informativeness (Ettredge *et al.*, 2005) and provides for greater disclosure of segment data and cross-segment transfers (Berger and Hann, 2003), which could reveal underlying agency problems to a greater extent (Ammann *et al.*, 2012). Moreover, we complement our estimation results with an instrumental variables estimation procedure to mitigate endogeneity concerns. By using the two-step generalized method of moments (GMM) system estimator, we are able to deal simultaneously with several sources of endogeneity in the diversification-value relationship, such as omitted variables bias from self-selection (Bascle, 2008) and simultaneous causality (Abdallah, Goergen and O'Sullivan, 2015).

The remainder of the paper proceeds as follows. Section 2 presents a review of the related literature and develops our study hypotheses. Section 3 describes our dataset, variables, and model. Section 4 analyses our main empirical findings, and Section 5 presents additional robustness analyses. Section 6 discusses the main implications of our research and concludes.

2. THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

2.1. The disciplinary role of debt and the diversification-value relationship

Debt financing is widely considered a key device for palliating overinvestment (Harris and Raviv, 1990). In the case of diversification, debt may be especially appropriate as a control for managerial agency costs by means of the leverage effect on incentives, monitoring, and signalling.

First, debt is considered to curb potential conflicts between managers and shareholders by forcing managers to pay out future cash flows in the form of interest and principal payments (Jensen, 1986; Myers, 2001). Should the firm default, managers will lose their jobs, perquisites, and reputation (Sutton and Callahan, 1987). As a result, debt serves as an efficient disciplining device that deters managers from implementing value-destroying diversification. Before diversifying, debt encourages managers to discard low-return projects that are not expected to generate sufficient cash flows to meet debt payments. After diversifying, debt reduces the opportunities for cross-subsidization by curtailing the free cash flows from profitable segments that are available for managers' discretionary spending (Myers, 2001) and by forcing managers to divest unprofitable businesses to meet debt payments.

Second, debt is also likely to serve as a better monitoring mechanism than equity to reveal overinvestment problems in diversification strategies. Under asymmetric information, equity might not efficiently detect and correct opportunistic diversification. In contrast, debt disseminates private information to financial markets that may reveal low-return activities, for instance through a firm's ability to meet its contractual payments. This monitoring role of leverage is exerted continuously, since interest on debt must be paid periodically, and principal must be repaid at the end of the contract, or new debt must be obtained (Jensen, 1986). Therefore, should managers be concerned about meeting lenders' demands, other corporate governance mechanisms, such as board monitoring or ownership structure, may decrease their relevance (O'Brien *et al*., 2014).

Third, debt can be used by managers in diversified firms as a signal to reduce the information asymmetry between insiders and the market. Debt allows managers to signal their compliance with monitoring by lenders and avoid overinvestment (Ross, 1977). Zwiebel (1996) uses a dynamic model to show that self-interested managers are willing to increase leverage to constrain overinvestment and deter takeovers. Even in the absence of any actual agency conflict, information asymmetry results in leverage having a positive effect on value, since it allows managers to provide information about their commitment to avoiding unprofitable diversification that could increase the threat of financial distress.[3]

Based on this evidence and the previous discussion, we formulate our first hypothesis:

> **H_1:** A firm's leverage positively influences the relationship between the degree of diversification and the firm's excess value.

2.2. The disciplinary role of debt, relatedness, and the diversification-value relationship

Consistent with the general view that related diversification enables companies to capitalize on economies of scope and synergies among businesses, most of the empirical evidence supports the notion of enhanced performance in related diversifiers (Berger and Ofek, 1995; Palich *et al.*, 2000; Villalonga, 2004a).

Conversely, unrelated diversification is considered more likely a response to agency motivations (Stein, 2003). This strategy reduces cash flow variability due to the addition of businesses with imperfectly correlated cash flows. However, as long as stockholders are able to diversify in financial markets on their own, unrelated diversification primarily satisfies managers who cannot otherwise diversify their undiversifiable human capital. Amihud and

[3] This implies that even when diversification is pursued by low-growth firms as a means of increasing their economic performance and value, leverage can be used by managers to signal their willingness to act in shareholders' interests. As a result, regardless of its ultimate motives, increased leverage would have a positive effect on the value of diversification.

Lev (1981, 1999) provide evidence that manager-controlled firms are more prone to implementing this type of diversification, while Boyd, Gove, and Hitt (2005) report that board control discourages unrelated diversification to a greater extent. Berger and Ofek (1995) show that more overinvestment causes lower excess values for diversified firms with unrelated businesses.

Taking all these arguments into consideration, we expect the disciplining effect of debt in the mitigation of agency costs to be greater in unrelated strategies, since the overinvestment problem is likely to worsen with such strategies. Therefore, we propose our second hypothesis:

> **H_2:** The positive influence of a firm's leverage on the relationship between the degree of diversification and the firm's excess value is higher (lower) for unrelated (related) diversifications.

2.3. The disciplinary role of debt, growth opportunities, and the diversification-value relationship

Agency theory raises concerns about the availability of poor growth opportunities insofar as this situation exacerbates the agency costs that arise from managerial overinvestment (Jensen, 1986; McConnell and Servaes, 1995). Previous studies suggest that debt may have a greater disciplinary effect in such low-growth companies. McConnell and Servaes (1995) find a positive correlation between leverage and firm value in low-growth firms. Conversely, the authors find that the association between leverage and corporate value becomes negative for high-growth firms because debt can drive underinvestment by forcing managers to forego positive net present value investments. Similarly, Harvey, Lins, and Roper (2004) find that investors discount firms that are more likely to overinvest and the incremental benefit of leverage is higher when future growth options are lower.[4]

These results are relevant for our predictions between the value of diversification and debt, since diversified firms are more prone to exhibit overinvestment problems and have fewer unexercised growth opportunities. First, internal capital markets enable diversified firms to use cash flows generated by better-performing divisions to subsidize worse performing divisions, thus increasing the chances of overinvestment (Berger and Ofek, 1995; Rajan *et al.*, 2000). Second, diversified firms have fewer unexercised growth opportunities than their undiversified counterparts, as long as diversification implies exercising profitable current growth options by replacing them with their underlying assets (Bernardo and Chowdhry, 2002).

Given the above discussion, we expect the disciplinary effect of debt may help discourage diversifying overinvestment initiatives more in firms with a poor set of growth opportunities. Hence, we state our third hypothesis:

> **H_3:** The positive influence of a firm's leverage on the relationship between the degree of diversification and the firm's excess value is higher (lower) for low-growth (high-growth) firms.

3. RESEARCH METHOD

3.1. Data sources and sample

Our primary sample consists of all public U.S. firms in the Thomson ONE database developed by Thomson Reuters over the period 1998 to 2014. This database covers all U.S.

[4] Other complementary evidence documents the beneficial effect of debt in alleviating overinvestment in low-growth firms as a substitute mechanism for stock options (Zhang, 2009).

companies filing with the Securities and Exchange Commission. We use Worldscope as our primary data source, and yearly data frequency at both the 4-digit SIC code industry segment and company levels. We supplement this information with Datastream to obtain market data. Given that SFAS 131 was implemented in the U.S. in 1998, our sample thus ensures the consistency of segment data throughout our analysis window. To mitigate survivorship bias, our sample retains currently inactive firms that ceased to operate during the analysis period for any reason (e.g. mergers or bankruptcy).

To build a dataset similar to those used in most prior research (e.g. Campa and Kedia, 2002; Santaló and Becerra, 2008; Kuppuswamy and Villalonga, 2016), our sample selection criteria are based on Berger and Ofek (1995). Accordingly, we exclude firm-year observations in any segment of the financial industry (SIC codes 6000-6999). We also remove observations with missing data for total capital, total sales, and segment-level sales. The sample firms are required to have at least $20 million in reported total sales, which may not deviate from the sum of segment sales by more than 1%. We also exclude observations with negative common equity. After applying these sample restrictions, our final sample comprises 15,151 firm-year observations (3,087 firms) for the 1998-2014 period. A total of 9,648 firm-year observations (63.68%) correspond to unisegment firms, and 5,503 firm-year observations (36.32%) are diversified firms.[5] Table 1 summarizes the distribution of our sample by diversification status.

TABLE 1 ABOUT HERE

3.2. Variables

[5] This proportion is similar to that reported in previous empirical studies such as Mansi and Reeb (2002), Villalonga (2004b), or Andrés, Fuente and Velasco (2017).

In this section, we explain the variables used in our empirical analyses: excess value, degree of diversification, leverage, growth opportunities, and the full set of control variables.[6]

Excess value

All models have the same dependent variable: excess value (*EXVAL*). This measure corresponds to the natural logarithm of the ratio of a firm's market value to its imputed value (Berger and Ofek, 1995). A firm's imputed value is derived from the sum of the imputed values of all its segments, each of which are estimated by multiplying the segment's sales by the annual median market-to-sales multiplier of the corresponding industry. Each median industry's market-to-sales multiplier is computed based on all unisegment companies operating in that industry. To match each firm's segment to an industry group, we take the same and most restrictive SIC group that comprises at least five unisegment firms (4-digit, 3-digit, 2-digit SIC code levels). This methodology compares a firm's market value against the estimated value of an equivalent portfolio of unisegment firms operating in the same industries.[7] Overall, *EXVAL* captures the value creation/loss of having the businesses under the same corporate umbrella in relation to the total value the same businesses would display were they to operate as stand-alone companies.[8]

Degree of diversification

[6] Table A.1. in the Appendix presents the definitions of all variables.

[7] We calculate a firm's market value as the sum of the market value of equity, long-term debt, short-term debt, and preferred stock (Campa and Kedia, 2002). A negative excess value indicates the presence of a value discount in diversified firms compared to their unisegment counterparts, whereas a positive excess value implies a value premium for those firms undertaking a diversification strategy. See Berger and Ofek (1995) for more details about calculating the excess value measure.

[8] Mansi and Reeb (2002) compute excess value using the market value of debt to evaluate the risk-based value shifting between shareholders and bondholders. However, debt market value might hide the potential destruction of equity value that emerges from the conflict of interest between shareholders and managers. Instead, using the book value of debt makes it easier to draw a more direct connection between the governance role of debt and diversification efficiency. While equity market values always reflect investors' expectations regarding a firm's strategy efficiency, debt market values depend on expectations concerning the degree of debtholder claim coverage, but not necessarily on the firm's likelihood of surviving after debt repayments.

