

# **Does Diversification Cause the “Diversification Discount”?**

**Belén Villalonga**

University of California, Los Angeles  
Anderson Graduate School of Management  
110 Westwood Plaza, Box 951481  
Los Angeles, CA 90095-1481, U.S.A.

Tel.: (310) 470-2623

Fax: (310) 470-0643

e-mail: [belen.villalonga@anderson.ucla.edu](mailto:belen.villalonga@anderson.ucla.edu)

web: <http://personal.anderson.ucla.edu/belen.villalonga>

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## **Does Diversification Cause the “Diversification Discount”?**

### **ABSTRACT**

I examine whether the discount of diversified firms can actually be attributed to diversification itself, using recent econometric developments about causal inference. The value effect of diversification is unbiasedly estimated by matching diversified and specialized firms on the propensity score—the predicted values from a probit model of the propensity to diversify. I apply this method on a sample of diversified firms that trade at a significant mean and median discount relative to specialized firms of similar size and industry. I find that, when a more comparable benchmark based on propensity scores is used, the diversification discount as such disappears or even turns into a premium.

In a seminal paper, Wernerfelt and Montgomery (1988) find that diversification has a negative effect on firm value, as measured by Tobin's  $q$ . Their result has been confirmed by the later studies of Lang and Stulz (1994), Berger and Ofek (1995), and others who, using an industry-adjusted Tobin's  $q$  or similar performance measures, find that diversified firms trade at an average discount in U.S. stock markets relative to specialized firms—what has come to be known as “the diversification discount”.

Yet, a substantial part of economic activity continues to be carried out within diversified firms. Between 1990 and 1996, for instance, diversified firms were home to nearly 50% of U.S. employment, and owned about 60% of the total assets of firms trading in U.S. stock markets.<sup>1</sup> Furthermore, and despite the emphasis placed on corporate refocusing by recent literature, firms have actually continued to engage in nearly as much diversification as refocusing during the past two decades.<sup>2</sup> In fact, Hatfield, Liebeskind, and Opler (1996) show that all this firm restructuring during the 1980s has resulted in lower, rather than higher, aggregate industry specialization.

The finding of a diversification discount thus raises an important economic puzzle: Are the forces of competition so weak that they consistently fail to eliminate diversified firms from the economic landscape, despite their relative inefficiency? The finding is also puzzling because it conflicts with most of the earlier evidence about the effect of diversification on corporate performance—whether measured as profitability, productivity, or even stock market performance in the form of abnormal returns to announcements of diversifying acquisitions.

Before attempting to resolve this puzzle, however, a more basic question needs to be asked,

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<sup>1</sup> Own computations, based on the Census Bureau's *Business Information Tracking Series (BITS)* and Compustat.

<sup>2</sup> *BITS* show that, for every 100 firms that reduce the number of SIC codes in which they operate in any year between 1990 and 1996, 95 increase it. The figure yielded by Compustat data for the same concept is 87%, which is comparable to the 82% reported by Hyland (1997) for the 1977–1992 period based on Compustat data.

namely: “Does diversification cause the “diversification discount” in the first place?” There is some evidence to the contrary—that diversified firms were already trading at a discount prior to diversifying (Lang and Stulz, 1994; Servaes, 1996; Hyland, 1997). There is also evidence that firms that choose to diversify differ from firms that choose not to diversify in a number of other characteristics (Lemelin, 1982; MacDonald, 1985; Montgomery and Hariharan, 1991; Rondi et al., 1996; Merino and Rodríguez, 1997; Silverman, 1999). The question, then, is how much of a discount, if any, is left after controlling for those differences.

This paper attempts to answer this question using recent econometric developments about causal inference. As Lalonde (1986) shows, non-experimental methods for assessing treatment effects may yield biased estimates because a matched sample of control observations is required to infer causality. However, when there are several characteristics in which the treatment and control groups differ, the task of constructing a matched sample becomes virtually impossible—what is often referred to as the “curse of dimensionality”.

