Diversification and Organizational Environment: The Effect of Resource Scarcity and Complexity on the Valuation of Multi-Segment Firms

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Forthcoming: Journal of Business Economics

In this study, we examine the effect of corporate diversification on firm valuation and the extent to which resource scarcity and complexity of the organizational environment moderate this relationship. Analyzing a dataset of 4,437 North American firms that covers the years 1998 through 2015, we find that diversification reduces firm valuation. In addition, we find that resource scarcity significantly decreases and that environmental complexity significantly increases this diversification discount. Our findings emphasize the relevance of environmental resource endowment and complexity when determining the value of multi-segment firms.

JEL classification: G11, G14, G31, L22, L25

Keywords: Firm valuation, multi-segment firms, environmental conditions, resource scarcity, complexity

1 Introduction

Corporate diversification has been a focus of researchers and economists since the early 1960s, when the diversified corporate structure became the prevalent organizational form of industrial firms (Davis, Diekmann, and Tinsley 1994). However, the costs and benefits of corporate diversification and its overall effect on the valuation of multi-segment firms still remain a controversial issue in literature (e.g., Lang and Stulz 1994, Berger and Ofek 1995, Servaes 1996, Villalonga 2004, Hovakimian 2011, and Matvos and Seru 2014). In this context, internal capital markets (Williamson 1975) have received much attention. This internal market enables corporate managers to allocate internal capital among the firm's business units. On the one hand, studies by Williamson (1975), Gertner, Scharfstein, and Stein (1994), and Fluck and Lynch (1999) and others have argued that corporate managers allocate internal capital within a multi-segment firm more efficiently than external capital market investors do and thus, diversified firms are valued higher than focused firms. On the other hand, studies by Berger and Ofek (1995), Scharfstein and Stein (2000) and Rajan et al. (2000) and others have argued that corporate managers allocate internal capital within a multi-segment firm less efficiently than external capital market investors do, and that power struggles between corporate managers and divisional managers and less effective corporate control and monitoring mechanisms result in multi-segment firms being valued lower than focused firms. In this paper, we argue that the cost–benefit trade-off of internal capital markets, and hence the valuation of multi-segment firms, depends on the environmental conditions a firm is operating in, in particular resource scarcity and environmental complexity.

Resource scarcity reflects the degree to which a lack of resources within an industry hinders the firm from exploiting their growth potential. The level of resource scarcity a firm faces is measured as the mean of asset-weighted fractions of non-dividend-paying firms of all firms operating in the same industries as the firm in question. We argue that resource scarcity reduces the discretion of the corporate manager, increases the efficiency of the internal capital

allocation process and thus reduces the agency costs of internal capital markets. In a context of scarce resources, corporate managers are less likely to indulge in value-destroying investment decisions (e.g., empire building). Resource scarcity reduces the discretion of corporate managers in the internal capital allocation decision-making because a lack of resources reduces the potential investment volume that can be used for rent-seeking actions. Because corporate managers in multi-segment firms tend to have greater managerial discretion (Denis et al. 1997) than corporate managers in focused firms, diversified firms will benefit more from operating in an environment of scarce resources than will focused firms.

Environmental complexity is the second environmental factor that we investigate. A firm's level of environmental complexity is calculated as the mean of asset-weighted research and development (R&D) expenditures of all firms operating in the same industries as the firm in question. Environmental complexity increases the need for specialized knowledge to manage the resource allocation process adequately (Keats and Hitt 1988; Christie et al. 2003). In a typical focused firm, the corporate manager is expected to have specific knowledge of and expertise in the industry in which the firm operates even if environmental complexity is high. However, in a multi-segment firm that operates in several industries, the corporate manager cannot be expected to have such knowledge and expertise in all these industries, and so decision-making tends to be decentralized from the corporate manager to business unit managers. Environmental complexity increases the discretion of these business unit managers in internal capital allocation decisions. Furthermore, environmental complexity complicates knowledge transfer and so makes monitoring of the business unit managers' decision-making more difficult. Higher discretion makes self-serving actions by the business unit manager more likely, which will result in less efficient resource allocations (Scharfstein and Stein 2000). Hence, we argue that environmental complexity reduces the relative value of multi-segment firms compared to focused firms.

Even though this is the first paper that empirically tests the moderating effects of resource scarcity and environmental complexity on the diversification-valuation relationship, prior literature has already tested the influence of contextual conditions on the value of multi-segment firms. Hund et al. (2010) indicate that during periods of economic recession, multi-segment firms increase in value relative to focused firms as a direct result of a lower level in idiosyncratic return volatility. Further, Hovakimian (2011), Matvos and Seru (2014), and Kuppuswamy and Villalonga (2015) show that external market frictions lead to more efficient internal capital markets, resulting in a greater market valuation of multi-segment firms. Hence, our study complements this strand of the literature by deepening understanding of the interplay between diversification, environment, and firm valuation.

To test our hypotheses, we analyze a dataset of 4,437 North American multi-segment firms covering the years 1998 through 2015 using firm fixed effects regression models. Our results show that diversified firms are valued lower than peer focused firms. Additionally, we show that both resource scarcity and environmental complexity moderate this relationship, resource scarcity having a significantly positive effect and environmental complexity a significantly negative effect. Our findings are robust to using alternative measures of excess value and a different sample period, as well as to using a dynamic panel GMM estimation that addresses potential endogeneity issues.

The remainder of the paper is structured as follows. Section 2 develops our hypotheses based on theoretical arguments and supported by existing studies. Sections 3 and 4 describe our methodology and present our main results, respectively. Section 5 discusses the findings of our study. Section 6 concludes with a summary.

2 Theory and hypotheses

Contingency theory suggests that a firm's strategic actions and their value implications are not independent of but rather embedded in the firm's environmental conditions (e.g., Donaldson 2001). In the context of corporate diversification, we have identified two such contingencies, namely resource scarcity and environmental complexity, that are likely to play important roles in the valuation of multi-segment firms, albeit for different reasons.