For robustness, we rely on three alternative diversification proxies (*DIV*). First, diversification is captured by the *NUM_4d* variable, which represents the number of different segments at the 4-digit SIC code level. Second, we employ the Herfindahl index (Hirschman, 1964), which is denoted by *HERF_4d* and is calculated as follows:

$$\text{HERF\_4d} = 1 - \sum_{s=1}^{n} P_s^2 \qquad [1]$$

where 'n' is the number of a firm's segments (at the 4-digit SIC code level), and 'P_s' is the proportion of the firm's sales from business 's'.

Finally, we proxy diversification by the entropy index (Jacquemin and Berry, 1979), which is denoted by *TENTROPY*, and is computed as:

$$\text{TENTROPY} = \sum_{s=1}^{n} P_s \times \ln\left(\frac{1}{P_s}\right) \qquad [2]$$

The Herfindahl and entropy indexes are measures of concentration that are commonly used to proxy for total diversification (e.g. Schommer, Richter and Karna, 2019). The main difference between them is the weight assigned to each segment 's'. Whereas the Herfindahl index weights the share of each segment by itself, the entropy index uses the logarithm of the inverse share. Both indexes equal zero for unisegment firms, and the greater a firm's level of diversification, the higher these two indexes will be. The Herfindahl index ranges between 0 and 1, while entropy has no upper boundary. The Herfindahl index is easy to use and intuitive. Its disadvantage is that it cannot be decomposed into related and unrelated diversification as directly as entropy can. However, both indexes are complementary: the Herfindahl index is less sensitive than entropy to differences in small business shares but is more sensitive to differences in large businesses.

<u>Leverage</u>

To identify firms with high and low leverage, we construct a dummy variable, *dumLEV*, which equals one if a firm's leverage is above the sample mean and zero otherwise. Leverage (*LEV*) is computed using the ratio of total debt[9] to the book value of assets (Frank and Goyal, 2009).[10]

Relatedness

To capture relatedness between segments, we calculate the related entropy measure developed by Jacquemin and Berry (1979). These authors capture a firm's unrelated and related diversification by measuring its segment distribution across and within 2-digit SIC levels, respectively. Accordingly, they compute related entropy as the difference between total entropy (*TENTROPY*) and unrelated entropy, where *TENTROPY* and unrelated entropy are calculated as in Equation [2], for segments defined at 4-digit and 2-digit SIC code levels, respectively. Therefore, the minimum value of related entropy is zero and the more related a firm's diversification is, the higher its related entropy will be. Based on this relatedness measure, we define a dummy variable (*dumRE*) that equals one if a firm's diversification related entropy is above the sample mean, and zero otherwise.

Growth opportunities

One stream of literature supports the use of stock return skewness as a direct proxy for a firm's growth opportunities on the grounds that their optional nature (exercised only in the event of positive payoffs and abandoned otherwise) causes a positively skewed distribution of payoffs (Andrés, Azofra and Fuente, 2006; Trigeorgis and Lambertides, 2014; Del Viva, Kasanen and Trigeorgis, 2017).[11] Based on this proxy, we define *dumSkewness* as equal to

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[9] Total debt comprises all interest bearing long and short term debt. Therefore, it does not include total current liabilities such as notes and accounts payable, which are reported in a separate account in Worldscope and which play no role in mitigating agency costs.

[10] We also consider the debt-to-equity ratio as an alternative measure of leverage to build our dummy variable *dumLEV*. The results of our hypotheses tests remain robust and are available upon request.

[11] Mitton and Vorkink (2010) directly analyse the relationship between return skewness of diversified firms and diversification discounts. They contend that if investors prefer return skewness, they will require a higher return

one if the firm's level of growth opportunities (measured by return skewness) is above the sample mean, and zero otherwise.[12]

Further, we evaluate the robustness of our results using an alternative measure based on R&D expenditures.[13] R&D activities are considered to enable a firm to access further growth opportunities (Grullon, Lyandres and Zhdanov, 2012). We define *dumRDsales* as equal to one if the firm's R&D-to-sales ratio is above the sample mean and zero otherwise. Observations with missing values for R&D are excluded rather than considered equal to zero to avoid bias in our analyses (Koh and Reeb, 2015).

Control variables

The negative relationship between debt and excess value could also be explained by the so-called coinsurance effect, which refers to the reduction in a firm's systematic risk as a result of combining divisions with cash flows that are imperfectly correlated (La Rocca *et al*., 2009; Park and Jang, 2013). The coinsurance effect leads to a substantial smoothing of earnings outcomes, thus increasing a firm's debt capacity, which may lead to an increase in risk-adjusted returns (Gahlon and Stover, 1979). Kuppuswamy and Villalonga (2016) refer to this idea as the 'more-money' effect and explore its relevance during the recent financial crisis. To control for this alternative relationship, we include the firm's annual returns volatility, which is proxied by the standard deviation of the firm's daily returns during each year (*VOLATILITY*).

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on stocks offering less upside potential. This effect of skewness on expected returns is used to explain why some diversified firms trade at a discount. Their findings confirm that the higher (lower) the positive skewness, the lower (higher) the diversification discount.

[12] Results are robust when we use the sample median to categorize the leverage dummy, relatedness dummy, and skewness dummy. These results are available upon request.

[13] Another usual proxy for growth opportunities is the market-to-book ratio. We choose not to use this proxy since it is influenced by the same market values on which Berger and Ofek's (1995) excess value measure is based and would therefore lead to a mechanical link between the two variables. In our sample, the correlation between the market-to-book ratio and *EXVAL* was 0.55 or above.

Additionally, our model comprises a set of control variables considered by previous research to affect *EXVAL* through channels other than the diversification strategy (Berger and Ofek, 1995; Campa and Kedia, 2002; Santaló and Becerra, 2008). We control for a firm's leverage (*dumLEV*), size (approximated by the natural logarithm of the book value of total assets, *LTA*), profitability (computed as the ratio of EBIT to total sales, *EBITsales*), and the level of investment (measured as the capital expenditures to total sales ratio, *CAPEXsales*). We consider industry (*dumINDUSTRY*) and year effects (*dumYEAR*) by including dummy variables.

Table 2 summarizes our descriptive statistics. Panel A reports the main statistics of the variables in our analyses. On average, our sample firms display a diversification discount (-0.07), which is in line with prior studies such as Berger and Ofek (1995), Servaes (1996), or Kuppuswamy and Villalonga (2016). Firms have a moderate diversification profile (1.48 segments at the 4-digit SIC level). Panel B presents the distribution of our dummy variable observations. Among diversified companies, the distribution of the dummy *dumRE* shows that a more related diversification pattern prevails, which is consistent with prior evidence attributing more value-enhancing effects to this strategy (Palich *et al.*, 2000).

TABLE 2 ABOUT HERE

Table 3 displays the correlation matrix.[14] The correlation of *NUM_4d*, *HERF_4d*, and *TENTROPY* is above 0.87, thereby supporting their suitability as alternative proxies for diversification. *LEV* is positively correlated with the diversification measures, suggesting the coinsurance effect of diversification documented in prior literature (La Rocca *et al.*, 2009; Park and Jang, 2013).

[14] To evaluate the potential presence of multicollinearity, we compute the variance inflation factors (VIF). In our models, the mean VIF ranges between 1.53 and 2.51, indicating that multicollinearity is not a concern in our dataset.

TABLE 3 ABOUT HERE

3.3. Empirical models

Our baseline model for testing the effect of corporate diversification on a firm's value can be expressed as follows:

$$EXVAL_{i,t} = \alpha + \beta_1\, DIV_{it} + \beta_2\, LEV_{it} + \beta_3\, LTA_{it} + \beta_4\, EBITsales_{it} + \beta_5\, CAPEXsales_{it} + \beta_6\, VOLATILITY_{it} + \beta_7\, dumINDUSTRY_{it} + \beta_8\, dumYEAR_{it} + \nu_{it} \quad [3]$$

where *i* identifies each firm, *t* indicates the observation year (from 1 to 17), α and β_p are the coefficients to be estimated, and ν_{it} represents the random disturbance for each observation. This model serves as the starting point for comparing and bridging our analyses to the prior literature, although this is not the main focus of our study.

To test the moderating effect of leverage on the relationship between diversification and excess value (Hypothesis 1), we include *dumLEV,* which equals one if a firm's leverage is above the sample mean and zero otherwise.[15] We incorporate the interaction between this dummy, also used as a control, with the diversification variable to assess its potential moderating effect on the influence of this strategy on a firm's excess value:

$$EXVAL_{i,t} = \alpha + \beta_1\, DIV_{it} + \beta_2\, DIV_{it} \times dumLEV_{i,t} + \beta_3\, dumLEV_{it} + \beta_4\, LTA_{it} + \beta_5\, EBITsales_{it} + \beta_6\, CAPEXsales_{it} + \beta_7\, VOLATILITY_{it} + \beta_8\, dumINDUSTRY_{it} + \beta_9\, dumYEAR_{it} + \nu_{it} \quad [4]$$

The impact of diversification on a firm's value is captured by β_1 for below-mean leveraged firms (since *dumLEV*=0) and by $\beta_1 + \beta_2$ for above-mean leveraged firms.

[15] When estimating models with interaction effects, we enter the leverage variable as a dummy variable to mitigate potential collinearity problems. Moreover, this approach allows us to better identify firms with below-mean and above-mean leverage so we can evaluate their economic significance and isolate this effect; this also allows us to interpret it more easily, as in prior research such as Pindado, Requejo, and De la Torre (2011).

To test Hypothesis 2, we add the dummy variable measuring relatedness (*dumRE*) to equation [4] and its triple interaction term with the moderating influence of leverage on the effect of diversification on excess value:

$$\begin{aligned}
EXVAL_{i,t} &= \alpha + \beta_1\, DIV_{it} + \beta_2\, DIV_{it} \times dumLEV_{it} + \\
&\beta_3\, DIV_{it} \times dumLEV_{it} \times dumRE_{it} + \beta_4\, dumLEV_{it} + \beta_5\, dumRE_{it} + \beta_6 LTA_{it} + \\
&\beta_7\, EBITsales_{it} + \beta_8\, CAPEXsales_{it} + \beta_9\, VOLATILITY_{it} + \\
&\beta_{10}\, dumINDUSTRY_{it} + \beta_{11} dumYEAR_{it} + \nu_{it} \qquad [5]
\end{aligned}$$

The triple interaction term (in equation [5]) enables us to examine whether debt plays a different role in the value effect of diversification when firms follow a related diversification strategy versus an unrelated diversification strategy. The moderating effect of leverage on the association between diversification and firm value is measured by $\beta_1 + \beta_2$ for below-mean related diversifiers (because *dumRE*=0) and by $\beta_1 + \beta_2 + \beta_3$ for above-mean related diversifiers.