The causal inference literature has typically been applied to the labor economics issue of evaluating the effect of training programs on participants’ earnings. Yet, the estimation of diversification’s effect on firm value is another example of the same more general statistical problem—and one of no less economic importance, considering the percentage of the working population diversified firms employ. Accordingly, in this paper I adapt to the diversification context the algorithm proposed by Dehejia and Wahba (1998, 1999) to deal with this problem. Specifically, propensity scores—the predicted values from a probit model of a firm’s decision to diversify—are used to match groups of diversified and specialized firms in order to yield an unbiased estimate of the value effect of diversification. I apply this method on a sample of diversified firms that trade at a significant mean and

median discount relative to specialized firms of similar size and industry. I find that, when a more comparable benchmark based on the propensity score is used, the diversification discount as such not only disappears, but even turns into a large significant premium.

The rest of the paper is organized as follows. Section I discusses the puzzle raised by the diversification discount from both a theoretical and an empirical point of view. Section 2 explains the problem of causal inference with non-experimental data as it applies to the diversification discount, as well as the propensity score methodology used to address it. Section 3 reports four sets of results: (1) the replication of earlier findings; (2) the estimates from the probit model of diversification that are used to construct propensity scores; (3) the resulting evidence about the effect of diversification on firm value; and (4) the outcome of several sensitivity analyses. Section 4 concludes. The data and variables are described in the Appendix.

## **I. The puzzle of the “diversification discount”**

### *A. The theoretical puzzle*

There is no shortage of theories that suggest diversification is a value maximizing strategy. Some suggest that managers possess monitoring and information advantages over external capital markets (Alchian, 1969; Williamson 1975). Hence, diversification creates internal capital markets that lead to a more efficient allocation of resources across businesses. Others point to potential benefits of diversification such as: lower risk, greater debt capacity, and lower taxes as a result of combining businesses with imperfectly correlated cash flows (Lewellen, 1971); and increased market power as a result of cross-subsidized predatory pricing (Tirole, 1995) or of mutual forbearance between multi-market competitors (Scott, 1982; Bernheim and Winston, 1990).

On the other hand, arguments have also been made about why diversification may be value-destroying. Agency theory sees diversification as a means through which managers can pursue their own interests at the expense of shareholders' (Jensen, 1986). Specifically, diversification may allow managers to: increase their compensation, power, and prestige (Jensen and Murphy, 1990); reduce their personal risk, which they cannot do by diversifying their portfolios (Amihud and Lev, 1981); or become entrenched by directing diversification in a way consistent with their own skills (Shleifer and Vishny, 1989). Other theories suggest that diversification creates inefficient internal capital markets through overinvestment in low-performing businesses (Stulz, 1990); or because of internal power struggles that generate influence costs (Rajan, Servaes and Zingales, 2000). This group of theories is clearly consistent with the finding of a diversification discount; indeed, some of them have emerged in order to explain it. From an economic standpoint, however, it is difficult to rationalize why, if diversified firms are relatively inefficient, they continue to play such an important role in economic activity.

A third group of theories that seem consistent with the observation of both diversification discounts and the persistence of diversification strategies are those that suggest there is an optimal level of diversification for each firm and/or time period. For instance, the resource-based theory of diversification argues that it results from firms' excess capacity in valuable resources and capabilities that are transferable across industries but subject to market imperfections. Under these circumstances, economies of scope arise, and the diversified firm becomes the most efficient form of organizing economic activity (Penrose 1959; Panzar and Willig, 1979). If those conditions are not met, either because the firm diversifies into unrelated industries where the firm's resources are of little use (Rumelt, 1974) or because no transaction costs prevent the firm from profitably exploiting its resources in the market (Teece, 1980, 1982), diversification becomes suboptimal. Likewise, Rotemberg and Saloner's

model leads them to conclude that “innovative firms must remain narrow while less innovative firms can be broad” (1994: 1347).

Bhide (1990) and Hubbard and Palia (1999) argue that the informational efficiency of external capital markets may have changed over the last decades. Hence, the relative value of diversified firms as internal capital markets is contingent on the time period examined. Other theories indicate that the optimal level of diversification differs *both* across firms and over time, i.e. depending on the life-cycle stage at which the firm is in. For instance, Matsusaka (1998) proposes a dynamic model of diversification in which firms repeatedly enter new businesses and exit old ones in search of good matches for their organizational capabilities. Bernardo and Chowdry (1999) advance the paradox that diversified firms may trade at a discount precisely because the market value of specialized firms reflects the real options value of diversification, whereas diversified firms have perhaps exhausted their options to diversify and expand. These and other dynamic views of diversification are also consistent with theories and evidence about the causes and consequences of corporate refocusing (Liebeskind and Opler, 1992; Comment and Jarrell, 1995; John and Ofek, 1995; Daley, Mehrotra, and Sivakumar, 1997, Berger and Ofek, 1999; Matsusaka and Nanda, 2000).