We argue that a lack of resources increases the value of multi-segment firms relative to that of focused firms. Resource scarcity lowers the firm's free cash flow and therefore the amount that is available for the corporate manager's discretion. Specifically, Jensen (1986) shows that high levels of free cash flow result in less efficient resource allocations. This is because a firm with high levels of free cash flow can fund all its projects with its own equity, which prevents the corporate manager from being monitored by outsiders. An absence of free cash flow, however, reduces the discretionary power of the corporate manager and so reduces the opportunity to extract private benefits at the cost of outsiders. Because information asymmetries between the corporate manager and outsiders (Denis et al. 1997) are greater in multi-segment firms, agency problems are more severe, and the level of managerial discretion in the resource allocation process is inherently higher in diversified firms. Thus, we argue that because of greater managerial discretion and its value-destroying implications for the firm, the beneficial effect of resource scarcity will be stronger in diversified firms than in focused firms. Formally stated:

Hypothesis 1 Resource scarcity reduces the diversification discount.

The second contingency factor is environmental complexity. We argue that environmental complexity lowers the value of multi-segment firms relative to that of focused firms. In particular, a complex environment is less predictable, and decisions in this context have

to be made more rapidly to sustain in the market. Thus, environmental complexity induces a firm to transfer the control rights in resource allocations to those who have the best knowledge and skills in managing the needs of the specific industry. In a complex environment, knowledge specialization is required to allocate resources efficiently (Keats and Hitt 1988; Christie et al. 2003). In focused firms, this controlling entity in the resource allocation process is typically the corporate manager, who usually has the greatest relevant skills and (industry) knowledge. Multi-segment firms operate in several industries, making it less likely for the corporate manager to have expertise in all industries to the same extent. In consequence, a diversified firm decentralizes the decision-making from the corporate manager to business unit managers who have the specialized knowledge in their particular industry. Such decentralization increases the decision power of the business unit manager. The higher the environmental complexity, the more specialized the knowledge. This in turn complicates knowledge transfer and monitoring of the business unit managers' decision-making, which increases the business unit manager's discretion in resource allocations even further. Therefore, inefficient resource allocations through the business unit manager's rent-seeking behavior are more likely to occur (Scharfstein and Stein 2000). Hence, we suppose that the greater likelihood of self-serving investments by business unit managers in the resource allocation process causes multi-segment firms to have a lower valuation in a complex environment. Formally stated:

Hypothesis 2 Environmental complexity increases the diversification discount.

3 Methods

3.1 Data and sample

The initial sample to test our hypotheses is composed of business unit- and firm-level data we have collected from *Compustat Fundamental*, *Compustat Industry Segment*, and the *Center for Research in Security Prices* database. The sample period covers the years 1998 through 2015. The start date of our initial sample is motivated by a change in the financial segment reporting standards of multi-segment firms that became effective in December 1997 (Statement of Financial Accounting Standards (SFAS) 131 superseded SFAS 14). In this context, Berger and Hann (2003) and Villalonga (2004) advise that the segment information reported before this change in reporting standards is not directly comparable with that reported since, which makes it reasonable to restrict our sample period to data reported after 1997.

Before merging the data from the three different databases, we treated in each firm and for each year business units with a common industry classification on the three-digit SIC level as a single business unit by aggregating the reported data from the individual business units (Villalonga 2004). Further, and in line with previous studies, we excluded from our initial sample all business units with missing industry classification, all business units that lacked competitors in a specific year, and all business units with a single-year appearance (McGahan and Porter 1997; Cleary 1999). In addition, we excluded all firms lacking a primary industry classification, all firms operating in unclassified or financial industries (SIC codes in 6000s and above 9000), all firms with average sales below $20 million, and all firms for which the sum of the business unit assets deviates from the firm assets by more than 25 percent (Berger and Ofek 1995). Finally, we excluded all firms that hold American Depositary Receipts. This procedure results in a final sample of 32,883 firm-year observations of 4,437 firms operating in 330 industries on the three-digit SIC-level that was used for testing our hypotheses.

3.2 Variables

3.2.1 Excess Value

Excess value, as derived from Berger and Ofek (1995), was operationalized by calculating the natural logarithm of the ratio between a firm's Tobin's q (hereafter, q) and its imputed q for each year and each firm in our sample. Specifically, a firm's q is measured by dividing the market capitalization of equity plus the book value of debt by the book value of assets. Imputed q is calculated as the business unit's asset-weighted q. For a robustness check, we also used sales-weighted q as an alternative measurement of the imputed q. Because q is not available on the business unit level, we approximated the business unit q by the median q of at least five focused firms operating in the same industry. To fulfill the criterion that at least five focused firms were included in this calculation, we stepwise integrated focused firms based on their SIC-Code industry classification. Specifically, when a business unit had less than five focused firms operating in the same industry on the three-digit SIC-level, we integrated the q of focused firms from the broader two-digit SIC-level until the criterion was satisfied. A positive (negative) value of the construct indicates that the firm is valued higher (lower) than its industry median: The higher the excess value the greater the valuation of the firm.

3.2.2 Diversification

Diversification denotes the number of industries on a three-digit SIC-level a firm is operating in. Firms operating in more than one industry are classified as multi-segment firms. This variable was entered in the regression models as a dummy variable, where a coding of 1 indicates multi-segment firms and 0 indicates focused firms.

3.2.3 Resource scarcity

Resource scarcity describes a situation in which firms do not generate sufficient free cash flow to pay out dividends. In other words, in a context of resource scarcity, firms have limited access to resources that can be deployed for investments and so tend to cut dividend payments in order to save resources for (future) investments. We therefore measure environment resource scarcity for each firm and each year by calculating the mean of asset-weighted fractions of non-dividend-paying firms of all firms operating in the same industries as the firm in question.[1] The pharmaceutical industry is an example in which resources are scarce because specific knowledge and commodities are needed for the development and production of new products. That is, firms operating in this industry need to reinvest resources in order to survive in the market. This in turn reduces a firm's free cash flow, which lowers the firm's ability and willingness to pay dividends. The current steel industry is an example in which resources are typically abundant and reinvestments in new technologies or processes are rare, which makes the payment of dividends for firms in such industries more likely.[2]

3.2.4 Environmental complexity

Environmental complexity describes the degree of complexity within the industry the firm is operating in. Young et al. (1996) and Ferrier (2001) characterize a complex environment by its lower predictability and the higher number of competitive actions, which in turn increases the amount of information needed to make adequate decisions. Because high R&D expenditures are typically associated with high uncertainty and low predictability (Barron et al. 2002), we measure environmental complexity for each firm and each year by calculating the mean of the asset-

[1] We are thankful to an anonymous referee for suggesting this proxy.

