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CORPORATE DIVERSIFICATION AND THE VALUE OF INDIVIDUAL FIRMS: A BAYESIAN APPROACH

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Research summary: *Prior theory suggests that the performance effects of a firm's diversification strategy depend on a firm's individual resources and capabilities and the setting within which it is operating. However, prior tests of this theory have examined the average diversification-performance relationship across all firms, instead of estimating the diversification-performance relationship at the individual firm level. Efforts to estimate this average relationship are inconsistent with a central assumption of much of strategic management theory—that firms maximize value by choosing strategies that exploit their heterogeneous resources and individual situation. By adopting an approach that allows an evaluation of the diversification-performance relationship for individual firms, this article shows that firms, both focused and diversified, tend to choose that diversification strategy—focus, related diversification, or unrelated diversification—that maximizes value.*

Managerial summary: *Instead of a universal diversification discount or premium, this article shows that the effect of diversification on performance is heterogeneously distributed across firms and that firms tend to be rational in their diversification decisions.*

INTRODUCTION

It may be the case that more has been written about the relationship between corporate diversification and firm performance than any other topic in the field of strategic management. Theoretically, some scholars have focused on the performance effects of different types of diversification (e.g., related versus unrelated) (Teece, 1980, 1982), while others have focused on when firms can enhance their performance by engaging in diversification instead of remaining focused (Gomes and Livdan, 2004; Maksimovic and Phillips, 2002; Montgomery and Wernerfelt, 1988). Taken as a whole, prior theory suggests that the ability of a diversification strategy to create value depends on the specific resources and capabilities controlled by a firm. For example, are they leveragable across multiple different businesses and the contexts within which they are operating (Teece, 1980)? Similarly, are there growth options in a business (Kogut, 1991).

Of course, this theoretical literature has given rise to a large empirical literature. Some of this work has examined the average impact of different types of diversification (e.g., related and unrelated) on firm value (Bettis, 1981; Chatterjee and Wernerfelt, 1991; Markides and Williamson, 1994; Palepu, 1985; Palich, Cardinal, and Miller, 2000; Rumelt, 1982), while other work has examined the average impact of diversification on a firm's value relative to a portfolio of focused firms (Berger and Ofek, 1995; Lang and Stulz, 1994; Montgomery and Wernerfelt, 1988). Overall, this empirical work seems to suggest that, on average, related diversifiers outperform unrelated diversifiers (Rumelt, 1982) and that, controlling for the propensity to

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diversify, diversified firms do not, on average, trade at a discount (or perhaps at a small premium) compared to focused firms (Campa and Kedia, 2002; Miller, 2004, 2006; Villalonga, 2004).

However, despite this voluminous empirical research, there is a fundamental mismatch between the theoretical diversification literature—which examines the relationship between diversification and firm performance for *individual firms*—and the empirical diversification literature—which examines the *average relationship* between diversification and firm performance for a sample of firms. Such a mismatch would not be problematic if it was possible to infer the firm-specific relationship between diversification and performance from the average relationship between diversification and firm performance in a sample of firms. However, this will rarely be the case. In particular, knowing that—on average—firms pursuing related diversification strategies outperform firms pursuing unrelated diversification strategies does not necessarily imply anything about the relationship between the type of diversification strategy chosen and performance for a *particular* firm. The value maximizing strategy for a particular firm depends on that firm's resources and capabilities and the context within which it is operating, not on the relationship between diversification strategy and firm value for a "hypothetical" average firm.

The purpose of this article is to re-examine the relationship between a firm's diversification strategy and its performance using a method—hierarchical Bayesian modeling—that enables the estimation of this relationship at the firm level. Consistent with prior theory, the empirical results in this article show that all forms of diversification strategy—related diversification, unrelated diversification, and remaining focused—can create value for different firms. Indeed, most firms in the sample studied in this article choose a value-creating diversification strategy.

THEORY AND HYPOTHESIS DEVELOPMENT

This section briefly summarizes previous theoretical work on the relationship between a firm's diversification strategy and its performance and derives a single hypothesis from this previous work. Empirical work that examines the average relationship between diversification strategy and firm performance is also briefly reviewed, together with a discussion of why it is rarely possible to infer the relationship between diversification and performance for a single firm from the average relationship between diversification and performance for a sample of firms.

Firm diversification and performance: theory

Received theory in strategic management describes conditions under which a firm can enhance its economic value by engaging in related diversification, unrelated diversification, or by remaining undiversified. It also describes conditions under which a firm may abandon its profit-maximizing objectives in choosing its diversification strategy. Each of these arguments is briefly summarized below.

Related diversification and firm value

Perhaps the largest of these theoretical literatures focuses on the settings within which a firm can enhance its value through related diversification (e.g., Bettis, 1981; Chatterjee and Wernerfelt, 1991). A firm is said to be engaging in related diversification when it exploits resources and capabilities across multiple different businesses simultaneously (Rumelt, 1982). These kinds of shared resources can create an economy of scope within a diversified firm such that the value of multiple businesses combined can be greater than the value of these businesses separately. Prior theory suggests that when diversification exploits an economy of scope that outside equity holders cannot duplicate on their own or that could not be replicated through market or intermediate forms of governance, diversification can create value for a firm's shareholders (Teece, 1980, 1982).

A wide variety of potential economies of scope have been identified in the literature including, for example, shared activities (e.g., a common sales force, a common research and development activity, a common manufacturing plant) (Barney, 2014) and shared core competencies (e.g., knowledge developed in a business that can be used in a second business) (Prahalad and Bettis, 1986; Prahalad and Hamel, 1990). A firm that possesses the kinds of resources and capabilities that can generate such economies of scope can, according to this logic, use related diversification to enhance its value.

Unrelated diversification and firm value

Historically, the logic that suggests that related diversification can create value for a firm has also been used to suggest that corporate diversification strategies that do not leverage economies of scope across multiple businesses—that is, unrelated diversification—are not likely to enhance a firm's value (Bettis, 1981; Markides and Williamson, 1994; Rumelt, 1982). In general, this logic suggests that since shareholders can, presumably, obtain all the benefits of an unrelated corporate diversification strategy on their own by purchasing and holding a diversified portfolio of stocks, unrelated diversification is not likely to create value for a firm's shareholders.

More recently, however, several scholars have identified conditions under which a firm may, in fact, create value through unrelated diversification. For example, Gomes and Livdan (2004), and Maksimovic and Phillips (2002) have argued that firms with high levels of managerial capability may create value for their shareholders by diversifying out of markets with low growth potential into unrelated markets, even though this diversification may not exploit any traditional economies of scope. Also, Wang and Barney (2006) have argued that diversification can increase a firm's value by decreasing the risks normally borne by employees who make firm specific investments, and can do so absent any of the traditional economies of scope associated with related diversification. These arguments suggest that unrelated diversification, for firms with the appropriate capabilities and in the right setting, may create value for a firm's shareholders.

Focus and firm value

Finally, if a firm does not have the kinds of resources and capabilities required to leverage economies of scope across multiple businesses and has growth opportunities in its current business, then neither related or unrelated diversification are likely to create value. This type of firm will maximize its value by not implementing diversification at all, that is, by remaining focused (Miller, 2004, 2006).

Taken together, these three arguments suggest that the optimal corporate strategy—related diversification, unrelated diversification, or focus—will vary across firms, depending on each firm's resources and situation. If firms seek to maximize their profits, then these arguments suggest the following hypothesis:

> *Hypothesis: A profit-maximizing firm will tend to pursue that corporate diversification strategy—related, unrelated, or focus—that enhances its economic value.*

Of course, this hypothesis is not novel. Indeed, it probably represents the consensus among strategic management scholars concerning the relationship among a firm's corporate diversification strategy and its performance. However, despite this broad consensus, the central thesis of this article is that this hypothesis has yet to be fully examined empirically.