Still, the finding that diversified firms *on average* trade at a discount is difficult to reconcile with such “optimal diversification” theories. Those theories explain why certain firms at certain points in time may be trading at a discount. In equilibrium, however, the forces of competition should push firms towards their optimal diversification level. Thus, in a large cross-sectional sample of firms, these theories would lead to expect neither a discount nor a premium for diversified firms.<sup>3</sup>

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<sup>3</sup> This is the same argument made by Demsetz (1983) and Demsetz and Lehn (1985) with respect to ownership structure and performance.

## *B. The empirical puzzle*

The finding that diversified firms trade at an average discount is also difficult to reconcile with most of the earlier evidence about the effect of diversification on corporate performance. Leaving aside the research that documents the existence of the diversification discount, empirical studies about this issue largely fall into three groups: strategy and industrial organization studies of the relationship between diversification and profitability, studies about the effect of diversification on productivity, and event studies of the stock market's reaction to announcements of diversifying acquisitions.<sup>4</sup>

The profitability studies group is by far the largest of the three, as shown in Ramanujam and Varadarajan (1989) and Montgomery's (1994) comprehensive reviews. These studies have used different measures of diversification, both continuous (e.g. Herfindahl and entropy indices) and categorical (Rumelt's (1974) categories), as well as a broad selection of control variables. The main finding, widely replicated across studies, is that related diversification is positively associated to profitability while unrelated diversification is negatively associated to it; or that diversification and performance follow a non-monotonic relationship. The statistical significance of these results varies across studies, however, and many have found no significant relationship. All this is primarily consistent with the optimal diversification theories mentioned, and contrasts with the apparent robustness of the diversification discount to different time periods and degrees of relatedness across diversified firms' divisions.

Research about the effect of diversification on plant or firm productivity is much more scarce

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<sup>4</sup> In addition, a recent strand of empirical literature presents evidence that is interpreted by those who find it as supporting the inefficient internal capital markets explanation to the diversification discount (e.g. Lamont, 1997; Shin and Stulz, 1998; Scharfstein, 1998; Rajan et al., 2000). However, Whited (1999) shows that the method common to these studies suffers from a measurement error problem which, when corrected, leads to the disappearance of all evidence of inefficient capital allocation across divisions.

and not totally clear cut. Lichtenberg (1992), for example, finds that the relationship between diversification and productivity is positive, but becomes negative when controlling for firm size. Maksimovic and Phillips (1999) find that single-business firms have significantly higher productivity than conglomerates. Their definition of businesses at the 3-digit SIC level, however, may lead to classify as single-business many firms that would otherwise be considered as diversified. Schoar (2000) finds that diversified firms are cross-sectionally more productive than specialized firms, and that plants that are newly acquired (through a diversifying acquisition) experience a productivity increase. At the acquiring firm level, however, this increase is more than offset by the productivity decrease suffered by the plants it formerly owned. The cumulative evidence from diversification studies about productivity thus offers no clear support for any diversification theory. However, Schoar (2000) provides direct evidence of a puzzling coexistence of a diversification discount with the productivity premium in her sample.

Even more puzzling is the coexistence of the finding of a diversification discount with the evidence from event studies that the stock market responds positively to announcements of diversifying acquisitions. Morck, Shleifer, and Vishny's (1990) study is often cited as evidence of a negative market reaction to this type of acquisitions. However, the rest of studies in this group actually offer a very different picture. Kaplan and Weisbach (1992) replicate the general result of acquisition event studies that bidder returns are slightly negative but combined returns to bidder and targets are positive, which imply that acquisitions increase combined shareholder value (Jensen and Ruback, 1983); they also find no significant differences between related and unrelated acquisitions in their stock returns' impact during the 1970s and early 1980s. The remaining studies all report *positive* market reactions to unrelated diversifying acquisitions: Schipper and Thompson (1983) and Hubbard and Palia (1999) for the 1960s, Matsusaka (1993) for the late 60s and 70s, Hyland (1997) and Chevalier (1999) for the 80s and 90s.