[2] We acknowledge the fact that firms may also fail to pay dividends for reasons other than a lack of free cash flow, for example, because of specific dividend policies to accumulate capital. Because such policies are typically unobserved, our proxy may suffer from a measurement error that leads to a downward bias of our effects toward zero.

weighted R&D expenditures of all firms operating in the same industries as the firm in question.[3] The IT industry, for example, is characterized by a high level of discontinuous technological change, which in turn reduces the predictability of future development and so complicates decision-making in the resource allocation process. Therefore, firms in such an environment face high environmental complexity. In contrast, firms operating in the clothing industry face low environmental complexity because radical changes in technologies or processes that would make future development unpredictable are less likely.

3.2.5 Controls

We included variables that previous studies (e.g., Berger and Ofek 1995; Campa and Kedia 2002; Hund et al. 2010; Hoechle et al. 2011; Kuppuswamy and Villalonga 2015) have identified as determinants of firm valuation as controls in our regression models. *Capital intensity* is defined as the ratio of the firm's capital expenditures to its assets. *Dividends paid* is defined as a dummy variable, where a coding of 1 indicates that the firm paid dividends and 0 indicates it did not. *Cash flow* is defined as the ratio of operating income after depreciation to assets. *Leverage* is defined as the sum of long-term debt and debt in current liabilities divided by assets. *Earnings before interest and taxes* is defined as the net income plus interest and taxes divided by assets. *Firm size* is defined as the natural logarithm of firm assets. *Sales growth* is defined as the yearly growth rate of the firm's sales. *Level of diversification* reflects the degree to which the firm's total assets are fragmented among its individual business units and is measured by the following formula:

$$Entropy = \sum_{i=1}^{n} p_i ln(1/p_i) \quad (1)$$

[3] We are thankful to an anonymous referee for suggesting this proxy.

where p_i is calculated as the ratio of business unit *i*'s assets to the firm's total assets within a firm with *n* different business units. *Fraction of diversified firms* reflects the industry attractiveness of multi-segment firms and is operationalized as the fraction of multi-segment firms within the industry. *External financing constraints* is defined as a dummy variable, where a coding of 1 indicates that the firm is constrained in their external financing and 0 otherwise. To determine whether a firm is subject to external financing constraints or not, we used the following formula derived by Lamont et al. (2001):

$$KZ - Index_{jt} = -1.002\ Cashflow_{jt} + 3.139\ Debt_{jt} - 39.368\ Dividends_{jt} - 1.315\ Cash_{jt} + 0.283\ TobinsQ_{jt} \quad (2)$$

where low levels of cash flow, dividends, and cash and high levels of debt and Tobin's q indicate a higher level of external financing constraints. We define a firm as financially constrained in a given year (coding 1) if the result of this calculation exceeds the 66th percentile of the KZ-Index in a given year. *Product market competition* considers the concentration and heterogeneity of the industry and is measured by the following formula:

$$Market\ Competition_{it} = 1 - \sum_{j=1}^{n} (market\ share_{ijt})^2 \quad (3)$$

where *market share* is the business unit *j*'s contribution of sales to consolidated total sales within the industry on the three-digit SIC-level. Subscript *i* denotes the firm, *j* the business unit, and *t* the year.

All variables in our final regression model were winsorized at the 1st and 99th percentiles to mitigate the influence of outliers on our coefficient estimates. Further, year dummies were included in all regression models to control for specific time trends. A detailed description and

the data source of all variables used for coefficient estimation are provided in Table A1 in the Appendix.

3.3 Model specification and estimation

To test our hypotheses, we ran panel fixed effects regressions of excess value on diversification, resource scarcity and environmental complexity, the interactions between diversification and resource scarcity as well as between diversification and environmental complexity, and several controls. We compute robust standard errors clustered at the firm-level. The interaction variables were standardized prior to the interaction to increase the interpretability of the regression results and to reduce multicollinearity of the interaction variables (Cronbach 1987). The Hausman specification test (Hausman 1978) was significant (χ^2=152.78, p=0.000), indicating that a random effects model inadequately describes firm-level effects. By using a firm fixed effects model, we controlled for time-constant firm heterogeneity. The full model is as follows:

$$
\begin{aligned}
Excess\ Value_{ti} \;=\; & \beta_{0i} + \beta_{1i}(Diversification)_{ti} \\
& + [\beta_{2i}(Diversification \times Resource\ Scarcity)_{ti}] \\
& + [\beta_{3i}(Diversification \times Complexity)_{ti}] \\
& + \beta_{4i}(CAPEX/assets)_{ti} + \beta_{5i}(Dividends\ paid)_{ti} + \beta_{6i}(Cash\ flow/assets)_{ti} \\
& + \beta_{7i}(Leverage)_{t-1ij} + \beta_{8i}\left(\frac{EBIT}{assets}\right)_{ti} + \beta_{8i}(Firm\ size)_{ti} \\
& + \beta_{10i}(Sales\ growth)_{ti} + \beta_{11i}(Level\ of\ diversification)_{ti} \\
& + \beta_{12i}(Fraction\ of\ diversified\ firms)_{ti} \\
& + \beta_{13i}(External\ financing\ constraints)_{ti} \\
& + \beta_{14i}(Product\ market\ competition)_{ti} + \varepsilon_{ti}
\end{aligned}
\tag{4}
$$

where *t* denotes the year and *i* the firm.