Finally, to test Hypothesis 3, we include the dummy variable approximating a firm's growth opportunities (*dumSkewness*) in equation [4] together with the corresponding interaction term with the moderating influence of leverage on the effect of diversification on a firm's value:

$$\begin{aligned}
EXVAL_{i,t} &= \alpha + \beta_1\, DIV_{it} + \beta_2\, DIV_{it} \times dumLEV_{it} + \\
&\beta_3\, DIV_{it} \times dumLEV_{it} \times dumSkewness_{it} + \beta_4 dumLEV_{it} + \beta_5 dumSkewness_{it} \\
&\beta_6\, LTA_{it} + \beta_7\, EBITsales_{it} + \beta_8\, CAPEXsales_{it} + \beta_9\, VOLATILITY_{it} + \\
&\beta_{10}\, dumINDUSTRY_{it} + \beta_{11}\, dumYEAR_{it} + \nu_{it} \qquad [6]
\end{aligned}$$

The triple interaction term (in equation [6]) reflects whether debt might exert a different influence on the value of a diversification strategy depending on a firm's level of growth opportunities. The moderating effect of leverage on the association between diversification and firm value is measured by $\beta_1 + \beta_2$ for firms with below-mean growth opportunities (because *dumSkewness*=0) and by $\beta_1 + \beta_2 + \beta_3$ for companies displaying above-mean growth opportunities.

3.4. Econometric approach and endogeneity

Initially, we rely on the simple estimation approach of ordinary least squares (OLS) to evaluate the role of corporate leverage in the relationship between diversification and value. We cluster standard errors at the firm level to account for heteroscedasticity and the lack of independence of the error terms for firms with multiple observations (Petersen, 2009). Moreover, in line with recent research on diversification (e.g. La Rocca *et al*., 2009; Hoechle *et al*., 2012; Andrés *et al.*, 2016), we use Blundell and Bond's (1998) two-step generalized method of moments (GMM) system estimator to address two econometric concerns common in this area of research. First, this method controls for unobserved firm heterogeneity, which refers to certain firm-specific characteristics (e.g. a firm's culture, strategy) that remain time constant and may play a part in explaining a firm's diversification status and overall value (La Rocca *et al*., 2009; Wintoki, Linck and Netter, 2009). Second, it accounts for particular endogeneity issues in the diversification-value relationship.

An increasing number of studies have indicated the presence of endogeneity in the diversification-performance relationship (Campa and Kedia, 2002; Bascle, 2008; Hoechle *et al*., 2012; Andrés *et al.*, 2016, 2017; Kuppuswamy and Villalonga, 2016). This problem arises when some regressors are correlated with the error term, thus causing OLS estimations to be inconsistent due to a violation of the exogeneity condition (Bascle, 2008). In the case of the diversification-performance relationship, this problem may have two causes. First, the decision to enter a new business can be motivated by unobservable factors (e.g. private information) that also affect firm performance. If so, the diversification decision would present a self-selection problem and generate an omitted variable bias (Campa and Kedia, 2002; Bascle, 2008; Abdallah *et al.*, 2015). Second, endogeneity may also stem from simultaneous causality as a result of the existence of a feedback loop in the diversification-value linkage: not only does diversification impact a firm's performance but past performance may also influence a firm's decision to diversify (Bascle, 2008; Abdallah *et al*., 2015).

GMM takes the lags of the explanatory variables as instruments. Using these internal instruments contained within the panel itself removes the need to seek external instruments or a natural experiment, which proves extremely complicated in many cases (Santaló and Becerra, 2008; Wintoki *et al.*, 2012). By contrast, internal instruments can allow us to take advantage of the dynamic diversification-performance relationship by using past values as instruments and enable us to mitigate such endogeneity, thereby producing consistent and efficient estimates (Hoechle *et al*., 2012; Abdallah *et al*., 2015). Moreover, by combining multiple orthogonality conditions, GMM offers efficiency gains compared to simpler instrumental variables techniques (Arellano and Bond, 1991; Almeida, Campello and Galvao, 2010). Other works such as Pindado *et al*. (2011) support the use of the GMM estimator, since it encompasses all other instrumental variables as particular cases.

GMM represents a step forward compared to existing studies on diversification and leverage such as Ruland and Zhou (2005), who apply a simultaneous equations approach that corrects for simultaneous causality but fails to correct for self-selection bias. Many studies on corporate governance, such as Renders and Gaeremynck (2012), point to simultaneous equations as suitable only for addressing the former endogeneity source. Moreover, the simultaneous equations approach requires identification of strictly exogenous instruments, that is, at least one variable from one equation that is not in the other. The greater the number of equations in a system, the higher the number of exogenous instruments needed, making it very difficult in practice to find and justify them (Wintoki *et al*., 2012).

On the other hand, one cost of using the GMM is that it results in a further loss of observations since we can only consider firms that have data available for at least four consecutive years in order to test for the absence of second-order residual serial correlation, as applied in previous studies (e.g., La Rocca *et al.*, 2009).[16]

We conduct several tests to evaluate the validity of our GMM estimations. Arellano and Bond's (1991) m_2 statistic tests for the lack of second-order serial correlation in first-difference residuals. The underlying assumption of this test is that the GMM estimator would not be consistent if the residuals were serially correlated because it employs lags as instruments under the assumption of white noise errors. The Hansen test of over-identifying restrictions contrasts the requirement of instrument exogeneity. The null hypothesis is the joint validity of all instruments, which is reflected in the absence of correlation between the instruments and residuals.

4. EMPIRICAL RESULTS

4.1. Diversification and firm value

Before testing our hypotheses, we run the regression of our baseline model (equation [3]). This starting point for our analysis enables us to better connect our research with the core diversification literature that addresses the direct relationship between this strategy and a firm's value. The results are presented in Table 4. The three alternative diversification measures computed at the 4-digit SIC level (either *NUM_4d*, *HERF_4d* or *TENTROPY*) show negative and statistically significant coefficients at or beyond the 5% level. The effect is particularly economically significant when using *HERF_4d* and *TENTROPY*. This evidence

[16] This econometric technique's unavoidable limitation is acknowledged in previous research (Bover and Watson, 2005). As a result of the time span of our dataset and considering the recent financial crisis that has challenged the survival of many companies, a missing firm-year observation exacerbates the loss of observations since we can only take the longest sub-period of consecutive observations. In any case, our sample size decreases similarly to those in previous studies such as Sembenelli and Siotis (2008).

supports the widely held view of a diversification discount, which occurs when this strategy destroys value.[17] Consistent with the prior literature (e.g. Berger and Ofek, 1995; Santaló and Becerra, 2008), our control variables *LTA*, *EBITsales*, and *CAPEXsales* display the expected positive coefficients, which are statistically significant at the 1% level in most cases.

TABLE 4 ABOUT HERE

The coefficient of *LEV* is negative and statistically significant at the 10% level. The sign of the impact of leverage on a firm's excess value has been controversial in prior literature. Some works find evidence of a positive sign (Campa and Kedia, 2002; Kuppuswamy and Villalonga, 2016), while others concur with our results by reporting a negative sign (Denis *et al.*, 2002; Chen and Chen, 2006; Duan and Li, 2006; Andrés *et al.*, 2016). Nevertheless, our investigation goes a step further in analysing this relationship by delving into the interaction between leverage and diversification to test the moderating role of debt on the relationship between diversification and excess value. Finally, *VOLATILITY* displays a negative coefficient, which is also consistent with the coinsurance hypothesis.

4.2. Diversification, leverage, and a firm's value

Table 5 summarizes the results of equation [4], which tests the moderating effect of a firm's leverage on the relationship between diversification and excess value. The diversification discount remains negative and statistically significant across the alternative estimations. Concerning the interaction effects, the positive and statistically significant coefficients of *NUM_4d×dumLEV*, *HERF_4d×dumLEV*, and *TENTROPY×dumLEV* indicate that leverage positively moderates the relationship between diversification and excess value. For instance, the coefficient of *HERF_4d×dumLEV* indicates that the diversification discount is 23.37

[17] This result is robust when computing the number of segments at a broader SIC level (2-digit SIC industries). These results are available upon request.

percentage points lower for firms with above-mean leverage compared to those with below-mean leverage. Furthermore, the joint impact of diversification and the interaction effect of leverage on the diversification variable ($\beta_1+\beta_2$) displays no statistical significance across the alternative estimations. This result suggests that, although the effect of diversification on *EXVAL* is negative and statistically significant for companies with below-mean leverage (β_1), its relevance becomes statistically insignificant for companies with above-mean leverage ($\beta_1+\beta_2$). This preliminary evidence supports the idea that leverage exerts a positive moderating influence on the relationship between diversification and firm value, which is consistent with our free cash flow hypothesis and the monitoring role played by debt in diversification.

TABLE 5 ABOUT HERE

4.3. Endogeneity

We examine the robustness of the association between diversification, leverage, and excess value by accounting for potential endogeneity concerns. First, following Santaló and Becerra (2008), we re-estimate our previous regressions for the subsample of firms that report an increase in their number of segments (at the 4-digit SIC level) during the sample period. This procedure aims to correct for potential self-selection bias (since companies endogenously decide to diversify) and evaluates the within-firm correlation between changes in excess value and changes in diversification. Results are displayed in Table 6 and are robust to those previously reported.

TABLE 6 ABOUT HERE

The diversification discount remains negative and statistically significant for two out of the three alternative diversification measures (*HERF_4d* and *TENTROPY*). The interaction terms of the diversification variables and leverage dummies are positive and statistically significant precisely in those cases in which the diversification discount exhibits statistical significance. Consequently, the joint impact of diversification plus the interaction effect of leverage on the diversification variable ($\beta_1+\beta_2$) becomes positive across the alternative estimations and is statistically significant at the 5% and 10% levels for *NUM_4d* and *TENTROPY,* respectively. This result suggests the diversification discount is only present in companies with below-mean leverage, whereas it becomes a diversification premium for companies with above-mean leverage.