## II. Causality, comparability, and the diversification discount

### A. The problem of causal inference in estimating the diversification discount

The estimation of diversification's effect on firm value is an example of the general statistical problem of estimating treatment effects in observational studies. The problem, in its essence, is that the simple average difference in outcomes between treatment and control groups is only an unbiased estimate of the treatment effect when units are randomly assigned to the treatment, as in a well-designed experiment. This is typically not the case, however, in studies for which experimental data are not available, as it happens in the context of diversification and managerial decision-making in general.

Using standard notation in causal inference theory (Rosenbaum and Rubin, 1983), let  $Y_{i1}$  represent firm value for diversified firms, and  $Y_{i0}$  the value of specialized firms. Let  $D_i$  be a diversification indicator that equals one when the firm diversifies and zero otherwise. Accordingly,  $E(Y_{i1} | D_i = 1)$  denotes the average value of diversified firms, and  $E(Y_{i0} | D_i = 0)$  the average value of specialized firms. The effect of interest is that of diversification on the value of the diversified firms, or the difference between the value of the average diversified firm and *the value its segments would have had if operated as stand-alone segments* ( $E(Y_{i0} | D_i = 1)$ ):<sup>5</sup>

$$\tau |_{T=1} = E(Y_{i1} | D_i = 1) - E(Y_{i0} | D_i = 1). \quad (1)$$

This difference is generally known as the *expected treatment effect on the treated*. Since  $E(Y_{i0} | D_i = 1)$  is obviously unobservable, what may be computed instead of (1) is the difference in average value between diversified and specialized firms:

$$\tau^e = E(Y_{i1} | D_i = 1) - E(Y_{i0} | D_i = 0). \quad (2)$$

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<sup>5</sup> In this paper, as in all the diversification discount literature, the term "segment" is adopted from Compustat data to refer to a firm's activities in a particular industry.

The problem, then, is that unless  $E(Y_{i0} | D_i = 1) = E(Y_{i0} | D_i = 0)$ , as it occurs under random assignment, (2) is a biased estimator of (1).

Rubin (1974, 1977) has shown that the expected treatment effect on the treated can still be identified in a non-experimental context, by assuming that treatment assignment is a function of observable variables. In that case, conditional on the observed variables, the assignment can be taken to be random, and the unconditional effect can be estimated as the expectation of the conditional effects over the distribution of the conditioning variables in the treated population:

$$\tau_{|T=1} = E_X \{E(Y_{i1} | X_i, D_i = 1) - E(Y_{i0} | X_i, D_i = 0) | D_i = 1\}. \quad (3)$$

Accordingly, non-experimental approaches to evaluating treatment effects attempt to replicate this setting by (1) selecting a control group as similar as possible to the treatment group, and (2) specifying an econometric model of outcomes and (ideally) treatment participation.

In his influential paper, however, Lalonde (1986) shows that econometric methods have great difficulty replicating the experimental results when using control groups other than the experimental one. Specifically, he uses data from a training program that was run by the government as a random experiment to compare the experimental and several non-experimental estimates of the effect of program participation on participants' earnings. He finds that one-step methods such as linear regression (uni- or multivariate) yield estimates that differ widely from the experimental benchmark in size, in significance, and even in sign. Two-stage methods such as Heckman's sample selection model come closer, but are still significantly different from the benchmark.

A similar exercise cannot be performed in the context of diversification due to the impossibility of observing the experimental benchmark. However, the combination of Lalonde's findings with the evidence that firms do not diversify at random, and with the standard practice in the literature of

constructing comparison groups by matching firms on industry and size only, suggest that prior estimates of diversification's effect on firm value may suffer from a similar bias. Campa and Kedia (1999), who use two-stage methods to estimate this effect, find that the diversification discount as estimated by earlier studies either disappears or turns into large significant premium.<sup>6</sup> What Lalonde's results suggest, however, is that these two-stage estimates may also be biased. The extent of the potential bias depends on the overlap between the distributions of characteristics for the treatment and control groups; the greater the overlap in *all* characteristics, the more comparable the groups, and the smaller the bias. Therefore, and given that there are many possible reasons why firms diversify, partial matches based on one or two characteristics may not yield the most relevant group for comparison.