4 Results

4.1 Univariate analysis

Table 1 reports the mean values, the standard deviations, and the differences in the means between the multi-segment firms and the focused firms. Whereas multi-segment firms have a mean excess value of –0.04 and a standard deviation of 0.51, focused firms have a mean excess value of 0.10 and a standard deviation of 0.40. The difference is statistically significant at the 1% level. Table 1 also shows that multi-segment firms are operating in an environment with significantly lower resource scarcity and significantly higher environmental complexity than focused firms. The last column in Table 1 shows that not only the mean values of the independent and moderator variables but also the mean values of the control variables differ significantly between multi-segment and focused firms. These differences confirm the importance of controlling for these firm characteristics that previous studies have identified as firm value determinants (e.g., Berger and Ofek 1995; Campa and Kedia 2002; Hund et al. 2010; Hoechle et al. 2011; Kuppuswamy and Villalonga 2015).

Insert Table 1 about here

Table 2 reports the correlations among our variables. The correlation between excess value and diversification is statistically significant and negative. Further, both resource scarcity and environmental complexity are also significantly negatively correlated with excess value.

Insert Table 2 about here

4.2 Multivariate analysis

4.2.1 Resource scarcity, environmental complexity, and firm valuation

In this study, we have developed arguments for the moderating role of resource scarcity and environmental complexity on the association between diversification and firm valuation and

empirically tested these arguments with firm fixed effects regressions. Regression results are reported in Table 3.

Insert Table 3 about here

Results show that the direct effect of corporate diversification on excess value is significantly negative in all regression models (Model 1: b=–0.119, p<0.01; Model 2: b=–0.120, p<0.01; Model 3: b=–0.118, p<0.01). Further, Models 2 and 3 show that the direct effect of resource scarcity on excess value is significantly negative (Model 2: b=–0.072, p<0.01; Model 3: b=–0.058, p<0.01) and that the direct effect of environmental complexity on excess value is also significantly negative (Model 2: b=–0.040, p<0.05; Model 3: b=–0.038, p<0.05).

Model 3 additionally includes an interaction term of diversification and resource scarcity to test Hypothesis 1, which predicts a positive moderating effect of resource scarcity on the association between diversification and firm valuation. The interaction effect of diversification and resource scarcity is significantly positive (b=0.022, p<0.01), confirming Hypothesis 1. The diversification discount is lower in an environment of scarce resources.

Model 3 also includes an interaction term of diversification and environmental complexity to test Hypothesis 2, which predicts a negative moderating effect of environmental complexity on the diversification/valuation-relationship. The interaction effect of diversification and environmental complexity is indeed statistically negative (b=–0.015, p<0.01), confirming Hypothesis 2. The diversification discount is magnified when the multi-segment firm is operating in a complex environment. [4]

[4] Because the excess value measurement introduced by Berger and Ofek (1995) uses the book value of debt and because the book values of debt may be a more downward-biased proxy of the market value of debt for multi-segment firms than for focused firms (Mansi and Reeb 2002; Glaser and Müller 2010), the diversification discount may be exaggerated. However, we do not expect this bias to affect our interaction effects as we assume that resource scarcity and environmental complexity generally increase a firm's debt risk. We are thankful to an anonymous referee for making us aware of the potential bias of the book value of debt.

Further, for all regression models we find that our controls *capital intensity*, *cash flow*, *earnings before interest and taxes*, and *fraction of diversified firms* significantly increase the firm's excess value and that the *level of diversification* and *external financing constraints* significantly decrease the firm's excess value.

4.2.2 Resource scarcity, environmental complexity, and internal capital allocation efficiency

While the question of whether internal capital allocations are more or less efficient than the capital allocations made by external capital providers is highly controversial (e.g., Williamson 1975, Fluck and Lynch 1999, Shin and Stulz 1998, Scharfstein 1998, Scharfstein and Stein 2000), there is a broad consensus that the efficiency of internal capital allocation is an important factor in understanding the value of diversification. In the previous analyses we found that resource scarcity lowered the diversification discount and that environmental complexity amplified the diversification discount. If the heterogeneity of the internal capital allocation efficiency is a channel of the documented moderating influence, we expect that resource scarcity increases and that environmental complexity decreases the internal capital allocation efficiency of multi-segment firms. Using a subsample of multi-segment firms, we test these predictions. We measure internal capital allocation efficiency with the following formula introduced by Rajan et al. (2000):

$$Efficiency = \sum_{j=1}^{n} \omega_j (q_j - \bar{q}) \left\{ \frac{Capex_j}{BA_j} - \left(\frac{Capex}{BA} \right)_{indj} - \sum_{j=1}^{n} \omega_j \left[\frac{Capex_j}{BA_j} - \left(\frac{Capex}{BA} \right)_{indj} \right] \right\} \quad (4)$$

where ω_j is the portion of business unit j assets to firm's total assets, q_j is the Tobin's q of the business unit j , $\bar{q}$ the mean Tobin's q of all segments within the considered multi-segment firm, $Capex_j$ the capital expenditure of the business unit j, BA_j the book value of business unit j assets,

and $\left(\frac{Capex}{BA}\right)_{indj}$ the ratio of capital expenditure to book value of assets, and *n* the total number of business units within the multi-segment firm.

To eliminate confounding effects of factors that correlate with resource scarcity, environmental complexity and internal capital allocation efficiency, we include control variables that are typically included in internal capital allocation efficiency models (e.g., Rajan et al. 2000, Campa and Kedia 2002). Specifically, we include Tobin's q, firm size, cost of capital, external financing constraints, product market competition, industry-adjusted leverage, industry-adjusted capital intensity, and industry-adjusted ROA as controls. Because the Hausman specification test was significant, we estimate a firm fixed effects model that takes all time-constant firm heterogeneity into account.

Insert Table 4 about here

The results in Table 4 show that resource scarcity significantly increases and that environmental complexity significantly decreases internal capital allocations efficiency. Thus, our results indicate that the internal capital market is indeed an important channel through which the beneficial effect of resource scarcity and the detrimental effect of environmental complexity on the valuation of multi-segment firms can be explained.