Firm diversification and performance: prior empirical work

The empirical literature on the average relationship between diversification and firm performance is vast (e.g., Berger and Ofek, 1995; Campa and Kedia, 2002; Lang and Stulz, 1994; Miller, 2006; Montgomery and Wernerfelt, 1988; Palich *et al.*, 2000). Yet, this literature fails to examine the relationship between diversification and value for individual firms. This has been the case in the management literature, which has broadly focused on which types of diversification (e.g., related versus unrelated diversification), on average, create more or less value among a sample of firms (Markides and Williamson, 1994; Palepu, 1985; Palich *et al.*, 2000; Rumelt, 1982). This has also been the case in the finance literature, which has focused more on the average relative benefits of diversification (of any variety) versus focused strategies—the so-called "diversification discount" literature (e.g., Berger and Ofek, 1995; Lang and Stulz, 1994; Montgomery and Wernerfelt, 1988). Even the most recent empirical work on diversification and firm value, work that relies on sophisticated statistical techniques to correct for the endogeneity of the diversification decision, still focuses on average effects of diversification on firm value (Bascle, 2008; Campa and Kedia, 2002; Miller, 2004, 2006; Villalonga, 2004).

Consider just two examples of this prior empirical work: Campa and Kedia (2002) and Miller (2006). These examples are chosen not because they are poor examples of this prior empirical literature, but because they are excellent examples of this work. Campa and Kedia's (2002) research is very much in the "diversification discount" tradition (Lang and Stulz, 1994) and compares the average value created by diversification compared to a portfolio of focused firms. Controlling for factors that lead a firm to diversify in the first place, Campa and Kedia (2002) find that the average effect of diversification on firm value is positive. Miller (2006) builds on Campa and Kedia (2002) by also controlling for the endogeneity of the decision to diversify, but positions his research in the "related versus unrelated" research tradition by interacting a measure of technological relatedness with the diversification indicator variable. Miller (2006) shows that, on average, firms that have related knowledge assets are more likely to create value through diversification—consistent with the view that related diversification, on average, outperforms unrelated diversification.

However, as sophisticated as these studies are, neither actually tests the hypothesis derived in this article from prior theoretical literature on diversification. Considering Campa and Kedia (2002), finding that on average, diversification creates value for firms does not mean that, for particular firms, remaining focused is not the most value creating strategy. Considering Miller (2006), finding that on average, related diversification creates more value than unrelated diversification does not mean that, for particular firms, engaging in unrelated diversification is not the most value creating strategy.

Firm versus average effects of diversification on performance

Indeed, all one can conclude from the average results reported in Campa and Kedia (2002), and Miller (2006) (and numerous similar studies) is that the percentage of firms in their samples that find diversification (in Campa and Kedia's case) and related diversification (in Miller's case) to be value enhancing is greater than the percentage of firms that find a different diversification strategy (focus in Campa and Kedia's case, and unrelated diversification or focus in Miller's case) to be value enhancing.

Consider the following general example: Suppose a population exists where there are different types of firms—some firms create value by adopting strategy X and other firms destroy a similar magnitude of value by pursuing that same strategy X. In a regression analysis of this population, the coefficient for the relationship between X and firm value is determined by the proportion of these two types of firms in a sample. If more firms in the population create value from X than destroy it, then the estimated relationship between X and firm performance for the sample will be positive, consistent with the conclusion that X creates value. On the other hand, if more firms in the population destroy value from X than create it, then the estimated relationship between X and firm performance will be negative, consistent with the conclusion that X destroys value. However, in either case, concluding that, on average, X creates (destroys) value is problematic since for some firms, X creates value, and for other firms, it destroys value.

Of course, if the proportion of these types of firms in a population happens to be similar, then the sample correlation between X and performance may not be large enough to be statistically significant. This is the case even though, for each firm in this population, X is assumed to have a determinative impact on performance.[1]

Indeed, the only time it is possible to infer the firm-specific relationship between a firm's corporate strategy and its performance from the average relationship between such strategies and firm performance is when firms in a sample are homogeneous with respect to the resources and capabilities they control and the context within which they operate. While theoretically possible, most prior work in strategic management suggests that firms are more heterogeneous than this (Barney and Arikan, 2001).

For these reasons, the positive average effect reported in Campa and Kedia (2002) and Miller (2006) does not constitute evidence that firms currently pursuing a focused strategy should pursue a diversification strategy (in Campa and Kedia's case), nor that firms currently pursuing an unrelated diversification strategy should pursue a related diversification strategy (in Miller's case). Ultimately, testing the hypothesis developed in this article requires the examination of the relationship between a particular firm's diversification strategy and its value, and not on the average relationship between diversification and value across a sample of firms.

Recently, several strategic management scholars have begun to recognize the impact of firm heterogeneity on the ability to generalize from the study

[1] This example can easily be generalized to settings where the relationship between a strategy and performance within a population varies from very negative to very positive.

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of average relationships between a strategy and firm performance in a sample of firms to the relationship between a strategy and the performance of a particular firm (Hansen, Perry, and Reese, 2004). Several scholars have introduced a number of methods to address this issue (e.g., Anand and Byzalov, 2011; Bascle, 2008; Shaver, 1998; McGahan and Porter, 2002). This article can be seen as a continuation of this line of work, although the methods used in this article vary from those used previously.

METHODS

When faced with a theory that focuses on the heterogeneous relationship between strategy and performance across a sample of firms, empirical researchers have two broad options: (1) they can control for firm level heterogeneity—essentially removing as much of it as possible from the estimation procedure—to generate the most accurate average effect possible, or (2) they can use this firm level heterogeneity to estimate firm-level relationships.

Removing heterogeneity

Fixed or random effects models used in panel data settings are an example of the first option. These models control for firm level heterogeneity by including a firm-specific indicator variable for each firm in the sample (in the case of fixed effects) or a firm-specific error term for each firm in the sample (in the case of random effects). These simple panel data models are very useful statistically because they allow researchers to isolate the effect of the variable of interest from the effect of unobserved firm characteristics. Still, fixed or random effects models only improve the accuracy of average effects through removing heterogeneity between firms. If the goal is to incorporate heterogeneity into the model, another methodology must be used (Hansen *et al.*, 2004).

Estimating firm-specific relationships

Contingency studies and mixed effects modeling are two examples of methods for estimating firm-specific relationships. Contingency studies seek to explain the conditions under which the relationship between the variables of interest may differ between firms by incorporating interaction terms to moderate the relationship between the variables of interest. However, a limitation of this method for estimating firm-specific relationships is that it can only account for the heterogeneity that is contained in the interaction variables. Although contingency studies are useful, these studies are unlikely to capture enough heterogeneity to truly estimate firm-specific relationships, thereby limiting the utility of these studies for estimating firm-specific relationships (Rossi, Allenby, and McCulloch, 2005).

Mixed effects models, random coefficient models, or hierarchical linear models are various names for a statistical technique that can also be used to estimate an average coefficient plus an individual-specific deviation from the average coefficient (Rabe-Hesketh and Skrondal, 2005). These models have primarily been used in the literature to estimate a more accurate average effect (e.g., Fong, Misangyi, and Tosi, 2010; Lim, Das, and Das, 2009). Incorporating additional information by estimating the determinants of the individual-level effects will improve the accuracy of the individual-level effects; however, because of the very large number of coefficients, computing the determinants of these individual level effects can be quite difficult using mixed effects models (Rossi *et al.*, 2005).

Hierarchical Bayesian models

Hierarchical Bayesian models combine many of the best features of contingency studies and mixed effects models. As with all Bayesian models, hierarchical Bayesian models estimate a distribution for each coefficient, making it possible to make statements about the probability that an independent variable will have a positive or negative impact on the dependent variable. However, within the broad class of Bayesian methods, a hierarchical Bayesian model is a distinct modeling approach that, like mixed effects models, estimates firm-specific parameters.

With panel data, it is rare to have very many observations on a single firm, so each firm-specific coefficient is estimated with weak confidence. Hierarchical Bayesian models acknowledge this imprecision by estimating probability distributions for each firm-specific parameter instead of calculating only point estimates for parameters as non-Bayesian models do.[2] Further, the hierarchical Bayesian model improves the precision of

[2] An introduction to Bayesian methods and their application to strategy research can be found in Hansen *et al.* (2004), and Hahn

firm-specific coefficients by "borrowing strength": imposing a common distribution between the firm-specific coefficients (Hansen *et al.*, 2004; Rossi *et al.*, 2005).