Second, we use the GMM procedure to re-estimate Equation (4). Table 7 presents our results. Both the Hansen and Arellano-Bond m_2 statistics report p-values that confirm the validity of our estimations. The Hansen J-statistic does not reject the null hypothesis that the instruments are uncorrelated to the error terms. The m_2 statistic does not reject the null hypothesis of an absence of second-order residual serial correlation. The Wald test is significant beyond the 1% level, thereby confirming the joint significance of the variables.

TABLE 7 ABOUT HERE

Our results once again confirm the presence of a diversification discount across the alternative estimations. When controlling for endogeneity, the positive moderating effect of leverage on the relationship between diversification and excess value emerges with both greater economic and greater statistical significance. Overall, our empirical findings lend strong support to Hypothesis 1 that a greater level of debt alleviates the diversification discount. In the cases of *NUM_4d* and *TENTROPY*, the coefficient of the interaction term of diversification and leverage offsets the negative coefficient of the individual diversification proxy. As a result, diversified firms with above-mean leverage exhibit a diversification premium that is statistically significant at or beyond the 10% level. When diversification is proxied by *HERF_4d*, diversified firms with above-mean leverage still present a statistically significant diversification discount, although 26.09 percentage points lower in economic terms than that in their diversified counterparts with below-mean leverage. This evidence is consistent with the disciplining role of debt. Greater leverage is likely to encourage managers to pursue only efficient diversification investments and curb any potential overinvestment that may result in value-decreasing diversification strategies.

4.4. Interaction effects (I): Diversification, leverage, relatedness, and firm value

We now examine whether the type of diversification shapes the moderating role of a firm's leverage in the diversification-excess value relationship. Table 8 provides the GMM estimates of equation [5].[18] Consistent with prior literature, *dumRE* displays a positive sign individually, thereby confirming that more-related diversification outperforms unrelated diversification (Berger and Ofek, 1995; Palich *et al.*, 2000). The results show a significantly negative coefficient for the triple effect *DIV* × *dumLEV* × *dumRE* across the alternative estimations. This coefficient indicates that the effect of leverage on the excess value of diversification is attenuated by relatedness. For instance, when diversification is measured by *NUM_4d* (Column (1)), above-mean related diversification reduces the positive effect of leverage on the excess value of diversification by 11.83 percentage points. As a result, whereas a one percentage point increase in the diversification level of companies with above-mean leverage results in a 0.0991 percentage point reduction in *EXVAL* for unrelated diversifiers ($\beta_1+\beta_2$=-0.1343+0.0352= -0.0991), it reduces *EXVAL* by 0.2174 percentage points for their counterparts with above-mean leverage and related diversifiers ($\beta_1+\beta_2+\beta_3$=-

[18] As related entropy can only be computed for firms with at least two business segments, the total number of observations for this subsample is reduced to 2,708.

0.1343+0.0352-0.1183=-0.2174)[19]. This finding is even more evident when *HERF_4d* and *TENTROPY* are applied and indicates that the disciplinary role of debt in improving a firm's excess value is beneficial for below-mean relatedness or unrelated diversifiers.

TABLE 8 ABOUT HERE

Overall, Hypothesis 2 receives strong support. This evidence suggests the disciplinary role of debt does indeed work for unrelated diversifiers, which is consistent with prior studies linking this type of diversification to more severe overinvestment problems (Amihud and Lev, 1981, 1999; Berger and Ofek, 1995; Boyd *et al.*, 2005). Conversely, related diversifiers are more likely to pursue more efficient investments *per se* to seek economies of scope and synergies (Palich *et al.*, 2000). Therefore, the disciplinary role of debt might not be necessary.

4.5. Interaction effects (II): Diversification, leverage, growth opportunities, and a firm's value

The results of equation [6] are reported in Table 9. Again, the evidence points to firm leverage having a positive moderating effect on the diversification-value relationship, which supports the robustness of our findings related to Hypothesis 1. Moreover, these results show that the effect differs depending on the level of growth opportunities. We include a triple interaction term of diversification, relatedness, and growth opportunities.

TABLE 9 ABOUT HERE

For instance, the coefficient of *HERF_4d* × *dumLEV_DTA* × *dumSkewness* equals -0.6081, implying that the effect of leverage on the excess value of diversification is attenuated by growth opportunities: having high growth potential reduces the positive effect

[19] Our results are robust to calculating the related diversification dummy based on the mean of an alternative relatedness measure in relative terms, namely, the ratio of related entropy to total entropy (Amit and Livnat, 1988). The results are available upon request.

of leverage on *EXVAL* by 60.81 percentage points compared to a lack of such growth opportunities. As a result, while a one percentage point increase in the diversification level in companies with above-mean leverage results in a 0.1699 percentage point decrease in *EXVAL* for companies with low growth opportunities ($\beta_1+\beta_2$= -0.3016+0.1317=-0.1699), it leads to a greater diversification discount for firms with high growth opportunities ($\beta_1+\beta_2+\beta_3$=-0.3016+0.1317-0.6081=-0.7780). This evidence suggests that leverage enhances the value of diversification for firms with lower growth opportunities, while it diminishes the firm's excess value in companies that display greater growth opportunities. Results continue to hold when *NUM_4d* and *TENTROPY* are used. We also check the robustness of our empirical finding using *dumRD* as an alternative proxy for growth. In all cases, the coefficient of the interaction term displays a negative sign and statistical significance beyond the 1% level.[20] In light of this evidence, Hypothesis 3 is supported.

5. ADDITIONAL ROBUSTNESS ANALYSES

5. 1.The disciplinary power of leverage and efficiency in internal investment allocation

Having confirmed our hypotheses, we further explore the channels through which leverage may enhance the value of diversification. In particular, we evaluate whether the disciplinary power of debt involves a more efficient allocation of funds across segments in the context of internal capital markets.[21]

Following Rajan *et al.* (2000), we compare the investment a segment undertakes when it is part of a diversified firm and the investment it would have made if it had remained a stand-alone company. The investment undertaken by each segment is approximated by its ratio of capital expenditures to total assets. The investment each segment would have undertaken if it

[20] Results are available upon request.
[21] We thank an anonymous referee for this suggestion.

had remained a stand-alone company is proxied by the asset-weighted average of the investment ratio of unisegment firms in the same 3-digit industry. We then compute the difference between each segment's actual investment ratio and its stand-alone imputed investment ratio:

$$ind\_INVEST_{ij} = \frac{CAPEX_{ij}}{Assets_{ij}} - \left(\frac{\overline{CAPEX}}{Assets}\right)_s \quad [7]$$

where $CAPEX_{ij}$ denotes the capital expenditures in segment j by firm i, $ASSETS_{ij}$ is total assets of segment j in firm i, and $\left(\frac{\overline{CAPEX}}{Assets}\right)_s$ is the stand-alone imputed investment ratio of unisegment firms in the 3-digit industry s to which segment j belongs. Such a difference (ind_INVEST_{ij}) represents a segment's industry-adjusted investment ratio and proxies for the transfers made (if negative) or received (if positive) by each segment to (from) other firm segments.[22]

Finally, to correct for the fact that diversified companies have more funds available overall, we estimate an industry- and firm-adjusted investment ratio ($firmind\_INVEST_{ij}$) by subtracting the industry-adjusted investment ratio averaged across all segments of firm i from each segment's previously calculated industry-adjusted investment ratio (ind_INVEST_{ij}).

To test whether the disciplinary power of debt entails greater investment efficiency, we split our sample into segments with Tobin's Q above the sample mean and below the sample mean (high-Q segments and low-Q segments, respectively) and estimate the following model:

$$\text{firmind\_INVEST} = \gamma_0 + \gamma_1 \text{ Inverse\_q}_{it} + \gamma_2 \text{ SIZE}_{it} + \gamma_3 \text{ LEV}_{it} + \gamma_4 \text{ DIVERSITY}_{it} + \varepsilon_{it} \quad [8]$$

[22] These terms refer to the idea of reallocating funds across business segments within the internal capital markets of diversified firms (Rajan *et al.*, 2000).

where *Inverse_q* represents the inverse of average Q, *SIZE* is a firm's size (the natural logarithm of total sales), *LEV* is leverage (measured by *DEBT_TA*) and *DIVERSITY* is Rajan *et al.*'s (2000) measure of diversity in investment opportunities between segments. We also re-estimate the model using *ind_INVEST* as an alternative dependent variable.

Table 10 reports the results. Consistent with Rajan *et al.* (2000), greater diversity in investment opportunities between segments intensifies inefficient transfers from better performing to poorer performing segments. Interestingly, our empirical findings also suggest that *LEV* has a negative impact on the investment ratios in low Q segments, thus confirming that it discourages subsidizing poorly performing segments. *LEV* positively impacts the investment ratios in high Q segments, thereby increasing investments in those segments. Therefore, one channel through which *LEV* enhances the value of diversification emerges from improving the efficiency of investment allocation.

TABLE 10 ABOUT HERE
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5. 2. The disciplinary role of debt versus the discretionary allocation of debt service[23]

One drawback of diversified companies that is associated with debt stems from managers' discretion in allocating debt service across segments. Ahn *et al.* (2006) show that managers allocate a greater debt service burden to higher-growth segments than lower-growth segments of diversified firms. Such a discretionary allocation of their debt service burden might offset some of the disciplinary benefits of debt in firms that are more diversified.

To examine this, we split our sample into firms with below-median diversification and above-median diversification (based on *TENTROPY*) and re-estimate equation [4]. The results are shown in Table 11. The positive moderating role of leverage on the relationship between

[23] We thank an anonymous referee for this suggestion.

diversification and firm value is only statistically significant in less diversified firms. In the subsample of firms with above-median diversification, leverage does not contribute to enhancing the value impact of diversification. This result is consistent with Ahn *et al*. (2006), who suggest that certain harmful effects of debt, such as discretionary allocation of debt service, take on major importance in highly diversified companies.