4.3 Robustness tests

4.3.1 Test for endogeneity

A firm's decision to diversify may depend on (unobserved) firm characteristics (e.g., Campa and Kedia 2002; Villalonga 2004), rendering our diversification dummy endogenous. Our environmental moderator variables resource scarcity and environmental complexity may also be endogenous if a firm's decision to enter an industry depends on unobserved factors that also influence the firm's excess value. According to Wintoki et al. (2012) there are three types of

endogeneity that may play an important role in this context: unobservable heterogeneity, simultaneity, and a dynamic relationship between current values of the independent variables (here, diversification) and (past) values of the dependent variable (here, excess value).

To address these endogeneity concerns, we re-estimated our regressions by using a dynamic panel GMM estimator with first-differenced variables. First, to control for a dynamic relationship between diversification and past excess values, we entered three lags of the dependent variable as additional controls. Additional analyses (see Table A2 in the Appendix) revealed that only the first three lags are significantly correlated with current firm performance. Second, we first-difference all variables included in the model. This procedure enables us to control for any time-constant firm heterogeneity and simultaneity. Third, we estimate the regression model by using the dynamic panel GMM estimator introduced by Arellano and Bond (1991). The dynamic panel GMM estimator relaxes the condition that all independent variables need to be strictly exogenous – a condition that no longer holds when lagged values of the dependent variable are included on the right-hand side of our regression model. Table 5 shows that the direct effect of corporate diversification remains significantly negative, that the interaction effect of resource scarcity and diversification remains significantly positive and that the interaction effect of environmental complexity and diversification remains significantly negative.

Insert Table 5 about here

4.3.2 Sensitivity tests

In our main specifications we have included observations of the years 1998 through 2015. Data prior to 1998 were not used because of a major change in financial segment reporting standards of multi-segment firms that became effective as of December 1997, which makes the comparison of reported segment information data before and after 1997 difficult (Berger and Hann 2003;

Villalonga 2004). However, to ensure that our findings are not particular to the chosen sample period, we re-ran our regressions on data covering the years 1978 through 1997. The regression results of this sensitivity test (see Table A3 in the Appendix) show that the interaction effect of diversification and resource scarcity remains significantly positive and that the interaction effect of diversification and environmental complexity remains significantly negative.

Further, to rule out that the findings may be driven by our measurement of excess value, we re-estimated our coefficients using a sales-multiplier instead of an asset-multiplier in the calculation of excess value. The regression results of this sensitivity test (see Table A4 in the Appendix) indicate that the regression coefficients remain virtually unchanged, demonstrating that our findings are robust when using a different measure of excess value.

5 Discussion

In this study we have investigated the effect of corporate diversification on firm valuation and how both resource scarcity and environmental complexity affect this association. We provide evidence that corporate diversification significantly reduces firm value. Specifically, we show that multi-segment firms are traded with a discount of between 11 and 12 percent relative to a portfolio of peer focused firms, a discount that is statistically significant at the 0.01 percent level. The magnitude of our diversification discount is similar in size to the diversification discounts found in prior studies (e.g., Lang and Stulz 1994; Berger and Ofek 1995; Servaes 1996). In addition, our results indicate that both resource scarcity and environmental complexity generally decrease the firm's excess value. That is, not only multi-segment firms but also focused firms have a lower valuation when operating in a context of high resource scarcity and environmental complexity. By increasing information asymmetry and uncertainty, the negative effect of environmental complexity is obvious. The negative effect of resource scarcity is surprising as resource scarcity is likely to decrease the agency costs. We find, however, that the negative

effects of a lack of resources and thus a higher probability of a cash shortfall and higher capital costs dominate.

Although we have demonstrated that diversification directly influences the firm value, the focus of this study is the moderating effects of resource scarcity and environmental complexity on this relationship. We find that an environment of scarce resources decreases the diversification discount. An explanation for this moderation effect may be that the agency conflict between the corporate management and outsiders also affects the resource allocation process. Even though both focused firms and multi-segment firms face agency problems between the corporate manager and outsiders, such problems are more severe in diversified organizational structures (Denis et al. 1997). The beneficial effect of scarce resources in terms of reducing managerial discretion and inefficient capital allocations is stronger for multi-segment firms than for focused firms.

An alternative explanation for our result could be the fact that diversified firms have access to an internal capital market, something that is more valuable in a context of scarce resources than in a context of abundant resources. This internal capital market has been proposed by prior works to be one of the most important drivers in determining the value of multi-segment firms (e.g., Stein 1997; Billet and Mauer 2003; Wulf 2009). The theoretical work of Stein (1997) shows that multi-segment firms can make use of "winner-picking", that is the (re)allocation of resources from business units with poor prospects to those with strong prospects. In the same line of arguments, Wan (2005) argues that in an environment of scarce resources, such internal resource allocations can help to sustain growth and so to maintain a competitive advantage. Thus, our findings could also be supported by this perspective in showing that multi-segment firms are valued more highly in an environment of lower resources.

Further, we provide evidence that environmental complexity significantly increases the diversification discount. An explanation for this effect could be that in a complex environment

business unit managers within multi-segment firms are more prone to rent-seeking behavior, resulting in less efficient resource allocations. Specifically, Scharfstein and Stein (2000) highlight that not only the corporate manager but also the business unit managers play an important role in the resource allocation process of multi-segment firms. Because the corporate manager is restricted in his knowledge and skills in managing the needs of the various specific industries a multi-segment firm is operating in, business unit managers receive control rights in the resource allocation process because they are assumed to have the required knowledge. In a context of environmental complexity, such a decentralization of decision-making makes a distortion in the allocation process more likely to occur. This is because environmental complexity encourages business unit managers to entrench themselves in the confidence that knowledge transfer is insufficient to allow informed outside assessment of their decisions and therefore that monitoring of their actions is likely to be neglected or impotent. This greater entrenchment raises the likelihood of business unit managers making value-destroying investment decisions.