In a hierarchical Bayesian model, the firm-specific coefficient can be determined by additional information about the firm, by estimating it as a function of firm characteristics. In this way, the relationship between the variables of interest can be contingent upon these firm characteristics in addition to the "borrowed strength" mentioned previously.

Hierarchical Bayesian modeling (and all Bayesian modeling) has another attribute that is beneficial to strategy research–its treatment of hypothesis testing. Specifically, rather than estimating a confidence interval around a point estimate to disprove the null hypothesis that a parameter is equal to zero, Bayesian models estimate the full probability distribution for a parameter. In other words, instead of asking, "Does the parameter equal zero?" as in non-Bayesian methods, the Bayesian model asks, "What is the probability that the parameter is greater (or less than) zero?" In strategy research, even though effect sizes may be small, it is unlikely that a strategy will have absolutely zero effect on firm performance. Thus, the Bayesian approach can be quite useful, since it is often the case that theory tells us that in some situations, a strategy will have a positive effect, and in other situations, the strategy will have a negative effect.

Firm-level heterogeneity implies, in the specific example of this article, that firms will differ in their potential for economies of scope as well as in their potential for growth opportunities in their original business. Thus, the central theory of this article suggests that for some firms, diversification will be beneficial, while for others, it will be harmful. The hierarchical Bayesian approach used in this article allows us to adequately model heterogeneity in the value of diversification to test this theory.

Certainly, Bayesian models are not the only methods for examining individual level effects and certainly, they are not without their limitations. As previously mentioned, mixed effects models can estimate firm-specific effects. Anand and Byzalov (2011) provide a particularly good example of using mixed effects models to estimate substantial heterogeneity in the value of diversification across firms.

and Doh (2006); more advanced treatments can be found in Rossi *et al.* (2005), and Gelman *et al.* (2004).

Of course, each of these methods has their own strengths and weaknesses, depending on the empirical context. For example, prior research on diversification and firm performance suggests that there are important self-selection and endogeneity effects that need to be controlled in examining the relationship between diversification and firm performance. The self-selection problem exists in the diversification literature because it is not possible to observe the counterfactual choice made by a firm—for a focused firm, we cannot observe the value the firm would have if it were diversified, and for a diversified firm, we can not observe the value it would have if it were focused. Of course, we often can observe firms undertaking different diversification choices in *different* time periods with panel data. This is why some prior works controlling for endogeneity use fixed effects regression as one control for self-selection (e.g., Campa and Kedia, 2002). In this literature, it is also common to use treatment effects models (Campa and Kedia, 2002; Miller, 2006) or propensity score matching (Villalonga, 2004) to control for the self-selection of the diversification decision.

Rather than using propensity score matching or treatment effects models that add a firm's propensity to diversify as another regressor, this article accounts for the endogeneity of the diversification decision explicitly with a simultaneous equations approach. In our model, one equation estimates firm value as a function of the diversification choice and other firm characteristics, and another equation estimates the diversification choice as a function of its expected impact on firm performance (a firm-specific diversification coefficient). We explain this model further in the model development section of this article.

Data and sample

To estimate the firm-specific relationship between diversification and firm value, a sample that includes all firms in the Compustat Industry Segment file from 1985 to 1996 was collected.[3] To make the results reported here comparable to more traditional research on the relationship between diversification and firm performance, sample selection criteria were similar to those used by Berger

[3] Changes in segment reporting requirements from SFAS 131 may affect the comparability of data before and after 1997; thus, consistent with the extant literature, we end our sample in 1996.

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and Ofek (1995), Campa and Kedia (2002), and Villalonga (2004): Firm years that have any segments in financial industries, years in which firm sales are less than $20 million, and years in which the data do not provide four-digit SIC industry coding for all of its reported segments are all removed from the sample. Firms with less than five observations are removed from the sample. Even though Bayesian analysis can borrow strength from other firms, the fewer the observations for each firm, the weaker the results will be. Since we were not limited in the number of firms available for the sample, we opted to remove those firms with less than five observations. This decision is consistent with prior work using Bayesian analysis (e.g., Hansen *et al.*, 2004). Observations for which the variables are not available are also removed from the sample, leaving 7,442 observations on 838 firms.

Measures

Dependent variable

Although much of the received empirical literature within the management area has used a variety of accounting measures (e.g., ROA) as a dependent variable, these measures are not adopted in this article as the limitations of these measures are now widely understood (Berger and Ofek, 1995; Palich *et al.*, 2000). Accounting measures are subject to managerial manipulations (Palich *et al.*, 2000), do not account for risk (Hoskisson *et al.*, 1993), and are not forward-looking.

Instead of adopting accounting measures, this article uses two market measures of firm value. The first measure, excess value, is not as common as other measures of firm value in the management literature (see Anand and Byzalov, 2011; Bascle, 2008; Zuckerman, 2000, for exceptions), but it is more commonly used in the finance literature and was developed specifically for the context of diversification (Berger and Ofek, 1995; LeBaron and Speidell, 1987). Conceptually, excess value is defined as the degree to which a diversified firm's value exceeds that of a portfolio of single segment firms competing in the same industries as the diversified firm.

This variable is measured by the percentage difference between the firm's value and the sum of the imputed values of its segments as single-segment firms. A firm's value is measured as total firm capital—the sum of a firm's market value of equity, long-term and short-term debt, and preferred stock. A segment's imputed value is calculated by multiplying its sales by the median value for single-segment firms in the segment's industry (the most restrictive SIC grouping—four-digit, three-digit, or two-digit—that includes at least five firms). Using the imputed values of each segment, the imputed value of the corporation is calculated as the sum of each of its segments' imputed values. The natural log of the ratio of a firm's value to its imputed value is the measure of excess value used as a dependent variable in this analysis.

Since this dependent variable is in log form, a negative excess value indicates that the firm has a lower value than its imputed value, that is, that a diversified firm is trading at a discount relative to a portfolio of focused firms in the same industries. A positive excess value indicates that the firm has a higher value than its imputed value, that is, that a diversified firm is trading at a premium relative to this portfolio of focused firms. Following Berger and Ofek (1995) and Campa and Kedia (2002), firms with extreme excess values (more than 1.386 or less than −1.386) are eliminated from the sample.

The second measure, the natural log of Tobin's q, is more commonly used within the management literature (e.g., Hoskisson *et al.*, 1993) although it has been used within the finance literature as well (Lang and Stulz, 1994). Using Tobin's q is an improvement over accounting measures as it incorporates forward-looking market valuations, but it is still limited in that the value of each segment within a firm is heavily dependent on the industry within which it competes, and it is difficult to adjust Tobin's q for industry because data are not available for segment-level market values or replacement values (Berger and Ofek, 1995). Data for calculating these measures were obtained from Compustat.

Independent variables

Corporate diversification is the central independent variable in this article. This article adopts a simple, discrete measure of the type of diversification in which a firm can engage—an indicator variable equal to one if the firm operates in multiple industries.

Certainly, more complicated measures of diversification exist in the literature (e.g., Bryce and Winter, 2009; Gort, 1962; Hoskisson *et al.*, 1993; Jacquemin and Berry, 1979; Robins and Wiersema, 1995). However, sometimes the implications of these measures are difficult to interpret (see Robins

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and Wiersema, 2003, for an extensive discussion of these issues), some of these measures are only available for manufacturing industries, and sometimes these measures are not well suited for addressing particular research questions.

Another limitation of continuous measures of diversification is particularly relevant in the current article as the primary purpose here is to compare firm value for diversified and focused firms instead of estimating the optimal degree of diversification, a task for which continuous measures are best suited (Hoskisson *et al.*, 1993). In particular, continuous measures of diversification are good at measuring differences in the degree of diversification, but are less effective at comparing diversified firms with focused firms. For example, if focused firms have a "zero" value for diversification and then they diversify to a level of say, 0.1, on the continuous measure, this event would be statistically treated the same as an already diversified firm that has a 0.4 value on the diversification continuum and then further diversifies to a value of 0.5 on the diversification continuum. Clearly, these types of changes in scope are substantively very different and should not be statistically treated as equivalent. In sum, continuous measures present some challenges in the current research context. For that reason, a simple discrete measure of diversification is used.