*B. Using propensity scores to construct comparable control groups of specialized firms*

Dehejia and Wahba (1998, 1999)—DW hereafter—propose an algorithm that solves the problems previously described, including the “curse of dimensionality” implicit in the selection of an adequate control group. The algorithm is based on Rosenbaum and Rubin's (1983) *propensity score* theorem. DW's contribution is to spell out in detail how the propensity score methodology can be implemented in practice. They also show, using Lalonde's (1986) same data, that the method closely

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<sup>6</sup> This paper was developed independently and simultaneously to Campa and Kedia's. Our papers are similar in that they both provide evidence, for the first time, that after controlling for sample selectivity, the diversification discount disappears or even turns into a premium. This is an important contribution of both papers because, while many others had shown that firms that choose to diversify differ from firms that choose not to diversify in various characteristics, not until these two studies has it been empirically confirmed that, after controlling for those differences, there is no “diversification discount” left.

My study differs from theirs in the following three main ways. (1) My specification of the probit model of the diversification decision is substantially more complete than theirs, which ignores all prior theory and evidence about this issue. (2) Following DW's method, the results of that model are taken advantage of in order to construct an appropriate control group of specialized firms. As Lalonde's results show, the construction of such a group or lack thereof may be relevant to the unbiasedness of the final estimates. (3) My study compares *diversifying* and *diversified* firms separately to their relevant control groups. In contrast, while their study initially acknowledges the difference, it eventually does not distinguish between the two in the estimation.

Nevertheless, the fact that both our studies reach a similar conclusion shows that our approaches are complementary and reinforces the validity of the conclusion itself.

replicates the experimental estimates of the treatment effect.

The propensity score is defined as the probability of assignment to treatment conditional on a vector of independent variables  $X_i$ :

$$p(X_i) \equiv \Pr (D_i = 1 | X_i) = E (D_i | X_i) . \quad (4)$$

The propensity score theorem says that if the treatment assignment is ignorable conditional on  $X$ , then it is also ignorable conditional on the propensity score:

$$Y_{i1}, Y_{i0} \perp D_i | X_i \Rightarrow Y_{i1}, Y_{i0} \perp D_i | p(X_i) . \quad (5)$$

The theorem implies that observations with the same propensity score have the same distribution of the full vector of variables  $X_i$ . Therefore, by matching on the propensity score, maximum comparability between treatment and control groups is attained. The treatment effect on the treated can then be estimated as the expectation of the conditional effects over the distribution of the propensity score in the treated population:

$$\tau |_{T=1} = E_{p(X)} \{E(Y_{i1} | p(X_i), D_i = 1) - E(Y_{i0} | p(X_i), D_i = 0) | D_i = 1\} . \quad (6)$$

In this paper, I adapt DW's method in order to estimate the effect of diversification on firm value. Following the literature on causal inference, this effect is primarily assessed by looking at diversification as a treatment that firms choose to go through or not during the period 1991-1997, and measuring the effect at the end of the treatment period (1997). In other words, the primary comparison here is between *diversifying* and *non-diversifying* firms. This requires looking at diversified firms at the point in time when they diversify, i.e. when they increase their number of segments from one to two or more. Nevertheless, in order to address situations of persistent and/or cumulative diversification and make my results more comparable to those of the diversification discount literature, I also compare, as a sensitivity analysis, *diversified* and *specialized* firms. The propensity score method can also be applied to

this case, but a slightly different interpretation is in order, since the propensity equation then refers to a firm's probability *to be diversified*. The data and variables used are described in the Appendix. The method involves the following steps:

1) *Estimating the propensity to diversify*. Following previous studies (Lemelin, 1982; MacDonald, 1985; Montgomery and Hariharan, 1991; Rondi et. al, 1996; Merino and Rodríguez, 1997; Silverman, 1999), the diversification decision is modeled using a discrete choice model of firm *i*'s propensity to diversify into industry *j*:

$$\Pr (D_{ij} = 1 | X_i, Q_i, W_j, R_{ij}) = f(X_i, W_j, R_{ij}) , \quad (7)$$

where  $X_i$  are firm characteristics,  $Q_i$  and  $W_j$  are origin and target industry characteristics, respectively, and  $R_{ij}$  are characteristics of the relationship between the two industries (or between the firm and the target industry). Models of this type have been found to yield much greater explanatory power than those that only include firm characteristics. As in the former studies, each observation in my sample represents a firm-target industry pair, and each firm in the control group is paired up with each of the potential target industries. Unlike those studies, however, both groups of firms are dealt with homogeneously by also pairing up treated firms with each potential target industry, although the dependent variable for a pair only equals one for the target industries in which the firm actually entered. To keep the dataset tractable, the set of potential targets for the control firms is restricted to the industries entered by diversifying firms after 1990.

I also contribute to the empirical literature on diversification motives by including variables from a larger set of diversification theories than those in prior studies. However, to avoid diverting the reader's attention from the central theme of this paper, the underlying theory for each variable and its expected sign is only noted within the table in the Appendix, and briefly discussed in the results section.

A more detailed discussion of these theories and their empirically testable implications can be found in Villalonga (2000).

2) *Computing propensity scores* for treated and control observations as the predicted values from the model of step 1. At this stage, then, for each firm-potential target industry pair there is one score which measures the firm's propensity to diversify *into a given industry*.

3) *Selecting one propensity score per firm only*. In order to estimate the effect of diversification on firm value, the interest is not really in a firm's propensity to diversify *into a given industry*, but in the *firm's overall propensity to diversify*.<sup>7</sup> For this purpose, each specialized firm is assigned the maximum score among those for all potential target industries; each diversified firm is assigned the propensity score for the industry into which it actually diversified, or the maximum of these when the firm diversified into more than one industry.

4) *Separating treatment and control groups (diversified vs. specialized firms), and sorting observations within each group from lowest to highest propensity scores*.

5) *Discarding all specialized firms with an estimated propensity score lower (higher) than the minimum (maximum) of the propensity score for diversified firms*. This step thus eliminates from the control group all firms to which diversified firms are not comparable to begin with.

6) *Classifying all firms (diversified and specialized) into blocks defined by the quintiles of the propensity score distribution for diversified firms*. This step and the following ensure that, even though both groups of firms are different prior to the diversification period in a number of characteristics, they are comparable within the blocks defined. The use of quantiles (quintiles or other) of the score

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<sup>7</sup> This prevents the inclusion of diversified firms among the control group for all industries into which it did not diversify. It also prevents the classification of a firm into different blocks at step 6 below.

distribution for diversified firms provide a convenient starting point for the definition of the blocks, as a minimum number of firms is allocated to each block by construction. As explained below, however, the blocks may need to be redefined at a later stage.

7) *For each pre-diversification variable, as well as for the propensity score, doing t-tests of differences in means between the diversified and specialized firms within each block.*

(a) If all blocks are well balanced (i.e. *t*-statistics non-significant) for most variables: Stopping

(b) If a block is not well balanced: Dividing block into finer blocks and re-evaluating

(c) If most blocks are not well balanced: Modifying logit model and re-evaluating.

8) *Estimating the effect of diversification on firm value* by taking the weighted average (by number of diversified firms) of the within-block mean differences in value between diversified and specialized firms. This is the *average treatment effect on the treated* of the causal inference literature.

### **III. Results**

#### *A.. Replication of earlier findings*

As a preliminary step to the main analyses, I verify that the finding of a “diversification discount” as estimated in prior studies also holds for my sample. Following Lang and Stulz (1994), Servaes (1996), and Rajan et al. (2000), I initially estimate the effect of diversification as the mean and median difference in industry-adjusted Tobin’s *q* between diversified and specialized firms. The construction of the industry-adjusted *qs* is detailed in the Appendix. These estimates are reported in Table 1. Negative values represent *discounts*, positive values represent *premia*. The last two columns, which refer to the differences between both groups of firms, show that diversified firms trade at a discount during the 1990s. The mean (median) discount found ranges between – 0.06 (– 0.02) in 1990 and – 0.24 (– 0.14)

in 1992, and is significant for all years except 1990. Pooling all years, the mean discount for the sample is  $-0.16$ , and the median discount is  $-0.08$ . These figures are smaller than those reported by Lang and Stulz (1994) and Servaes (1996) for the 1980s and the 1960s, respectively, using a similar measure. This result is consistent, however, with the general downward trend in the size of the diversification discount reported by Lang and Stulz (1994) for the late 1980s.