Krishnaswami and Subramaniam (1999) provide an alternative explanation of why environmental complexity increases the diversification discount. They argue that investors find it more difficult to value the business units in multi-segment firms than the focal firms in the same industry because information on profitability, operating efficiency, strategy and future prospects is more difficult to obtain and process in the context of a diversified firm. Rather than enabling inefficient internal resource allocation, this information asymmetry causes uncertainty in the mind of the investor, who factors this into valuation of the diversified firm as a discount. Krishnaswami and Subramaniam (1999) find that multi-segment firms, aware of being undervalued, are more likely to spin-off business units into separate entities if information asymmetry is high, seeking to become more transparent by reducing their degree of diversification to make it easier for investors to accurately evaluate the firm's remaining business

units. As environmental complexity goes hand in hand with a higher information asymmetry, we could conclude that investors apply a higher diversification discount when the industry environment is more complex. Nevertheless, the results of Section 4.2.2 demonstrate that environmental complexity significantly reduces the efficiency of internal resource allocation in multi-segment firms and therefore support our argument that agency costs within the internal capital market explain the increased diversification discount in a complex environment.

Another explanation for our findings may be differences in the information processes of multi-segment and focused firms. Specifically, multi-segment firms are by nature characterized by a more inhibited information flow than focused firms because of their greater size and bureaucracy. In such diversified organizational structures, the information essential to effective decision-making is likely to be conveyed more slowly and less completely than in focused firms. In fact, such an information disadvantage, being inherent to all multi-segment firms, could explain the diversification discount per se. However, in a context of environmental complexity, access to such information becomes even more important. This is because complex environmental conditions lower predictability and increase competitive actions (Young et al. 1996; Ferrier 2001). This in turn increases the need for information to make adequate decisions in such environmental conditions to survive in the market. Because multi-segment firms have a more complicated information transfer than focused firms, environmental complexity may lead in this context to an even lower valuation, which helps to explain our findings.

In the development of our theoretical arguments and in the explanation of the empirical evidence of the moderation effects, we argue that the agency costs of internal capital allocations are a crucial factor in determining the beneficial effect of resource scarcity and the detrimental effect of environmental complexity on the valuation of multi-segment firms. To provide evidence of the exact channel of influence, we encourage future studies to examine in more detail the role of agency costs in this context.

In sum, we shed new light on the interplay between diversification, resource scarcity, environmental complexity, and firm valuation. We contribute to the discussion of the benefits and costs of corporate diversification and highlight the important role of internal capital markets, information flow, and potential agency conflicts for the valuation of multi-segment firms. Based on our findings, we encourage future studies to develop arguments for and to empirically test the effects of further environmental factors, such as dynamism, that are likely to play a role in the valuation of multi-segment firms.

6 Conclusion

This study examines the moderating effects of resource scarcity and environmental complexity on the association between diversification and firm valuation. We argue that both environmental dimensions influence the agency costs of multi-segment firms, whose effect can be beneficial as well as harmful to the valuation of such firms. In particular, we suppose that resource scarcity decreases the diversification discount by lowering the agency costs of internal capital allocations, whereas environmental complexity increases the diversification discount by increasing the agency costs due to greater information asymmetries. For our investigation, we have analyzed a dataset of 4,437 North American multi-segment firms covering the years 1998 through 2015 with firm fixed effects regression models, and we find a significant diversification discount. We find empirical evidence that resource scarcity significantly decreases the diversification discount and that environmental complexity significantly increases the diversification discount. These results contribute to the diversification literature by providing new insights into the interplay between diversification, environment, and firm valuation.

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Table 1
Descriptive statistics

	Multi-segment firms (1)		Focused firms (2)		
	Mean	SD	Mean	SD	Difference (1)–(2)
Excess value	–0.04	0.51	0.10	0.40	–0.14***
Resource scarcity	0.31	0.22	0.53	0.29	–0.22***
Complexity	0.08	0.29	0.20	0.68	–0.12***
CAPEX/assets	0.05	0.05	0.06	0.06	–0.01***
Dividends paid	0.73	0.45	0.43	0.50	0.30***
Cash flow/assets	0.09	0.05	0.10	0.06	–0.01***
Leverage	0.91	0.90	0.83	1.02	0.08***
EBIT/assets	0.09	0.06	0.10	0.08	–0.01***
Size	7.83	1.87	6.64	1.72	1.19***
Sales growth	0.24	0.28	0.31	0.29	–0.07***
Level of diversification	0.48	0.36	0.00	0.00	0.48***
Fraction of diversified firms	0.72	0.20	0.41	0.24	0.31***
External financing constraints	0.49	0.50	0.26	0.44	0.23***
Product market competition	0.19	0.20	0.21	0.08	–0.02***
Number of firms	1,169		3,268		
Number of observations	18,829		14,054		

Notes. Panel A reports the summary statistics of firm-specific characteristics for our sample including 18,829 firm-year observations of 1,169 multi-segment firms and 14,054 firm-year observations of 3,268 focused firms covering the period between the years 1998 and 2015.
* Significance at the 10 percent level; ** significance at the 5 percent level; *** significance at the 1 percent level.