TABLE 11 ABOUT HERE

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5. 3. The disciplinary role of debt versus other corporate monitoring devices (ownership concentration)

Our previous findings reveal that the underlying mechanism through which leverage improves the value of diversification is by alleviating agency costs. Hence, we test whether the existence of other monitoring mechanisms within the firm, such as concentrated ownership, might reduce the importance of the disciplinary role of debt. A higher proportion of closely held shares is considered a sign of better corporate governance (Glaser and Müller, 2010) since the interests of managers and shareholders are more likely to be aligned.

We re-estimate equation [4] for the subsamples of below-mean and above-mean ownership concentration companies separately and control for ownership in the regressions. We use closely held shares divided by common stock outstanding (Glaser and Müller, 2010) as a proxy for ownership concentration (*OWNERSHIP*). The results are reported in Table 12. *OWNERSHIP* displays no individual statistical significance. In support of our arguments, the positive moderating effect of leverage on the relationship between diversification and *EXVAL* loses its statistical significance for firms with more concentrated ownership. This agrees with the idea that leverage and ownership concentration can serve as alternative monitoring devices and that the presence of one of them lessens the importance of the other. In the subsample of firms with lower ownership concentration levels, the disciplinary role of debt still proves important vis-à-vis mitigating the diversification discount.

TABLE 12 ABOUT HERE
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6. CONCLUSIONS

The main focus of prior literature has been the analysis of the impact of corporate diversification on firm value, with conflicting evidence emerging that remains inconclusive. While acknowledging all these important contributions, which have built a rich and solid methodological base in the field, most prior research seems to have addressed diversification as a generic strategy, overlooking the heterogeneous situations in which it is implemented. Recent studies in this research area (Santaló and Becerra, 2008; Kuppuswamy and Villalonga, 2016) call for further examination of the factors that shape the diversification-value relationship and lead to diversification strategy performance that is more likely to result in a discount or premium.

Our investigation provides new insights into how a firm-specific characteristic such as capital structure might affect the value outcome of this strategy. We answer the research demands made in recent studies such as O'Brien *et al.* (2014: 1014), who call for empirical research on 'how the governance role of debt shapes the performance consequences of diversification'. We examine how an internal corporate governance mechanism such as debt palliates managerial agency costs in the particular context of diversification and encourages efficient investment behaviour. Using a sample of U.S. public companies from 1998 to 2014, we find evidence that greater firm leverage improves the performance of a diversification strategy. The use of GMM to deal with the endogeneity issues of diversification represents a methodological contribution to examining this question.

Moreover, our research goes a step further by exploring some scenarios in which the governance role of debt may become acute. Prior studies highlight different characteristics of diversification vis-à-vis understanding the diverse nature of this corporate strategy and its performance effects. We provide evidence that the use of corporate debt in particular improves a firm's diversification outcomes in unrelated diversification and under low growth opportunities. This finding is consistent with the view that the agency costs of free cash flows are aggravated in such contexts.

We further explore in depth whether the relationship between leverage and the diversification discount is due to the disciplinary role of debt. Our results confirm that debt does indeed play a governance role, since leverage fosters efficiency in investments across segments and discourages cross-subsidization. Finally, we also show that the benefits of debt weaken in the presence of an alternative monitoring device such as concentrated ownership and when allocation of debt becomes discretionary in highly diversified companies.

Our study has interesting implications for managers. Our findings show debt can serve as an internal monitoring device that companies can employ to prevent managers from deviating from efficient resource allocation practices. However, our results also point to the contingent role of debt, depending on the scale of overinvestment problems. Therefore, managers are urged to examine in detail the specific circumstances affecting their companies. In contexts of related diversification or major growth opportunities, which are likely to give rise to fewer agency overinvestment problems, our evidence reveals that the beneficial effect of leverage is reversed, and overuse of debt may prove detrimental to the company.

Finally, our study suggests a number of potential avenues to explore in future research. In addition to relatedness and growth opportunities, it may be worth analysing other factors that may make debt particularly valuable for improving the performance of a diversification strategy. Moreover, the complementary role of alternative mechanisms that could encourage managers to pursue value-increasing diversification strategies could be examined. One opportunity for further research might be to explore in greater depth the role corporate boards play in this corporate strategic choice, as initiated by prior research such as Boyd *et al.* (2005). In all these issues, previous empirical findings could be enriched and complemented by studying how the value of diversification might change in response to exogenous shocks that affect a firm's capital structure.

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Table 1
Distribution of firm-year observations by year and diversification status

	UNISEGMENT FIRMS		DIVERSIFIED FIRMS		TOTAL
Year	**n**	**%**	**n**	**%**	
1998	402	60.36	264	39.64	666
1999	431	56.05	338	43.95	769
2000	399	53.85	342	46.15	741
2001	417	53.81	358	46.19	775
2002	424	55.42	341	44.58	765
2003	510	60.93	327	39.07	837
2004	551	63.41	318	36.59	869
2005	560	64.29	311	35.71	871
2006	633	65.87	328	34.13	961
2007	688	68.46	317	31.54	1,005
2008	701	68.93	316	31.07	1,017
2009	636	69.06	285	30.94	921
2010	696	71.75	274	28.25	970
2011	749	73.58	269	26.42	1,018
2012	667	67.44	322	32.56	989
2013	612	61.02	391	38.98	1,003
2014	572	58.73	402	41.27	974
Total	9,648	63.68%	5,503	36.32%	15,151

Table 2
Summary descriptive statistics of the variables

PANEL A: MAIN DESCRIPTIVE STATISTICS

	N	Mean	Median	Standard deviation	10th percentile	90th percentile
EXVAL	15,151	-0.0704	0	1.1261	-1.4186	1.2189
NUM_4d	15,151	1.4833	1	0.7441	1	2
HERF_4d	15,151	0.1329	0	0.2064	0	0.4892
TENTROPY	15,151	0.2114	0	0.3286	0	0.6887
RELATED	5,503	0.1270	0	0.2396	0	0.5736
SKEWNESS	15,151	0.5769	0.4359	1.8175	-0.8095	2.0672
Leverage						
LEV	15,151	0.2101	0.1862	0.1851	0	0.4689
Other controls						
LTA	15,151	6.2211	6.1225	2.0057	3.6169	8.9646
EBITsales	15,151	0.0339	0.0714	0.3151	-0.1347	0.2394
CAPEXsales	15,151	0.0934	0.0337	0.2370	0.0075	0.1795
VOLATILITY	15,151	0.0644	0.0246	4.2093	0.0131	0.0512

PANEL B: DISTRIBUTION OF DUMMY VARIABLES

	N	No. Obs. equal to 1	% Obs. equal to 1	No. Obs. equal to 0	% Obs. equal to 0
dumRE	5,503	1,284	23.33	4,219	76.67
dumSkewness	15,151	6,675	44.06	8,476	55.94
dumLEV	15,151	6,934	45.77	8,217	54.23

This table provides descriptive statistics of the variables involved in our analyses for the full sample (15,151 firm-year observations). *EXVAL* denotes the excess value measure developed by Berger and Ofek (1995) to assess value created by diversifying. *NUM_4d* (number of business segments at the 4-digit SIC code level), *HERF_4d* (the Herfindahl index at the 4-digit SIC code level), and *TENTROPY* (the entropy index) are alternative measures for the level of diversification. *RELATED* (related entropy) is the relative entropy measure developed by Jacquemin and Berry (1979) to capture business relatedness. *SKEWNESS* denotes stock return skewness and proxies for a firm's growth opportunities. *LEV* (the ratio of total debt to the book value of assets) measures a firm's leverage. The control variables are *LTA* (size), *EBITsales* (profitability), *CAPEXsales* (level of investment), and *VOLATILITY* (standard deviation of daily returns). The dummy variables are *dumRE* (coded 1 if the related entropy measure is above the sample mean and 0 otherwise), *dumSkewness* (coded 1 if the stock return skewness is above the sample mean and 0 otherwise), and *dumLEV* (coded 1 if the ratio of total debt to the book value of assets is above the sample mean and 0 otherwise).

Table 3
Correlation matrix

	EXVAL	NUM_4d	HERF_4d	TENTROPY	RELATED	SKEWNESS	LEV	LTA	EBITsales	CAPEXsales	VOLATILITY	dumRE	dumSkewness	dumLEV
EXVAL	1.0000													
NUM_4d	0.0134	1.0000												
HERF_4d	-0.0001	0.8706***	1.0000											
TENTROPY	0.0063	0.9177***	0.9912***	1.0000										
RELATED	-0.0005	0.2686***	0.3233***	0.3371***	1.0000									
SKEWNESS	-0.1187***	-0.0374***	-0.0332***	-0.0362***	-0.0369***	1.0000								
LEV	0.0605***	0.0400***	0.0308***	0.0323***	-0.0271**	0.0037	1.0000							
LTA	0.3295***	0.1609***	0.1337***	0.1457***	0.1364***	-0.2089***	0.2491***	1.0000						
EBITsales	0.1068***	0.0456***	0.0303***	0.0353***	-0.0130	-0.0669***	0.0382***	0.2029***	1.0000					
CAPEXsales	0.1212***	-0.0775***	-0.0866***	-0.0858***	0.0172	-0.0354***	0.1767***	0.1283***	-0.0168**	1.0000				
VOLATILITY	-0.0153*	-0.0059	-0.0058	-0.0058	-0.0189	0.0854***	0.0012	-0.0062	-0.0028	-0.0031	1.0000			
dumRE	0.0156	0.2834***	0.3052***	0.3343***	0.9221***	-0.0351***	-0.0372***	0.1248***	-0.0080	0.0111	-0.0147	1.0000		
dumSkewness	-0.1139***	-0.0380***	-0.0345***	-0.0375***	-0.0300**	0.5739***	-0.0147*	-0.2585***	-0.0829***	-0.0626***	0.0107	-0.0247*	1.0000	
dumLEV	0.0597***	0.0589***	0.0509***	0.0532***	0.0001	-0.0114	0.8354***	0.2549***	0.0493***	0.1483***	0.0088	-0.0129	-0.0360***	1.0000

This table lists the pair-wise correlations for our main variables. *EXVAL* denotes the excess value measure developed by Berger and Ofek (1995) to assess the value created by diversifying. *NUM_4d* (number of business segments at the 4-digit SIC code level), *HERF_4d* (the Herfindahl index at the 4-digit SIC code level), and *TENTROPY* (the entropy index) are alternative measures for the level of diversification. *RELATED* (related entropy) is the relative entropy measure developed by Jacquemin and Berry (1979) to capture business relatedness. *SKEWNESS* denotes stock return skewness and proxies for a firm's growth opportunities. *LEV* (the ratio of total debt to the book value of assets) measures a firm's leverage. The control variables are *LTA* (size), *EBITsales* (profitability), *CAPEXsales* (level of investment), and *VOLATILITY* (standard deviation of daily returns). The dummy variables are *dumRE* (coded 1 if the related entropy measure is above the sample mean and 0 otherwise), *dumSkewness* (coded 1 if the stock return skewness is above the sample mean and 0 otherwise), and *dumLEV* (coded 1 if the ratio of total debt to the book value of assets is above the sample mean and 0 otherwise). ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Note: The correlations between the variables *RELATED* and *dumRE* with each of the remaining variables are calculated using the diversified firms subsample (5,503 firm-year observations with no missing observations). The remaining correlations refer to the full sample (15,151 firm-year observations).