In applying this measure of diversification, a firm is considered nondiversified (i.e., focused) if it operates in a single four-digit SIC industry. It is considered diversified if it operates in more than one four-digit SIC industry. Data for calculating this measure were taken from the Compustat segments data. In the sample used for this analysis, 64 percent of the observations are nondiversified and 36 percent are diversified.

Control variables

A variety of other variables have been shown to be related to the value created by diversification (Hoskisson *et al.*, 1993). These other variables, including firm size (measured by the log of a firm's assets), firm growth (measured by the annual percent change in assets), capital intensity (measured by capital expenditures as a percentage of firm sales), the level of research and development (measured by R&D expenditure divided by sales[4]), and level of firm profitability (measured by return on sales), each averaged over the years the firm is in the sample, are included as control variables in this research.

These characteristics need to be accounted for in the estimation of both the firm-specific intercept and the firm-specific diversification coefficient as these firm attributes may affect *both* the value of the firm directly and the value of diversification for each firm. Within a hierarchical Bayesian context, using this additional information in the estimation of firm-specific coefficients requires that the firm and industry controls are time-invariant (Rossi *et al.*, 2005). In our estimation, for each of k controls, we split each variable x_{kit} into a time-invariant firm-level average, $\overline{x}_{ki}$, and a deviation from the average, $\widetilde{x}_{kit}$. As will be explained further in the model development section, the time-invariant firm-level averages are used to estimate firm-specific coefficients and the deviations from the averages are used in the equation estimating firm value. Data for these measures were obtained from Compustat.

An explicit assumption in the hypothesis is that firms intend to maximize profits. Of course, another important stream in the theoretical literature on diversification and firm value—that is, agency theory—suggests that this assumption may not hold in all firms. In particular, agency theory suggests that the interests of managers and shareholders concerning which strategies a firm should pursue will often come into conflict (Jensen and Meckling, 1976). In this setting, managers may engage in diversification strategies that may not enhance the value of the firm, but do enable managers to diversify some of the risks they bear (Jensen, 1986). Of course, shareholders can anticipate many of these nonprofit-maximizing actions taken by managers and will significantly discount the value of a firm's shares unless a firm improves its governance (Shleifer and Vishny, 1986). A wide variety of these governance mechanisms exist, including several different monitoring devices such as concentrated stock ownership, large institutional ownership, more outsiders on the board of directors, and so forth (Baysinger and Butler, 1985; Beatty and Zajac, 1994).

Thus, to control for differences in corporate governance across firms, we adopt four commonly

[4] Following Hall's (1990) observation that "when R&D is not reported, it usually means that the R&D to sales ratio is very low" (p. 106), R&D is set equal to zero for firms that do not report R&D data, instead of removing these firms from the sample.

Table 1. Descriptive statistics and correlations

Variable	Mean	Std. dev.	1	2	3	4	5	6	7	8	9	10	11
1 Tobin's q	0.28	0.40	1										
2 Excess value	0.13	0.50	−0.03	1									
3 Size (log of total assets)	6.47	1.60	−0.02	0.00	1								
4 Profitability	0.11	0.10	−0.02	0.29	0.25	1							
5 Capital intensity	0.09	0.13	−0.03	0.10	0.13	0.20	1						
6 R&D/sales	0.03	0.05	0.04	0.05	−0.13	−0.06	−0.04	1					
7 Growth (Pct. change in total assets)	0.12	0.20	−0.01	0.25	−0.12	0.19	0.10	0.07	1				
8 Pct. shares owned by dominant shareholders	0.06	0.17	−0.02	0.04	−0.10	−0.07	−0.04	−0.10	0.02	1			
9 Pct. shares owned by institutions	0.61	0.18	0.03	0.00	−0.04	−0.11	0.03	0.09	0.06	−0.23	1		
10 Pct. shares owned by insiders	0.26	0.18	0.01	−0.02	−0.30	−0.17	−0.11	−0.08	0.04	0.39	−0.02	1	
11 Pct. of directors who are outsiders	0.29	0.16	0.00	0.09	−0.34	−0.06	−0.05	−0.05	0.10	0.21	−0.18	0.27	1

accepted measures for the quality of corporate governance (Beatty and Zajac, 1994). These measures are as follows: the percent of shares held by dominant shareholders, the percent of shares held by institutions, the percent of shares held by insiders, and the percent of the board that is composed of outsiders.

Previous research demonstrates that higher levels of ownership by dominant shareholders and institutions are generally seen as factors indicating greater monitoring of a firm's decisions by the capital markets, consistent with high quality corporate governance (Shleifer and Vishny, 1986). Higher levels of insiders' ownership and a higher percentage of outsiders on the board of directors are also expected to indicate effective, quality governance by creating incentive alignment between management and shareholders (Baysinger and Butler, 1985). These measures are used as control variables to determine the direct effects of governance on firm value as well as to moderate the diversification—firm value relationship in predicting the firm-specific diversification coefficient. Data for these variables were obtained from Board Analyst. Descriptive statistics for these controls, independent, and dependent variables are displayed in Table 1.

Model development

The model specified below is designed to address two key difficulties that arise in estimating the impact of diversification on performance. First, the heterogeneous (i.e., firm-specific) effect of diversification on firm performance is modeled using hierarchical Bayesian methods. Second, the model formally accommodates (and tests for) endogeneity in the choice of diversification. This is accomplished by jointly specifying a model for firm performance as a function of diversification, and a model for diversification as a function of its expected benefit to the firm. The resulting system of equations is jointly estimated using Bayesian methods. Taken collectively, this approach alleviates empirical concerns that have been raised in the diversification literature and provides new insights into the process that governs the diversification-performance connection.

The impact of diversification (and other covariates) on firm performance is modeled using the following equation:

$$y_{it} = \beta_{0i} + \rho_i y_{it-1} + \beta_{Di} D_{it} + \sum_k \gamma_k \widetilde{x}_{kit} + \varepsilon_{it}. \quad (1)$$

Let y_{it} denote a measure of performance (i.e., Excess Value or Tobin's q) for firm i in time period t. Firm performance is driven by the diversification state of the firm in each time period, D_{it}, and a collection of k time varying covariates denoted by $\widetilde{x}_{kit}$. D_{it} is a vector of binary indicators, where a value of 1 denotes that the firm was diversified in time period t and value of 0 denotes that the firm was focused. We operationalize $\widetilde{x}_{kit}$ as $x_{kit} - \overline{x}_{ki}$, where $\overline{x}_{ki}$ is the average (over time) of the set of control

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variables included in the performance equation. By so doing, we allow temporal changes in the set of control variables to have a direct, contemporaneous impact on performance.

We also accommodate temporal dynamics through the inclusion of y_{it-1}. This is consistent with the specification used by McGahan and Porter (1999, 2003), and is a geometric or Koyck lag structure (Koyck, 1954). Through this lag structure, we are able to compute the long-term or persistent effect of diversification (or any of the variables) as $\beta_{Di}/(1-\rho_i)$.

Given the panel structure of the dataset, we accommodate heterogeneity in firm response to diversification by fitting a Bayesian hierarchical model. This is accomplished by specifying a distribution of heterogeneity for both the collection of betas and gammas. Following common practice in hierarchical modeling (Rossi *et al.*, 2005) we specify:

$$\beta_i = \left\{\beta_{0i}, \beta_{Di}\right\} \sim N\left(\Delta z_i, \Sigma\right)$$

and

$$\gamma_i \sim N\left(\overline{\gamma}, \Omega\right).$$

Separating the distribution of heterogeneity, the β_i and γ_i allows us to explore the relationship between firm characteristics and the impact of diversification on performance. As specified above, we allow the mean of the distribution of heterogeneity for β_i to differ across firms as a function of their characteristics, $z_i = \left\{1, \overline{x}_i, c_i\right\}$, and an estimated matrix of coefficients, Δ. Included in the set of firm characteristics, z_i, are an intercept, the average levels of the control variables, $\overline{x_i}$ (described above), and the collection of firm governance variables, c_i, also discussed above. Specifying the model this way yields two benefits. First, it provides a more flexible distribution of heterogeneity that allows us to better capture meaningful cross-firm differences in the impact of diversification on performance. Second, it allows us to better understand the relationship between firm characteristics and the impact of diversification.