Table 2

Correlations among our variables

Variable	N	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Excess value	32,883	0.04	0.47														
2. Diversification	32,883	0.57	0.49	–0.12													
3. Resource scarcity	32,883	0.40	0.38	–0.05	–0.25												
4. Complexity	32,883	0.11	0.44	–0.04	–0.13	0.13											
5. CAPEX/assets	32,883	0.06	0.05	0.03	0.08	–0.01	0.05										
6. Dividends paid	32,883	0.60	0.49	0.02	0.30	–0.60	–0.08	0.05									
7. Cash flow/assets	32,883	0.09	0.06	0.05	0.13	–0.11	–0.09	0.33	0.01								
8. Leverage	32,883	0.87	0.95	–0.01	–0.04	0.14	0.08	0.01	–0.06	–0.23							
9. EBIT/assets	32,883	0.09	0.07	0.03	0.10	–0.05	–0.07	0.08	–0.03	0.76	–0.16						
10. Size	32,883	7.32	1.90	–0.06	0.31	–0.39	0.04	0.04	0.41	0.13	–0.17	0.08					
11. Sales growth	32,883	0.28	0.28	0.05	–0.05	0.14	0.03	0.09	–0.04	0.07	–0.00	0.11	–0.03				
12. Level of diversification	32,883	0.27	0.36	–0.08	0.65	–0.21	–0.09	0.03	0.21	0.06	–0.01	0.03	0.20	–0.03			
13. Fraction of diversified firms	32,883	0.58	0.27	0.02	0.57	–0.48	–0.16	0.07	0.29	0.12	–0.06	0.09	0.25	–0.10	0.43		
14. External financing constraints	32,883	0.39	0.49	–0.03	0.24	0.30	–0.00	0.01	–0.33	–0.14	0.34	–0.09	–0.74	0.01	–0.16	–0.20	
15. Product market competition	32,883	0.20	0.16	0.01	–0.24	–0.04	0.04	–0.02	–0.19	0.01	–0.01	0.04	–0.34	–0.01	–0.31	–0.20	0.25

Notes. Absolute correlations of 0.03 and above are significant at the 5 percent level.

Table 3
Fixed effects results of how diversification and environmental dimensions affect firm valuation

Model	1	2	3
Dependent variable	Excess value	Excess value	Excess value
Diversification	–0.119***	–0.120***	–0.118***
	(0.012)	(0.012)	(0.011)
Resource scarcity		–0.072***	–0.058***
		(0.015)	(0.015)
Complexity		–0.040**	–0.038**
		(0.019)	(0.020)
Diversification × Resource scarcity			0.022***
			(0.004)
Diversification × Complexity			–0.015***
			(0.004)
CAPEX/assets	0.237***	0.236***	0.237***
	(0.064)	(0.064)	(0.064)
Dividends paid	0.010	0.011	0.011
	(0.008)	(0.008)	(0.008)
Cash flow/assets	0.182**	0.182**	0.180**
	(0.087)	(0.087)	(0.087)
Leverage	0.001	0.001	0.001
	(0.004)	(0.004)	(0.004)
EBIT/assets	0.463***	0.466***	0.459***
	(0.073)	(0.073)	(0.073)
Firm size	0.012	0.011	0.011
	(0.007)	(0.006)	(0.006)
Sales growth	0.024	0.024	0.024
	(0.014)	(0.015)	(0.014)
Level of diversification	–0.068***	–0.067***	–0.063***
	(0.016)	(0.016)	(0.016)
Fraction of diversified firms	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)
External financing constraints	–0.019*	–0.019*	–0.019*
	(0.010)	(0.010)	(0.010)
Product market competition	0.009	0.008	0.010
	(0.021)	(0.021)	(0.020)
Intercept	–0.049	–0.037	–0.142**
	(0.054)	(0.054)	(0.054)
Firm fixed effects	YES	YES	YES
Year fixed effects	YES	YES	YES
Number of firms	4,437	4,437	4,437
Number of observations	32,883	32,883	32,883
R^2 (within)	0.06	0.06	0.08

Notes. Fixed effects regression results with firm-clustered robust standard errors in parentheses are shown. The sample includes 32,883 firm-year observations of 4,437 multi-segment and focused firms covering the period between the years 1998 and 2015.
* Significance at the 10 percent level; ** significance at the 5 percent level; *** significance at the 1 percent level.

Table 4

Effects of environmental dimensions on the internal capital allocation efficiency of multi-segment firms

Model	1	2
Dependent variable	Internal capital allocation efficiency	Internal capital allocation efficiency
		0.031*
		(0.015)
		–0.007**
		(0.003)
Tobin's q	0.120***	0.121***
	(0.034)	(0.034)
Firm size	0.199	0.198
	(0.130)	(0.130)
Cost of capital	–0.000	–0.001
	(0.001)	(0.001)
External financing constraints	0.079**	0.077**
	(0.035)	(0.036)
Product market competition	0.266	0.241
	(0.164)	(0.160)
Industry-adjusted leverage	0.088***	0.083***
	(0.029)	(0.029)
Industry-adjusted capital intensity	0.034	0.037*
	(0.020)	(0.020)
Industry-adjusted ROA	0.122*	0.120*
	(0.068)	(0.069)
Intercept	–0.216***	–0.198***
	(0.021)	(0.024)
Firm fixed effects	YES	YES
Year fixed effects	YES	YES
Number of firms	1,169	1,169
Number of observations	18,829	18,829
R^2 (within)	0.27	0.30

Notes. Fixed effects regression results with firm-clustered robust standard errors in parentheses are shown. The sample includes 18,829 firm-year observations of 1,169 multi-segment covering the period between the years 1998 and 2015.

* Significance at the 10 percent level; ** significance at the 5 percent level; *** significance at the 1 percent level.

Table 5

Dynamic panel GMM estimation to address endogeneity concerns

Model	1	2	3
Dependent variable	Excess value	Excess value	Excess value
Diversification	–0.100*	–0.101*	–0.101*
	(0.047)	(0.046)	(0.047)
Resource scarcity		–0.016*	–0.014
		(0.008)	(0.009)
Complexity		0.035	0.027
		(0.087)	(0.085)
Diversification × Resource scarcity			0.016*
			(0.009)
Diversification × Complexity			–0.007**
			(0.003)
Intercept	–0.155	–0.207	–0.222
	(0.164)	(0.164)	(0.165)
Controls	YES	YES	YES
Year fixed effects	YES	YES	YES
AR(1) test (*p*-value)	0.00	0.00	0.03
AR(2) test (*p*-value)	0.24	0.27	0.50
Number of firms	2,386	2,386	2,386
Number of observations	11,340	11,340	11,340

Notes. Dynamic panel GMM regression results with firm-clustered robust standard errors in parentheses are shown. AR(1) and AR(2) tests for serial correlation in the first- and second-order of first-differenced residuals with the null hypothesis that no serial correlation exists.

Controls were the same as in the regression models of Table 3.