Table 4
Degree of diversification and excess value

Model Excess Value=(Diversification, control variables)			
	Dependent variable: EXVAL		
	(1)	(2)	(3)
Constant	-1.4088***	-1.4634***	-1.4659***
	(0.0766)	(0.0763)	(0.0765)
NUM_4d	-0.0583**		
	(0.0238)		
HERF_4d		-0.2643***	
		(0.0871)	
TENTROPY			-0.1572***
			(0.0540)
Control variables			
LEV	-0.1794*	-0.1769*	-0.1778*
	(0.0946)	(0.0951)	(0.0951)
LTA	0.2046***	0.2051***	0.2052***
	(0.0101)	(0.0102)	(0.0102)
EBITsales	0.1995***	0.1987***	0.1991***
	(0.0622)	(0.0622)	(0.0622)
CAPEXsales	0.6774***	0.6752***	0.6761***
	(0.0709)	(0.0716)	(0.0716)
VOLATILITY	-0.0034***	-0.0034***	-0.0034***
	(0.0002)	(0.0002)	(0.0002)
dumINDUSTRY	YES	YES	YES
dumYEAR	YES	YES	YES
No. obs.	15,151	15,151	15,151
F-test	34.46***	34.21***	34.23***
R^2	0.1473	0.1481	0.1479

This table reports the OLS estimations of Eq. [3] with clustered standard errors. Excess value (*EXVAL*) is regressed on the level of diversification. *NUM_4d* (number of business segments at the 4-digit SIC code level), *HERF_4d* (the Herfindahl index at the 4-digit SIC code level), and *TENTROPY* (the entropy index) are alternative measures for the level of diversification. A firm's leverage (*LEV*, measured by the ratio of total debt to the book value of assets), size (*LTA*), profitability (*EBITsales*), level of investment (*CAPEXsales*), standard deviation of daily returns (*VOLATILITY*), industry effects (*dumINDUSTRY*), and time effects (*dumYEAR*) are controlled in all estimations. The F statistic tests the null hypothesis of no joint significance of the explanatory variables. Standard errors are shown in parentheses under the coefficients and are clustered at the firm-level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5
Diversification, leverage, and excess value

Model Excess Value=(Diversification, Diversification x Leverage, control variables)			
	Dependent variable: EXVAL		
	(1)	(2)	(3)
Constant	-1.3668*** (0.0853)	-1.4576*** (0.0762)	-1.4610*** (0.0764)
NUM_4d	-0.0939*** (0.0363)		
HERF_4d		-0.3719*** (0.1227)	
TENTROPY			-0.2221*** (0.0765)
Interaction effects			
NUM_4d x dumLEV	0.0732* (0.0394)		
HERF_4d x dumLEV		0.2337* (0.1329)	
TENTROPY x dumLEV			0.1393* (0.0822)
Leverage			
dumLEV	-0.1721*** (0.0616)	-0.0932*** (0.0362)	-0.0918** (0.0359)
Other control variables			
LTA	0.2046*** (0.0101)	0.2048*** (0.0102)	0.2049*** (0.0102)
EBITsales	0.2023*** (0.0622)	0.2012*** (0.0622)	0.2014*** (0.0621)
CAPEXsales	0.6797*** (0.0716)	0.6777*** (0.0721)	0.6781*** (0.0721)
VOLATILITY	-0.0033*** (0.0002)	-0.0033*** (0.0002)	-0.0033*** (0.0002)
dumINDUSTRY	YES	YES	YES
dumYEAR	YES	YES	YES
No. of Obs.	15,151	15,151	15,151
F-test	33.21***	32.80***	32.83***
R^2	0.1478	0.1485	0.1482

This table reports the OLS estimations of Eq. [4] with clustered standard errors. Excess value (*EXVAL*) is regressed on the level of diversification and the interaction term of diversification and leverage. *NUM_4d* (number of business segments at the 4-digit SIC code level), *HERF_4d* (the Herfindahl index at the 4-digit SIC code level), and *TENTROPY* (the entropy index) are alternative measures for the level of diversification. *dumLEV* (coded 1 if the ratio of total debt to the book value of assets is above the sample mean, and 0 otherwise) proxies for a firm's leverage. A firm's size (*LTA*), profitability (*EBITsales*), level of investment (*CAPEXsales*), standard deviation of daily returns (*VOLATILITY*), industry effects (*dumINDUSTRY*), and time effects (*dumYEAR*) are controlled in all estimations. The F statistic tests the null hypothesis of no joint significance of the explanatory variables. Standard errors are shown in parentheses under the coefficients and are clustered at the firm-level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6
Diversification, leverage and excess value – within firm estimates (fixed effects) for firms with an increase in the number of segments

Model Excess Value=(Diversification, Diversification x Leverage, control variables)			
	Dependent variable: EXVAL		
	(1)	(2)	(3)
Constant	-0.7226*** (0.2318)	-0.7253*** (0.2272)	-0.7282*** (0.2271)
NUM_4d	-0.0238 (0.0312)		
HERF_4d		-0.2568** (0.1143)	
TENTROPY			-0.1485** (0.0719)
Interaction effects			
NUM_4d x dumLEV	0.0553 (0.0359)		
HERF_4d x dumLEV		0.2615** (0.1322)	
TENTROPY x dumLEV			0.1569* (0.0824)
Leverage			
dumLEV	-0.0110 (0.0693)	0.0349 (0.0438)	0.0362 (0.0436)
Other control variables			
LTA	0.0277 (0.0290)	0.0289 (0.0290)	0.0287 (0.0290)
EBITsales	0.2053*** (0.0636)	0.2040*** (0.0635)	0.2045*** (0.0635)
CAPEXsales	1.3253*** (0.2164)	1.3367*** (0.2162)	1.3362*** (0.2162)
VOLATILITY	0.1541 (1.3675)	0.2031 (1.3660)	0.2008 (1.3662)
dumINDUSTRY	YES	YES	YES
dumYEAR	YES	YES	YES
No. of Obs.	2,272	2,272	2,272
F-test	9.91***	10.05	10.02***
R^2	0.1310	0.1326	0.1323

This table reports the within firm estimations (fixed effects) of Eq. [4] for the subsample of firms that report a change in their number of segments during the sample period. As a result of focusing on this subsample, the total number of observations in these regressions is reduced to 2,272 observations. Excess value (*EXVAL*) is regressed on the level of diversification and the interaction term of diversification and leverage. *NUM_4d* (number of business segments at the 4-digit SIC code level), *HERF_4d* (the Herfindahl index at the 4-digit SIC code level), and *TENTROPY* (the entropy index) are alternative measures for the level of diversification. *dumLEV* (coded 1 if the ratio of total debt to the book value of assets is above the sample median, and 0 otherwise) proxies for a firm's leverage. A firm's size (*LTA*), profitability (*EBITsales*), level of investment (*CAPEXsales*), standard deviation of daily returns (*VOLATILITY*), industry effects (*dumINDUSTRY*), and time effects (*dumYEAR*) are controlled in all estimations. The F statistic tests the null hypothesis of no joint significance of the explanatory variables. Standard errors are shown in parentheses under the coefficients and are clustered at the firm-level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7
Diversification, leverage, and excess value controlling for endogeneity (GMM)

Model Excess Value=(Diversification, Diversification x Leverage, control variables)			
	Dependent variable: EXVAL		
	(1)	(2)	(3)
Constant	-0.6239***	-0.1788**	0.0067
	(0.1387)	(0.0745)	(0.1394)
NUM_4d	-0.0546**		
	(0.0255)		
HERF_4d		-0.3153***	
		(0.0327)	
TENTROPY			-0.1264**
			(0.0638)
Interaction effects			
NUM_4d x dumLEV	0.1460***		
	(0.0374)		
HERF_4d x dumLEV		0.2609***	
		(0.0463)	
TENTROPY x dumLEV			0.2475***
			(0.0698)
Leverage			
dumLEV	-0.1757**	-0.0408***	-0.2451***
	(0.0793)	(0.0098)	(0.0443)
Other control variables			
LTA	0.1364***	0.0552***	0.0614***
	(0.0107)	(0.0038)	(0.0142)
EBITsales	1.3096***	1.8775***	1.1752***
	(0.1014)	(0.0176)	(0.0885)
CAPEXsales	-0.4156***	0.1042**	-0.1848
	(0.1444)	(0.0468)	(0.1760)
VOLATILITY	-3.1771*	-5.8080***	-8.1203***
	(1.8478)	(0.2263)	(1.4572)
dumINDUSTRY	YES	YES	YES
dumYEAR	YES	YES	YES
No. of Obs.	4,436	4,436	4,436
Wald test	2593.74***	747689.94***	1281.07***
m_1 statistic	-6.06***	-4.94***	-6.37***
m_2 statistic	-1.25	-1.00	-1.29
p-value m_2 test	0.211	0.318	0.198
Hansen test	157.77	275.76	239.58
p-value Hansen test	0.145	0.392	0.271