Endogenous diversification

Under the assumption of rational, profit-maximizing behavior, we expect that firms that derive a larger benefit from diversification will be more likely to diversify. This implies that the impact of diversification on performance is heterogeneous, and that firms have some understanding of the relationship between their behavior and its corresponding impact on the firm act accordingly. The existence of these conditions has been referred to in the economics literature as essential heterogeneity (Heckman, Urzua, and Vytlacil, 2006). In the context of Equation 1, this implies that the decision to diversify, D_{it}, is a function of β_{Di}. If firms choose to diversify as a function of reasonable expectations of the resulting impact on performance, then D_{it} is endogenous to the system of study and standard methods of estimation will yield parameter estimates that are both biased and inconsistent. Further, even econometric methods that have been developed to accommodate endogeneity (i.e., instrumental variables or selection methods) are ineffectual under the conditions of essential heterogeneity (Bascle, 2008; Heckman *et al.*, 2006). We resolve this issue by explicitly modeling the joint impact of diversification on both performance and the choice to diversify (Dotson and Allenby, 2010; Nandialath, Dotson, and Durand, 2014). This is accomplished by first specifying a function for the value, V_{it}, that the firm derives from diversification:

$$V_{it} = \alpha_0 + \alpha_1\left(\beta_{Di}/\left(1-\rho_i\right)\right) + \sum_k \delta_k x_{kit} + \xi_{it}. \tag{2}$$

In this equation, V_{it} is influenced by the expected, long-term impact of diversification on performance, $\beta_{Di}/(1-\rho_i)$, and the collection of time varying control variables, x_{it} described above. By assuming that the ξ_{it} follows a Gumbel distribution, we can compute the probability that a firm will diversify (or remain diversified) in each time period as:

$$pr\left\{D_{it}=1\right\} = \frac{e^{V_{it}}}{1+e^{V_{it}}}. \tag{3}$$

Note that information about the impact of diversification, β_{Di}, is contained in both of these equations. As such, estimation must proceed through simultaneous evaluation of the joint likelihood derived from Equations 1 and 3. Given a likelihood and prior distributions specified over all model parameters, estimation can proceed using standard methods for Bayesian inference. Specifically, we estimate the model using Markov Chain Monte Carlo methods using 50,000 draws from a hybrid sampler (both Gibbs sampling and use of the Metropolis-Hastings

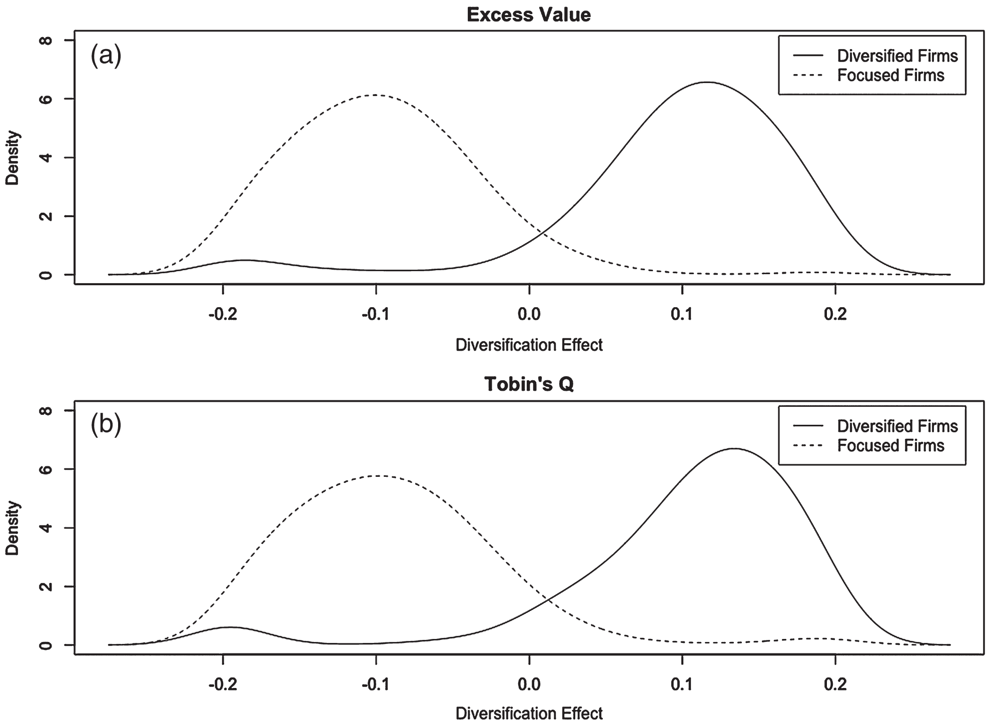

Figure 1. Effects of diversification on excess value and Tobin's q for diversified and undiversified firms

algorithm), keeping every 25th draw after a burn-in period of 25,000 draws (see Rossi *et al.*, 2005, for a discussion of this methodology).

RESULTS

The distribution of firm-specific effects of diversification on firm value

Using the Bayesian methods described above, the relationship between diversification and firm value was estimated for each of the 838 firms in the sample. Clearly, it was not feasible to numerically report such a large number of coefficients. Nor would it be useful to report results for one or a few firms since it is difficult to generalize across what is assumed to be a heterogeneous set of firms. Thus, researchers estimating results at the individual firm level must take care to report results at the most relevant level.

In the current setting of corporate diversification, the central theory in this article is that firms choose the diversification strategy that maximizes firm value, and as such, the prediction is that the effect of diversification on firm value will be different for diversified firms compared with focused firms as well as for related diversifiers compared with unrelated diversifiers. Therefore, empirical implementation of the theory in this article requires dividing the distribution of the firm-specific diversification coefficients into subdistributions for diversified and focused firms and further dividing into subdistributions for related diversifiers and unrelated diversifiers.[5]

This approach is different from methodologies that split a sample and re-estimate the model for specific subsamples. Here, the model is estimated once, obtaining a unique distribution of the diversification coefficient for each firm, and these distributions are grouped for diversified firms (both related and unrelated) and compared with the distributions for focused firms.

The results are presented both graphically (see Figure 1) and numerically (see Tables 2–4).

[5] Among diversified firms, a firm is considered a related diversifier if it has any two segments in the same two-digit SIC industry. Firms are categorized as unrelated diversifiers if they do not have any two segments in the same two-digit SIC industry. This approach is equivalent to classifying any firm as a related diversifier if it has a related entropy value greater than zero (Jacquemin and Berry, 1979; Palepu, 1985). Of these diversified firms, 47 percent of the observations are in related diversified firms and 53 percent are unrelated diversified firms.

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Table 2. The distribution of firm specific coefficients affecting excess value and Tobin's q and impact of diversification effect and control variables on diversification decision

		Excess value		*Tobin's q*	
Variable type	Variable	Mean	% > 0	Mean	% > 0
Impact on performance	Intercept	0.077	58.9%	0.165	75.3%
	Diversification	−0.033	34.4%	−0.026	35.8%
	Rho	0.243	100.0%	0.275	100.0%
	Size	−0.051	48.6%	−0.008	48.9%
	Profitability	1.013	61.2%	−0.054	48.0%
	Capital intensity	0.272	57.4%	0.039	51.9%
	R&D/sales	0.063	52.0%	−0.067	47.7%
	Growth	0.392	66.0%	0.076	50.4%
Diversification decision	Intercept	−0.748	0.0%	−1.057	0.0%
	Diversification effect	28.500	100.0%	26.687	100.0%
	Size	0.133	81.6%	0.229	92.0%
	Profitability	−0.717	19.9%	−1.478	0.0%
	Capital intensity	0.459	76.6%	−0.077	42.8%
	R&D/sales	0.158	52.2%	0.128	62.7%
	Growth	0.602	94.0%	0.738	94.5%

Table 3. Impact of diversification and control variables on excess value and Tobin's q for various types of firms