* Significance at the 10 percent level; ** significance at the 5 percent level; *** significance at the 1 percent level.

APPENDIX

Table A1
Variable description

Variable	Description	Data source
Dependent variable		
Excess value	Natural logarithm of the ratio of the firm's q to business units' imputed q.	COMPUSTAT/CRSP
Explanatory variables		
Complexity	Mean asset-weighted R&D expenditures of all firms in the industries the firm is operating in.	COMPUSTAT
Diversification	Dummy variable with a coding of 1 if the firm operates in more than one business unit on the four-digit SIC-level and 0 otherwise.	COMPUSTAT
Resource scarcity	Mean asset-weighted fraction of non-dividend-paying firms of the industries the firm is operating in.	COMPUSTAT
Control variables		
CAPEX/assets	Ratio of the firm's capital expenditures to its assets.	COMPUSTAT
Cash flow/assets	Ratio of the firm's cash flow to its assets.	COMPUSTAT
Dividends paid	Dummy variable with a coding of 1 if the firm paid dividends and 0 otherwise.	COMPUSTAT
EBIT/assets	Ratio of the firm's net income plus interest and taxes to its assets.	COMPUSTAT
External financing constraints	$KZ - Index_{jt} = -1.002\ Cashflow_{jt} + 3.139\ Debt_{jt} - 39.368\ Dividends_{jt} - 1.315\ Cash_{jt} + 0.283\ TobinsQ_{jt}$	COMPUSTAT
Firm size	Natural logarithm of firm assets.	COMPUSTAT
Fraction of diversified firms	Fraction of multi-segment firms within the industry	COMPUSTAT
Level of diversification	$Entropy = \sum_{i=1}^{N} p_i ln(1/p_i)$ where p_i is calculated as the ratio of business unit i's assets to the firm's total assets within a firm with N different business units.	COMPUSTAT
Leverage	Ratio of the firm's sum of long-term debt and debt in current liabilities to its assets.	COMPUSTAT
Product market competition	$Market\ Competition_{it} = 1 - \sum_{j=1}^{n} (market\ share_{ijt})^2$ where *market share* is the business unit *j*'s contribution of sales to consolidated totals within the industry on the three-digit SIC-level. Subscript *i* denotes the firm, *j* the business units, and *t* the year.	COMPUSTAT
Sales growth	Yearly growth rate of firm sales.	COMPUSTAT
Variables for further analyses		
Cost of capital	Ratio of the firm's total interest expense to its sum of short-term liabilities constituting debt and long-term debt.	COMPUSTAT
Industry-adjusted capital intensity	Capital expenditure scaled by assets in the primary industry a firm is operating in minus its industry mean.	COMPUSTAT

Industry-adjusted leverage	Leverage in the primary industry a firm is operating in minus its industry mean.	COMPUSTAT
Industry-adjusted ROA	The firm's ratio of net income to total assets minus its industry mean.	COMPUSTAT

Table A2

Testing the number of lags of serial correlations of the dependent variable

Model	1	2	3	4	5
Dependent variable	Excess value	Excess value	Excess value	Excess value	Excess value
Diversification	–0.077***	–0.071***	–0.071***	–0.073***	–0.070***
	(0.007)	(0.008)	(0.009)	(0.010)	(0.010)
	0.688***	0.634***	0.640***	0.613***	0.610***
	(0.006)	(0.012)	(0.014)	(0.016)	(0.019)
		0.070***	0.054***	0.046***	0.050***
		(0.011)	(0.010)	(0.014)	(0.010)
			0.084***	0.045***	0.057***
			(0.001)	(0.016)	(0.018)
				0.061	0.060
				(0.040)	(0.040)
					0.040
					(0.081)
Controls	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES
R^2	0.55	0.51	0.50	0.50	0.50

Notes. Controls were the same as in the regression models of Table 3.

* Significance at the 10 percent level; ** significance at the 5 percent level; *** significance at the 1 percent level.

Table A3

Sensitivity analysis when including observations before 1998

Model	1
Dependent variable	Excess value
Diversification	–0.057***
	(0.006)
Resource scarcity	–0.050***
	(0.017)
Complexity	–0.006
	(0.004)
Diversification × Resource scarcity	0.011**
	(0.004)
Diversification × Complexity	–0.015*
	(0.008)
Intercept	–0.063
	(0.027)
Controls	YES
Firm fixed effects	YES
Year fixed effects	YES
Number of firms	6,224
Number of observations	49,563
R^2 (within)	0.06

Notes. Fixed effects regression results with firm-clustered robust standard errors in parentheses are shown. The sample includes 49,563 firm-year observations of 6,224 multi-segment and focused firms covering the period between the years 1978 and 1997.

Controls were the same as in the regression models of Table 3.

* Significance at the 10 percent level; ** significance at the 5 percent level; *** significance at the 1 percent level.

Table A4

Sensitivity tests with sales-multiplier excess value as dependent variable.

Model	1	2	3
Dependent variable	Excess value	Excess value	Excess value
Diversification	–0.119***	–0.119***	–0.116***
	(0.012)	(0.012)	(0.012)
Resource scarcity		–0.079***	–0.064***
		(0.015)	(0.015)
Complexity		0.000	–0.002
		(0.006)	(0.005)
Diversification × Resource scarcity			0.022***
			(0.005)
Diversification × Complexity			–0.010**
			(0.004)
Intercept	–0.177***	–0.095*	–0.83
	(0.046)	(0.047)	(0.049)
Controls	YES	YES	YES
Firm fixed effects	YES	YES	YES
Year fixed effects	YES	YES	YES
Number of firms	4,437	4,437	4,437
Number of observations	32,883	32,883	32,883
R^2 (within)	0.04	0.06	0.09

Notes. Fixed effects regression results with firm-clustered robust standard errors in parentheses are shown. The sample includes 32,883 firm-year observations of 4,437 multi-segment and focused firms covering the period between the years 1998 and 2015.

Controls were the same as in the regression models of Table 3.

* Significance at the 10 percent level; ** significance at the 5 percent level; *** significance at the 1 percent level.