This table reports the two-step GMM system estimations of Eq. [4]. As the GMM requires data to be available for at least four consecutive years for each firm, this requirement restricts the sample size to 4,436 observations. Excess value (*EXVAL*) is regressed on the level of diversification and the interaction term of diversification and leverage. *NUM_4d* (number of business segments at the 4-digit SIC code level), *HERF_4d* (the Herfindahl index at the 4-digit SIC code level), and *TENTROPY* (the entropy index) are alternative measures for the level of diversification. *dumLEV* (coded 1 if the ratio of total debt to the book value of assets is above the sample mean, and 0 otherwise) proxies for a firm's leverage. A firm's size (*LTA*), profitability (*EBITsales*), level of investment (*CAPEXsales*), standard deviation of daily returns (*VOLATILITY*), industry effects (*dumINDUSTRY*), and time effects (*dumYEAR*) are controlled in all estimations. The Wald statistic tests the null hypothesis of no joint significance of the explanatory variables. Arellano-Bond's m_1 and m_2 statistics test for the lack of first-order and second-order serial correlation, respectively, in the first difference residuals. The Hansen J-statistic is the test of over-identifying restrictions and contrasts the requirement of instrument exogeneity. Standard errors are shown in parentheses under the coefficients. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8
Diversification, leverage, relatedness, and excess value controlling for endogeneity (GMM)

Model Excess Value=(Diversification, Diversification x Leverage, Diversification x Leverage x Relatedness, control variables)

	Dependent variable: EXVAL		
	(1)	(2)	(3)
Constant	-1.2263***	-1.1868***	-1.4367***
	(0.0682)	(0.0393)	(0.0709)
NUM_4d	-0.1343***		
	(0.0138)		
HERF_4d		-1.1105***	
		(0.0474)	
TENTROPY			-0.3386***
			(0.0599)
Interaction effects			
NUM_4d x dumLEV	0.0352*		
	(0.0211)		
HERF_4d x dumLEV		0.1569***	
		(0.0523)	
TENTROPY x dumLEV			0.1968**
			(0.0888)
NUM_4d x dumLEV x dumRE	-0.1183***		
	(0.0137)		
HERF_4d x dumLEV x dumRE		-0.3796***	
		(0.0298)	
TENTROPY x dumLEV x dumRE			-0.4097***
			(0.0451)
Leverage			
dumLEV	-0.0679	-0.0463**	-0.0969*
	(0.0582)	(0.0200)	(0.0514)
Relatedness			
dumRE	0.1090***	0.0995***	0.0626*
	(0.0293)	(0.0108)	(0.0323)
Other control variables			
LTA	0.2836***	0.2929***	0.2977***
	(0.0063)	(0.0034)	(0.0068)
EBITsales	0.6252***	0.2302***	0.2702***
	(0.0357)	(0.0158)	(0.0275)
CAPEXsales	1.3234***	1.8625***	2.0696***
	(0.0792)	(0.0300)	(0.0655)
VOLATILITY	-8.1418***	-7.1384***	-7.9558***
	(0.6413)	(0.1944)	(0.4470)
dumINDUSTRY	YES	YES	YES
dumYEAR	YES	YES	YES
No. of Obs.	2,708	2,708	2,708
Wald test	17220.85***	424658.47***	43646.75***
m_1 statistic	-4.89***	-4.72***	-4.71***
m_2 statistic	-0.82	-1.53	-1.47
p-value m_2 test	0.413	0.125	0.140
Hansen test	290.33	328.90	296.68
p-value Hansen test	0.323	0.628	0.527

This table reports the two-step GMM system estimations of Eq. [5]. As the GMM requires data to be available for at least four consecutive years for each firm, this requirement, together with the fact that we are only considering the subsample of diversified firms, restricts the sample size to 2,708 observations. Excess value (*EXVAL*) is regressed on the level of diversification and the interaction term of diversification, leverage, and relatedness. *NUM_4d* (number of business segments at the 4-digit SIC code level), *HERF_4d* (the Herfindahl index at the 4-digit SIC code level), and *TENTROPY* (the entropy index) are alternative measures for the level of diversification. *dumLEV* (coded 1 if the ratio of total debt to the book value of assets is above the sample mean, and 0 otherwise) proxies for a firm's leverage. *dumRE* proxies for business relatedness and is coded 1 if a firm's diversification related entropy is above the sample mean and 0 otherwise. A firm's size (*LTA*), profitability (*EBITsales*), level of investment (*CAPEXsales*), standard deviation of daily returns (*VOLATILITY*), industry effects (*dumINDUSTRY*), and time effects (*dumYEAR*) are controlled in all estimations. The Wald statistic tests the null hypothesis of no joint significance of the explanatory variables.

Arellano-Bond's m_1 and m_2 statistics test for the lack of first-order and second-order serial correlation, respectively, in the first difference residuals. The Hansen J-statistic is the test of over-identifying restrictions and contrasts the requirement of instrument exogeneity. Standard errors are shown in parentheses under the coefficients. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 9
Diversification, leverage, growth opportunities, and excess value controlling for endogeneity (GMM)

Model Excess Value=(Diversification, Diversification x Leverage, Diversification x Leverage x Skewness, control variables)			
	Dependent variable: EXVAL		
	(1)	(2)	(3)
Constant	-1.1021***	-0.5856***	-0.6566***
	(0.0709)	(0.0645)	(0.0739)
NUM_4d	-0.0674***		
	(0.0064)		
HERF_4d		-0.3016***	
		(0.0108)	
TENTROPY			-0.1525***
			(0.0233)
Interaction effects			
NUM_4d x dumLEV	0.0181***		
	(0.0062)		
HERF_4d x dumLEV		0.1317***	
		(0.0126)	
TENTROPY x dumLEV			0.0317
			(0.0243)
NUM_4d x dumLEV x dumSkewness	-0.0608***		
	(0.0031)		
HERF_4d x dumLEV x dumSkewness		-0.6081***	
		(0.0137)	
TENTROPY x dumLEV x dumSkewness			-0.3478***
			(0.0254)
Leverage			
dumLEV	0.1780***	0.2157***	0.1768***
	(0.0121)	(0.0056)	(0.0158)
Growth opportunities			
dumSkewness	0.0945***	0.0890***	0.0529***
	(0.0076)	(0.0034)	(0.0087)
Other control variables			
LTA	0.1813***	0.0918***	0.0974***
	(0.0037)	(0.0029)	(0.0043)
EBITsales	1.6387***	2.0527***	2.0487***
	(0.0276)	(0.0214)	(0.0307)
CAPEXsales	-0.0299	0.0968***	0.1669***
	(0.0309)	(0.0208)	(0.0540)
VOLATILITY	-1.3779***	-3.5500***	-2.4496***
	(0.3936)	(0.1804)	(0.3756)
dumINDUSTRY	YES	YES	YES
dumYEAR	YES	YES	YES
No. of Obs.	4,436	4,436	4,436
Wald test	80246.64***	2.34e+08***	73985.70***
m_1 statistic	-5.46***	-4.93***	-4.87***
m_2 statistic	-1.33	-0.98	-0.99
p-value m_2 test	0.182	0.329	0.323
Hansen test	320.25	330.51	298.55
p-value Hansen test	0.347	0.742	0.226

This table reports the two-step GMM system estimations of Eq. [6]. As the GMM requires data to be available for at least four consecutive years for each firm, this requirement restricts the sample size to 4,436 observations. Excess value (*EXVAL*) is regressed on the level of diversification and the interaction term of diversification, leverage, and a firm's growth opportunities. *NUM_4d* (number of business segments at the 4-digit SIC code level), *HERF_4d* (the Herfindahl index at the 4-digit SIC code level), and *TENTROPY* (the entropy index) are alternative measures for the level of diversification. *dumLEV* (coded 1 if the ratio of total debt to the book value of assets is above the sample mean, and 0 otherwise) proxies for a firm's leverage. *dumSkewness* proxies for a firm's growth opportunities and is coded 1 if a firm's level of growth opportunities (as measured by stock return skewness) is above the sample mean and 0 otherwise. A firm's size (*LTA*), profitability (*EBITsales*), level of investment (*CAPEXsales*), standard deviation of daily returns (*VOLATILITY*), industry effects (*dumINDUSTRY*), and time effects (*dumYEAR*) are controlled in all estimations. The Wald statistic tests the null hypothesis of no joint significance of the explanatory variables. Arellano-Bond's m_1 and m_2 statistics test for the lack of first-order and second-order serial correlation, respectively, in the first difference residuals. The Hansen J-statistic is the test of over-identifying restrictions and contrasts the requirement of instrument exogeneity. Standard errors are shown in parentheses under the coefficients. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 10
Leverage and investment allocation

	PANEL A: Without controlling for Rajan *et al.'s* (2000) diversity				PANEL B: Controlling for Rajan *et al.'s* (2000) diversity			
	Dependent variable				Dependent variable			
	ind_INVEST	firmind_INVEST	ind_INVEST	firmind_INVEST	ind_INVEST	firmind_INVEST	ind_INVEST	firmind_INVEST
	High Q segments		Low Q segments		High Q segments		Low Q segments	
Constant	-0.0531***	-0.0074***	-0.0365***	0.0011***	-0.0414***	-0.0198***	-0.0517***	-0.0263***
	(0.0088)	(0.0024)	(0.0056)	(0.0100)	(0.0094)	(0.0058)	(0.0069)	(0.0033)
Inverse_q	0.0001***	0.0001***	-0.0001*	-0.0001***	0.0002***	0.0002***	-0.0001**	-0.0001***
	(0.0001)	(3.56e-06)	(0.0001)	(0.0001)	(7.43e-06)	(0.0001)	(0.0001)	(5.37e-06)
SIZE	0.0064***	-0.0004***	0.0001	0.0009***	-0.0018***	0.0021***	0.0013***	0.0038***
	(0.0006)	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0004)	(0.0002)	(0.0001)
LEV	-0.0001	0.0307***	-0.0389***	-0.0132***	0.0348***	0.0286***	-0.0402***	-0.0123***
	(0.0067)	(0.0017)	(0.0030)	(0.0012)	(0.0007)	(0.0042)	(0.0038)	(0.0079)
DIVERSITY					-0.0122***	-0.0268***	0.0102***	0.0323***
					(0.0002)	(0.0032)	(0.0009)	(0.0001)
dumYEAR	YES	YES	YES	YES	YES	YES	YES	YES
No. of Obs.	2,807	2,807	1,329	1,329	1,275	1,275	1,275	1,275
Wald test	451.44***	22613.28***	61844.93***	31954.93***	5.72e+07***	4601.42***	1.21e+07***	3.59e+06***
m_1 statistic	-1.71*	-1.71*	-1.73	-2.87**	-1.22	-1.14	-1.63	-2.69
m_2 statistic	-0.86	-0.93	-1.38	-0.56	-0.94	-1.20	-1.41	-0.46
p-value m_2 test	0.389	0.350	0.167	0.574	0.348	0.232	0.159	0.647
Hansen test	127.52	151.51	87.21	89.11	173.82	98.85	90.63	172.58
p-value Hansen test	0.445	0.277	0.677	0.623	0.304	0.887	0.550	0.580