		All firms		Diversified firms		Undiversified firms		Related diversifiers		Unrelated diversifiers	
Dependent variable	Variable	Mean	% > 0	Mean	% > 0	Mean	% > 0	Mean	% > 0	Mean	% > 0
Excess value	Intercept	0.077	58.9%	−0.047	0.413	0.138	0.675	−0.053	0.408	−0.051	0.408
	Diversification	−0.033	34.4%	0.097	0.931	−0.097	0.053	0.103	0.954	0.087	0.895
	Rho	0.243	100.0%	0.276	1.000	0.226	1.000	0.262	1.000	0.284	1.000
	Size	−0.051	48.6%	0.060	0.513	−0.106	0.473	0.067	0.500	0.052	0.524
	Profitability	1.013	61.2%	0.754	0.594	1.142	0.621	0.640	0.586	0.885	0.584
	Capital intensity	0.272	57.4%	0.371	0.586	0.223	0.569	0.398	0.597	0.392	0.558
	R&D/sales	0.063	52.0%	−0.011	0.473	0.099	0.543	0.005	0.473	−0.029	0.488
	Growth	0.392	66.0%	0.292	0.649	0.442	0.666	0.211	0.641	0.321	0.652
Tobin's q	Intercept	0.165	75.3%	0.102	0.635	0.196	0.811	0.117	0.653	0.085	0.626
	Diversification	−0.026	35.8%	0.103	0.933	−0.090	0.074	0.111	0.946	0.089	0.911
	Rho	0.275	100.0%	0.275	1.000	0.275	1.000	0.252	1.000	0.296	1.000
	Size	−0.008	48.9%	0.078	0.508	−0.051	0.479	0.132	0.527	0.064	0.494
	Profitability	−0.054	48.0%	−0.045	0.466	−0.058	0.487	−0.118	0.446	−0.056	0.472
	Capital intensity	0.039	51.9%	−0.032	0.544	0.074	0.507	−0.088	0.529	0.036	0.575
	R&D/sales	−0.067	47.7%	−0.149	0.453	−0.027	0.489	−0.144	0.472	−0.093	0.462
	Growth	0.076	50.4%	0.069	0.519	0.080	0.497	0.100	0.538	−0.045	0.499

Interpreting these graphs and tables requires some explanation. Recall from the earlier discussion of hypothesis testing that Bayesian methods estimate probability distributions for parameters and that these probability distributions do not represent confidence intervals or the probability that the "true parameter" is different from zero (as is done in non-Bayesian statistics). With the full distribution of a parameter, we can learn the mean (or median) of the distribution as well as the probability that the parameter is greater (or less) than zero (or any other number, if desired). Both the mean of the distribution and the probability that the parameter is greater than zero are specified in the tables. Thus, in the current context of diversification, these statistics inform us of the percent of firms likely to create

Table 4. Determinants of firm-specific parameters affecting excess value and Tobin's q

	Excess value				Tobin's q			
	Diversification effect		Intercept		Diversification effect		Intercept	
	Mean	% > 0	Mean	% > 0	Mean	% > 0	Mean	% > 0
Intercept	−0.087	0.0%	−0.256	0.0%	−0.095	0.0%	0.131	98.0%
Size	0.016	100.0%	−0.005	27.9%	0.018	100.0%	−0.002	37.8%
Profitability	−0.010	48.3%	1.204	100.0%	0.022	64.2%	0.012	55.7%
Capital intensity	−0.041	13.4%	0.007	51.2%	−0.032	15.9%	−0.042	26.9%
R&D/sales	−0.234	0.0%	0.431	97.5%	−0.244	0.5%	0.412	99.0%
Growth	−0.122	0.0%	0.582	100.0%	−0.149	0.0%	−0.021	40.8%
% of shares held by dominant shareholders	−0.043	9.5%	0.152	98.5%	−0.064	0.5%	0.003	52.2%
% of shares held by insiders	−0.007	38.3%	0.120	95.5%	0.005	57.7%	−0.004	50.2%
% of shares held by institutions	0.003	53.2%	−0.065	13.9%	−0.029	14.4%	0.110	99.0%
% of board composed of outsiders	−0.055	3.5%	0.243	100.0%	−0.037	9.5%	0.042	80.1%

value from diversification and the percent of firms likely to not create value from diversification.

Recall that the hypothesis suggests that a profit-maximizing firm will tend to pursue the diversification strategy—related, unrelated, or focus—that enhances its economic value. Evaluating this hypothesis requires that we look at the value of diversification separately for firms pursuing different types of diversification strategies. For example, just looking at the distribution of firm-specific effects of diversification on firm value for all firms in the sample is not terribly insightful for evaluating this hypothesis (see the top half of Table 2, or the "All Firms" column of Table 3). However, when the results are split by subdistributions, we find a much clearer picture about the value of diversification, one that is consistent with the hypothesis.

In comparing the results for diversified firms and focused firms, it is possible to see the difference in the effect of diversification on diversified firms compared with the effect diversification would have on focused firms if they diversified. For example, for the distribution of firms who are diversified, diversification increases excess value for 93.1 percent of the draws (see Table 3, column "Diversified Firms"). The mean of this distribution is 0.097, meaning that diversified firms have an expected increase in value of 9.7 percent through diversification. The results when firm value is measured by Tobin's q are similar—that is, diversification increases Tobin's q for 93.3 percent of the draws with an expected increase in value of 10.3 percent.

Turning to the distribution of undiversified firms, diversification is expected to increase excess value for only 5.3 percent of the draws (i.e., diversification decreases excess value for 94.7 percent of the draws on the focused firms). The mean of the distribution of focused firms is −0.097, meaning that focused firms are generally making the right choice by not diversifying; if they diversified, they would have an expected decrease in value of 9.7 percent through diversification. Similar results are obtained for focused firms using Tobin's q as the dependent variable.

As noted by Hansen, Perry, and Reese (2004: 128), "these results do not represent a confidence interval, nor are they 'significant' because they have passed a '*p*-value' threshold. These results are the actual probabilities based on the data in this sample." However, these results *can* be used to examine a hypothesis. In this case, evidence in favor of the hypothesis would be finding a positive diversification coefficient for most diversified firms, and a negative diversification coefficient for most focused firms. Evidence against the hypothesis would be results showing either a negative diversification coefficient for most diversified and most focused firms (a general diversification discount) or a positive diversification coefficient for most diversified and most focused firms (a general diversification premium). Thus, since the results show that firms tend to make the profit-maximizing choice in their corporate diversification strategy—diversified firms create more value through diversification than through focused strategies, and focused firms create more value through focus than through diversification strategies—these results yield strong support for the hypothesis. Although firms do not always choose the profit-maximizing diversification strategy, more often than not, they do make the "right" choice.

Given the extensive literature demonstrating the superiority of related diversification to unrelated diversification, lumping these two groups together for an analysis of all diversified firms could be problematic for understanding the effects of diversification on firm value. Thus, the distribution is split further into subdistributions of related and unrelated diversifiers so that the effects of diversification for the related diversifiers can be compared to the effects of diversification for the unrelated diversifiers. The results for the subdistributions of related diversifiers and unrelated diversifiers are also found in Table 3.

These results suggest that, in terms of excess value, 95.4 percent of the draws on diversification for related diversifiers are positive. The distribution has a mean of 0.103, meaning that related diversifiers have an expected increase in excess value of 10.3 percent from diversifying. Similar results are obtained using Tobin's q.

For unrelated diversifiers, in terms of excess value, 89.5 percent of the draws on diversification for are positive. The distribution of unrelated diversifiers has a mean of 0.087. Similar results are obtained for unrelated diversifiers using Tobin's q as the dependent variable. These results suggest that it is *not* the case that the majority of unrelated diversifiers are not creating value from diversification, but that both related and unrelated diversifiers tend to create value from their diversification choices. Thus, the hypothesis appears to hold for both related diversifiers and unrelated diversifiers—that is, firms tend to make the profit-maximizing choice in their corporate diversification strategy.

Although the model estimated does not directly compare related and unrelated diversification, the fact that diversification tends to create less value for unrelated diversifiers than it does for related diversifiers raises the question of whether unrelated diversifiers are making a suboptimal choice relative to choosing related diversification. This study cannot provide a sufficient answer to this question, inasmuch as the unrelated diversifiers may not have the same value-creating opportunities for related diversification that the related diversifiers have.

Although not directly related to the hypothesis, the results for the firm-specific intercepts are nevertheless interesting to consider (see the "Intercept" rows of Table 3). For example, regardless of which measure of firm value is used, the firm-specific intercepts are higher for focused firms than for diversified firms. Focused firms have an average firm-specific intercept of 0.196 with Tobin's q as the dependent variable (0.138 with excess value), while diversified firms have an average firm-specific intercept of 0.102 (−0.047 with excess value). This indicates that factors unrelated to the diversification choice lead diversified firms to have a lower value than focused firms. This is consistent with prior research showing that while focused firms have a higher value than diversified firms, diversification may still be the optimal choice for diversified firms (Campa and Kedia, 2002; Maksimovic and Phillips, 2002; Miller, 2006; Villalonga, 2004).

Modeling the diversification choice

Inasmuch as the diversification choice is not randomly assigned, but endogenously determined (Campa and Kedia, 2002; Miller, 2004; Villalonga, 2004), we control for the endogeneity of the diversification choice with the logit model previously explained. We find that the expected value of diversification has a very strong effect on the diversification choice—firms that are more likely to create value from diversification are much more likely to choose to diversify. The estimated coefficient is 28.500 in the excess value model and 26.687 in the Tobin's q model,[6] both with 100 percent of the distributions being greater than zero (see the bottom half of Table 2). Growth is a positive factor in the diversification choice in both models (the average coefficient is 0.602 for excess value, and 0.738 for Tobin's q, with 94.0 percent and 94.5 percent of the distributions greater than zero, respectively). In the Tobin's q model, larger firms are more likely to diversify, with an average firm size coefficient of 0.229 (92% positive), and more profitable firms are less likely to diversify, with an average coefficient of −1.478 (0.0% positive).

[6] Although the coefficients seem large, remember that the scale of the diversification coefficients is quite small, with the average diversification coefficient being 0.077 for excess value and 0.165 for Tobin's q.

Attributes affecting the relationship between diversification and firm value

As previously noted in the section introducing the control variables, with the hierarchical Bayesian model, additional information about firm characteristics affecting the relationships between diversification and firm value are incorporated into the estimation of both the firm-specific intercept and the firm-specific diversification coefficient, thereby improving the accuracy of firm-specific coefficients. The results for these attributes affecting the relationship between diversification and firm value are shown in Table 4.

Similar to Tables 2 and 3, the first two columns of Table 4 characterize the mean of the distribution of the effects of firm attributes (the control variables) on the value of diversification (β_{Di}), and the probability that this effect is positive. The other columns in Table 4 indicate these statistics for the firm attributes influencing the firm-specific intercept (α_i). In interpreting the results in these tables, it is important to notice that the coefficients that influence the firm-specific intercept (α_i) should be interpreted as the direct effect that its corresponding variable has on a firm's value, but the coefficients that influence the firm-specific diversification coefficient (β_{Di}) should be interpreted as the moderating effect of that variable on diversification's effect on firm value. For example, a coefficient of −0.005 for the effect of size (the natural log of assets) on the firm-specific intercept (α_i) can be interpreted as meaning that an increase in the natural log of assets by 1 is associated with a decrease in the value of the firm of 0.5 percent (i.e., larger firms, regardless of diversification status, have lower excess values). A coefficient of 0.016 for the effect of size on the firm-specific diversification coefficient (β_{Di}) means that an increase in the natural log of assets by 1 is associated with an increase in the value of diversification of 1.6 percent (i.e., larger firms derive more value from diversification than smaller firms).

The results in Table 4 also show the probabilities that a particular firm attribute has a positive effect on the firm-specific intercept (α_i) or the firm-specific diversification coefficient (β_{Di}). The interpretation of these probabilities is different from the interpretation of the probabilities in Table 3—namely, Table 3 characterized a distribution of firm-specific coefficients, but the distributions characterized in Table 4 are not firm-specific, but common to all firms. For example, to interpret the % > 0 column in Table 4, we would not interpret this column to mean that increased profitability increases diversification's effect on excess value for 48.3 percent *of firms.* Rather, the interpretation is that that larger firm size increases diversification's effect on excess value with 48.3 percent probability. Similarly, the results suggest that a faster growth rate increases the value of diversification with 0 percent probability (or decreases it with 100% probability), and higher capital intensity increases the value of diversification with 13.4 percent probability (or decreases it with 86.6% probability). Table 4 shows similar results for the influence of these variables on diversification's effect on the log of Tobin's q. These results are consistent with work showing that mature firms with few investment opportunities in existing businesses are more likely to create value through diversification than growing firms (Gomes and Livdan, 2004; Maksimovic and Phillips, 2002; Rumelt, 1977; Stimpert and Duhaime, 1997).

Table 4 also shows that firms with higher R&D intensity are less likely to diversify successfully, and that profitability has little effect on the value of diversification.

Turning to the controls for quality of corporate governance, the evidence is mixed; ownership by dominant shareholders reduces the value of diversification, but more outsiders on the board increases the value of diversification. Insider ownership and institutional ownership have little effect on the value of diversification.

A finding that governance has little impact on the value of diversification may actually be consistent with the logic of agency theory. Agency theory (Jensen and Meckling, 1976) predicts that a firm's managers may have an incentive to make decisions that maximize the manager's utility rather than firm value; agency theory takes the value of each decision as given. In the context of diversification, a careful application of agency theory would predict that while poor governance may affect the diversification *decision* by increasing the incentive to diversify when it is a value-reducing decision, it should not affect the *value* of diversification (Jensen, 1986). While this work incorporates the endogenous diversification decision into the model, estimating the diversification decision as a function of governance properly would require incorporating governance in a way in which governance only affects the diversification choice conditional on the diversification coefficient being negative. This is a complicated matter that deserves a thorough treatment in separate research.

DISCUSSION AND CONCLUSION

Summary

This article seeks to examine the relationship between a firm's diversification strategy and its performance for individual firms. Unlike prior studies in which researchers relied on empirical methodologies that estimate the average relationship between diversification and firm value, this research employs a hierarchical Bayesian modeling approach that allowed for firm-level estimates of this relationship for individual firms. Several important findings from this approach add new insight into a multi-decade debate within the literature concerning the value of diversification.

First, as hypothesized, the results suggest that firms tend to be profit-maximizing in their choice of corporate diversification strategy. Specifically, related diversifiers tend to make the right choice by diversifying, unrelated diversifiers also tend to make the right choice by diversifying, and focused firms tend to make the right choice by refraining from diversifying.

Of course, while diversified and focused firms tend to make the right respective choices of corporate strategy, not all firms make the value-enhancing choice. Some diversified firms would be better off focused, and some focused firms would be better off diversifying. Clearly, as with many strategic decisions that managers make, there is considerable heterogeneity between firms in terms of how a strategy will affect firm value (Hansen *et al.*, 2004). Without the Bayesian hierarchical model used in this article, these important findings highlighting the considerable heterogeneity in the value of diversification, would be obscured.

Additionally, this article, by modeling heterogeneity in the value of diversification in a subdistribution of related diversifiers, unrelated diversifiers, and focused firms, has been able to show that diversification has a higher expected value for related diversifiers than unrelated diversifiers, but that diversification also has a higher expected value than focus for unrelated diversifiers as well. Finding that diversified firms (whether related or unrelated diversifiers) are creating value by choosing to diversify leads to at least two important implications for research comparing related and unrelated diversifiers. First, related diversification is clearly not the "lesser of two evils" compared with unrelated diversification, and second, even though related diversifiers tend to create more value through diversification than unrelated diversifiers, this does not imply that unrelated diversifiers are making the wrong choice and should instead seek related diversification. Certainly, related diversification can create value through economies of scope (Teece, 1980, 1982); however, not all firms have opportunities to pursue economies of scope through related diversification. Indeed, each diversification strategy—focused, related, and unrelated—tends to be economically sound for the firms that choose it.