This table reports the GMM estimations of equation [8]. Our sample size changes as a result of employing different subsamples in each regression. The industry-adjusted investment ratio (*ind_INVEST*) and firm- and industry-adjusted investment ratio (*firmind_INVEST*) are regressed on the inverse of average Q (*Inverse_q*), *SIZE* (a firm's size as measured by the natural logarithm of total sales), *LEV* (a firm's leverage as proxied by the ratio of total debt to the book value of assets), and *DIVERSITY* (Rajan *et al.*'s (2000) measure of diversity in investment opportunities between segments). Time effect (*dumYEAR*) is controlled in all estimations. The Wald statistic tests the null hypothesis of no joint significance of the explanatory variables. Arellano-Bond's m_1 and m_2 statistics test for the lack of first-order and second-order serial correlation, respectively, in the first difference residuals. The Hansen J-statistic is the test of over-identifying restrictions and contrasts the requirement of instrument exogeneity. Standard errors are shown in parentheses under the coefficients. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 11
Diversification, leverage, and excess value –
By subsamples of firms with below median and above median diversification

Model Excess Value=(Diversification, Diversification x Leverage, control variables)						
	Dependent variable: EXVAL					
	Panel A: BELOW MEDIAN DIVERSIFIED FIRMS			Panel B: ABOVE MEDIAN DIVERSIFIED FIRMS		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-1.3399*** (0.2101)	-1.5064*** (0.1503)	-1.5067*** (0.1503)	-1.2717*** (0.2135)	-1.0507*** (0.2052)	-1.1214*** (.1978)
NUM_4d	-0.1675 (0.1322)			0.0231 (0.0712)		
HERF_4d		-0.2149 (2.4924)			-0.4676 (0.3082)	
TENTROPY			-0.2159 (1.1334)			-0.1916 (0.1793)
Interaction effects						
NUM_4d x dumLEV	0.3908*** (0.1359)			-0.0664 (0.0722)		
HERF_4d x dumLEV		4.5353* (2.5445)			0.1988 (0.3366)	
TENTROPY x dumLEV			2.1794* (1.1515)			0.0335 (0.1892)
Leverage						
dumLEV	-0.5469*** (0.1576)	-0.1309** (0.0533)	-0.1340** (0.0534)	0.1448 (0.1861)	-0.0999 (0.1607)	-0.0403 (0.1477)
Control variables	YES	YES	YES	YES	YES	YES
dumINDUSTRY	YES	YES	YES	YES	YES	YES
dumYEAR	YES	YES	YES	YES	YES	YES
No. of Obs.	3,777	3,777	3,777	3,776	3,776	3,776
F-test	162.48***	161.51***	161.85***	12.00***	12.01***	12.04***
R^2	0.1634	0.1618	0.1620	0.1999	0.2023	0.2011

This table reports the OLS estimations of Eq. [4] with clustered standard errors by subsamples of firms with below median and above median diversification. Our sample size changes as a result of taking different subsamples. Excess value (*EXVAL*) is regressed on the level of diversification and the interaction term of diversification and leverage. *NUM_4d* (number of business segments at the 4-digit SIC code level), *HERF_4d* (the Herfindahl index at the 4-digit SIC code level), and *TENTROPY* (the entropy index) are alternative measures for the level of diversification. *dumLEV* (coded 1 if the ratio of total debt to the book value of assets is above the sample mean, and 0 otherwise) proxies for a firm's leverage. A firm's size (*LTA*), profitability (*EBITsales*), level of investment (*CAPEXsales*), standard deviation of daily returns (*VOLATILITY*), industry effects (*dumINDUSTRY*), and time effects (*dumYEAR*) are controlled in all estimations. The F statistic tests the null hypothesis of no joint significance of the explanatory variables. Standard errors are shown in parentheses under the coefficients and are clustered at the firm-level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 12
Diversification, leverage, ownership concentration, and excess value

Model Excess Value=(Diversification, Diversification x Leverage, control variables)						
	Dependent variable: EXVAL					
	Panel A: Low ownership concentration			Panel B: High ownership concentration		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-0.8894***	-0.9779***	-0.9835***	-1.8723***	-1.9160***	-1.9180***
	(0.1514)	(0.1467)	(0.1469)	(0.1898)	(0.1666)	(0.1667)
NUM_4d	-0.0981**			-0.0421		
	(0.0427)			(0.0644)		
HERF_4d		-0.4537***			-0.0928	
		(0.1501)			(0.1901)	
TENTROPY			-0.2639***			-0.0480
			(0.0918)			(0.1233)
Interaction effects						
NUM_4d x dumLEV	0.0947**			0.0063		
	(0.0457)			(0.0737)		
HERF_4d x dumLEV		0.3525**			-0.0068	
		(0.1647)			(0.2217)	
TENTROPY x dumLEV			0.2063**			-0.0214
			(0.0999)			(0.1431)
Leverage						
dumLEV	-0.2295***	-0.1341***	-0.1313***	-0.0236	-0.0137	-0.0108
	(0.0765)	(0.0466)	(0.0461)	(0.1066)	(0.0561)	(0.0560)
Other control variables						
OWNERSHIP	0.3453	0.3210	0.1469	-0.2186	-0.2166	-0.2165
	(0.2506)	(0.2495)	(0.2498)	(0.1449)	(0.1438)	(0.1440)
LTA	0.1396***	0.1397***	0.1399***	0.2700***	0.2699***	0.2699***
	(0.0155)	(0.0156)	(0.0156)	(0.0177)	(0.0177)	(0.0177)
EBITsales	0.3563***	0.3537***	0.3545***	0.1826*	0.1822*	0.1822*
	(0.0954)	(0.0953)	(0.0953)	(0.0959)	(0.0960)	(0.0959)
CAPEXsales	0.6594***	0.6484***	0.6500***	0.9289***	0.9323***	0.9318***
	(0.0927)	(0.0920)	(0.0921)	(0.1674)	(0.1686)	(0.1685)
VOLATILITY	-4.696**	-4.7099**	-4.7090**	-0.0030***	-0.0030***	-0.0030***
	(1.8658)	(1.8742)	(1.8750)	(0.0002)	(0.0002)	(0.0002)
dumINDUSTRY	YES	YES	YES	YES	YES	YES
dumYEAR	YES	YES	YES	YES	YES	YES
No. of Obs.	7,615	7,615	7,615	5,219	5,219	5,219
F-test	11.04***	10.82***	10.82***	48.46***	48.37***	48.41***
R^2	0.1278	0.1295	0.1289	0.1880	0.1879	0.1878

This table reports the OLS estimations of Eq. [4] with clustered standard errors controlling for ownership concentration. Our sample size changes as a result of taking different subsamples. Excess value (*EXVAL*) is regressed on the level of diversification and the interaction term of diversification and leverage. *NUM_4d* (number of business segments at the 4-digit SIC code level), *HERF_4d* (the Herfindahl index at the 4-digit SIC code level), and *TENTROPY* (the entropy index) are alternative measures for the level of diversification. *dumLEV* (coded 1 if the ratio of total debt to the book value of assets is above the sample mean, and 0 otherwise) proxies for a firm's leverage. A firm's ownership concentration (*OWNERSHIP*), size (*LTA*), profitability (*EBITsales*), level of investment (*CAPEXsales*), standard deviation of daily returns (*VOLATILITY*), industry effects (*dumINDUSTRY*), and time effects (*dumYEAR*) are controlled in all estimations. The F statistic tests the null hypothesis of no joint significance of the explanatory variables. Standard errors are shown in parentheses under the coefficients and are clustered at the firm-level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

APPENDIX

Table A.1.
Variable definitions

Variable	Description	Label
Dependent variable		
Excess value	The natural logarithm of the ratio of a firm's market value to its imputed value (Berger and Ofek, 1995).	EXVAL
Degree of diversification		
Number of segments (4-digit SIC level)	Number of a firm's business segments at the 4-digit SIC code level.	NUM_4d
Herfindahl index (4-digit SIC level)	Herfindahl index (Hirschman, 1964) based on a firm's 4-digit SIC code degree of diversification.	HERF_4d
Total entropy	Total entropy index (Jacquemin and Berry, 1979).	TENTROPY
Leverage		
Leverage	The ratio of total debt to the book value of assets (Frank and Goyal, 2009).	LEV
Leverage dummy	Coded 1 if the ratio of total debt to the book value of assets is above the sample mean and 0 otherwise.	dumLEV
Relatedness		
Related entropy dummy	Coded 1 if the related entropy measure (Jacquemin and Berry, 1979) is above the sample mean and 0 otherwise.	dumRE
Growth opportunities		
Skewness dummy	Coded 1 if the stock return skewness (used as a proxy for a firm's growth opportunities: Andrés *et al.*, 2006; Trigeorgis and Lambertides, 2014; Del Viva *et al.*, 2017) is above the sample mean and 0 otherwise.	dumSkewness
R&D dummy	Coded 1 if a firm's R&D to sales ratio (used as a proxy for a firm's growth opportunities: Grullon *et al.*, 2012) is above the sample mean and 0 otherwise.	dumRDsales
Other control variables		
Firm's size	The natural logarithm of the book value of total assets.	LTA
Firm's profitability	The ratio of EBIT to total sales.	EBITsales
Firm's level of investment	The ratio of capital expenditures to total sales.	CAPEXsales
Firm's annual returns volatility	The standard deviation of the firm's daily returns during each year (Grullon *et al.*, 2012).	VOLATILITY
Industry dummies	Industry dummies based on major groups of industries as defined by the U.S. Department of Labor. The industry dummy j is coded 1 if the firm's core business belongs to industry j and 0 otherwise.	dumINDUSTRY
Year dummies	The year dummy k takes the value of 1 if the firm-year observation belongs to year k and 0 otherwise.	dumYEAR