This article is broadly consistent with both received theory and empirical work on unrelated diversification. Theoretically, there are conditions under which a firm can create value through unrelated diversification (Wang and Barney, 2006; Gomes and Livdan, 2004; Maksimovic and Phillips, 2002; Rumelt, 1977; Stimpert and Duhaime, 1997). Further, the extant empirical literature comparing related and unrelated diversification generally concludes that related diversification outperforms unrelated diversification (as does this article); however, the extant empirical literature typically does not address whether or not a focused strategy would be better for unrelated diversifiers that are limited in their opportunities for related diversification. Thus, while consistent with prior empirical work, the findings of this article add to our understanding of the benefits for firms of related, unrelated, and focused strategies.

As a limitation, however, diversification is a broad characterization that encapsulates many possible decisions a firm could make. This article only estimates the effects of diversifying in the way that a firm actually diversified compared with the choice of not diversifying. Of all the possible diversification choices a firm can make, we only observe the ones actually made. It could be the case that firms that diversify could have done better (or worse) by implementing diversification in a different way, or by diversifying into a different industry. As such, the estimated coefficients for diversification are only a comparison of the expected value of a firm being diversified compared with the value of the firm if it were not diversified. Diversification and focus is only one dimension of the firm's choice set. While it may be the case that, for a particular firm, being diversified is better than not being diversified, "not being diversified" is a description that may encompass a very broad set of potential actions. For example, for a firm with free cash flow that is considering diversification, the firm might instead use the free cash flow to increase their dividend or repurchase stock (Mackey and Barney, 2013), pay back debt, engage in a nondiversifying (horizontal) merger, invest in existing businesses, or buy a fleet of corporate jets, among other possible decisions. An ideal empirical model would compare all of the potential alternatives to diversification simultaneously in such a way that it might estimate the optimal allocation of each dollar of free cash flow to each of these potential alternatives. Identification of this ideal model would be a burdensome challenge.

Implications for strategy scholarship

Beyond the value of diversification, incorporating firm heterogeneity into the analysis of the effects of diversification could be assimilated into other topics pertaining to diversification. One stream of research that would benefit from incorporating firm heterogeneity into the empirical methodology is the literature on governance and the firm's *choice* to diversify. As noted previously, the results suggest that poor governance does not affect the value of diversification. Although not empirically tested in this work, it is likely that, as predicted by agency theory, poor governance will increase the probability that a firm will choose to diversify when it is already the value reducing choice (i.e., the firm has a negative diversification coefficient), but the actual value of diversification is determined by the resources possessed by the firm and the context within which it is operating and not by the incentives facing the firm's managers. Thus, agency conflicts, while they may affect the diversification choice, may not reduce the value of diversification. Future research might clarify a recent empirical debate between strategy and finance scholars about whether agency conflicts are a cause of firm diversification (e.g., Denis, Denis, and Sarin, 1997, 1999; Lane, Cannella, and Lubatkin, 1998, 1999). In this debate, Denis *et al.* (1997) find that agency problems lead firms to remain diversified when they should refocus, but they do not find evidence that agency is the cause of increased diversification. Lane *et al.* (1998) critique agency theory as a determinant of corporate strategy, finding no evidence that governance or managerial risk-reduction affects a firm's level of diversification.

Firm-level heterogeneity in the value of diversification suggests that one reason why the results of this debate have been conflicting could be that poor governance is the cause of harmful diversification in only a limited subsample of firms—those firms who shouldn't diversify and are on the margin of being able to justify a diversification decision. Weakly governed firms with a large, negative, firm-specific diversification coefficient can't justify the diversification choice, and firms with a positive diversification coefficient should diversify, regardless of the quality of their governance. Weak governance is most likely to be the cause of diversification for only a few firms that have both weak governance and a small, negative firm-specific diversification coefficient. In other cases, firms with a negative firm-specific diversification coefficient might have chosen to diversify because of inferior expectations about the value of their diversification opportunities.

When firms destroy value by diversifying, future research estimating firm-specific relationships might be able to learn how often value-reducing diversification was motivated by agency conflicts and how often it was motivated by inferior expectations. It could, in fact, be the case that the number of managers who can gain private benefits from diversifying at the expense of firm value is actually quite small (Lane *et al.*, 1999).

More broadly, this research has implications for studying the performance effects of a wide variety of strategic phenomena. For some time now, there has been a mismatch between strategic management theory—which has emphasized the importance of individual firms exploiting their resources and capabilities in conceiving and implementing value maximizing strategies (Barney, 1991)—and strategic management research methods—which have built on models based on estimating average relationships (Hansen *et al.*, 2004). Knowing that, on average, a strategy has a positive or negative correlation with firm value is of less interest to strategic management scholars than knowing the conditions under which and the probability that a particular strategy can be a source of value creation for a particular firm (Hahn and Doh, 2006; Hansen *et al.*, 2004).

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Implications for strategy practice

Indeed, as shown here, efforts to identify these overall average relationships can generate results that are fundamentally misleading to individual firms looking to choose strategies that maximize their economic value. For example, if the coefficient characterizing the relationship between a particular strategy and firm performance is found to be positive (or negative), how should managers interpret those findings? Clearly, these findings should not be interpreted as a "rule for riches" suggesting that all firms should pursue this particular strategy (or avoid it in the case of a negative relationship). Such an interpretation, in the case of diversification for example, would indicate that all focused firms should diversify to obtain a premium if a diversification premium is found (e.g., Campa and Kedia, 2002; Miller, 2006; Villalonga, 2004) or that all diversified firms should be broken up in the case of the diversification discount.[7] Such notions of simple rules of strategy have long been debunked (Rumelt, Schendel, and Teece, 1994). Further, such interpretations rest upon faulty statistical assumptions—namely, that the coefficient represents the true relationship between the strategy and the performance for every firm in the sample or even the most likely outcome of this strategy. In reality, the coefficient represents the average relationship for the particular mix of firms in the sample. Since the coefficient is, roughly speaking, the average of all the relationships in the sample, there can certainly be many firms within the sample that have a different relationship between the strategy and performance than what the average coefficient suggests.

Thus, the prescriptive limits of average effects, at best, can only inform scholars and practitioners if a strategy is more likely to create value, or if it is more likely to destroy value for the mythical "average firm." At worst, by ignoring firm heterogeneity, estimating only average effects may ignore a substantial subset of firms that are likely to have the opposite outcome from choosing that strategy.

Prior theory suggests that rare and costly to imitate strategies are most likely to be sources of superior performance (Barney, 1991). However, when these unusual firms are included in a larger sample, and applying traditional methods to examine the link between firm resources and capabilities and firm performance will often generate either negative coefficients or null results, as few firms in the mix of firms in a sample will be creating value from this strategy. Yet, quite ironically, these are the types of strategies that actually hold the promise of sustained competitive advantage.

This logic is completely the opposite of how average effects studies are currently interpreted—that is, it is thought that strategies with positive average effects are "good" to pursue and those with "negative" average effects are "bad" to pursue, when from a competitive advantage perspective, it may in fact be the opposite. That is, it may be that a small set of firms can create value from a particular strategy (e.g., it might require special resources to create value) and that because most firms are unable to create value from this strategy, the average effect of pursuing this strategy will be negative.

Shifting the object of research efforts from examining the "overall relationship" between a strategy and firm value to estimating firm-specific relationships and the probability that a strategy will create value is likely to require the field of strategic management to adopt new methodological approaches (Hahn and Doh, 2006; Hansen *et al.*, 2004). The approach described in this article is just one example of the methodologies that may be required to begin to address what is most strategic about strategic management theory.

[7] The results in this article actually suggest that most firms, most of the time, choose that diversification strategy that maximizes their value—and thus, arbitrage opportunities associated with these firms, creating value through diversification, are rare. This, of course, does not suggest that such arbitrage opportunities do not exist for any firms since there are examples of firms that implement diversification strategies that do not maximize their economic value. However, these arbitrage opportunities depend on a mismatch between the specific resources and capabilities a firm has and the diversification strategies it is pursuing, not on the overall relationship between diversification strategy and firm performance.

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