The last row of Table 1 reports the mean and median discount of the diversified firms in the subsample of diversifying firms for 1997, which is the year on which the effect of diversification on firm value will be estimated using the propensity score method. These firms also trade at a significant discount with respect to the control group of non-diversifying firms in the same sample. The mean discount is smaller than that obtained for the same year on the larger sample ( $-0.08$  vs.  $-0.13$ ), but the median discount is slightly higher ( $-0.06$  vs.  $-0.05$ ).

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Insert Table 1 about here

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Table 1 also reports the mean and median industry-adjusted  $qs$  of diversified and specialized firms that are used to compute the discount. By using *all* single-segment firms in Compustat to compute the industry averages, as opposed to just those in the sample, I am able to uncover an interesting result that has remained hidden in the earlier literature. Namely, that the discount at which the specialized firms in the sample trade with respect to all specialized firms in Compustat is *as large* as the discount at which diversified firms trade with respect to the specialized firms in the sample. On average over all years in my sample, this mean (median) discount of specialized firms is  $-0.16$  ( $-0.17$ ), as compared to the  $-0.16$  ( $-0.08$ ) within-sample discount of diversified firms. Given that the sample has been selected from Compustat mainly on size, this finding suggests that the discount may largely be attributable to size rather

than (or in addition) to diversification per se.

The latter finding also highlights that by computing an industry-adjusted discount with respect to the specialized firms in the sample, one is effectively comparing the diversified firms of interest to a group of specialized firms selected on size and industry. The causal inference literature reviewed above has shown, however, that the construction of control groups based on single (or on two) characteristics is neither necessary nor desirable, because those groups may leave out comparison units that are nonetheless good overall comparisons with treatment units. In contrast, what the propensity score theorem and DW's results show is that the propensity score provides a rigorous criterion for selecting a comparison group that will yield unbiased estimates of the effect of interest.

#### *B. Probit estimates of the propensity to diversify*

Table 2 reports the coefficient estimates from different specifications of the propensity equation (Panel A), as well as the final estimates of diversification's effect on firm value that result from each specification (Panel B). The results from all intermediate steps between these two are not reported, but are available from the author upon request. This subsection focuses on the probit estimates from the main specification, while the rest of the table is discussed in the next two subsections.

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Insert Table 2 about here

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The coefficient estimates from the main model of firms' propensity to diversify are shown in column 1. To facilitate the interpretation of the results, the marginal effects associated to these coefficients are also reported, in column 2.<sup>8</sup> The significance of most target industry variables as well as

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<sup>8</sup> Marginal effects are the partial derivatives of  $E[y/x] = \Phi(\beta'x)$  with respect to the vector of characteristics, and are computed at the variable means. They indicate the effect on the estimated probability of diversification of increasing by one unit each independent variable from its mean, conditional on all other variables being fixed at their mean values.

of all the origin-target industry relationship variables confirm the importance of taking both groups of variables into account when estimating the propensity to diversify. The goodness-of-fit indicators are substantially higher than those achieved by earlier researchers using firm (and origin industry) characteristics only. In fact, they are greater than any of those reported in earlier studies of a firm's propensity to diversify into a given industry as well.

The results are consistent with the predictions of several of the diversification theories discussed in Section 1. Particularly, the four variables used to represent agency motives have the expected sign, and are consistent with earlier evidence: (1) the fact that firms which have a higher institutional presence in their ownership structure are less likely to diversify suggests that those institutions may be playing a monitoring role over the managers of those firms; (2) the negative sign on insiders suggests that the propensity to diversify is smaller the greater the alignment of interests between managers and shareholders in the form of insider ownership (Denis, Denis, and Sarin, 1997); (3) as hypothesized by Amihud and Lev (1981), managers seem to seek in diversification a reduction in their own personal risk; and (4) consistent with Jensen's (1986) view of debt as a form of monitoring, managers are unlikely to diversify into industries that would increase their financial leverage.<sup>9</sup>

These results are not in themselves evidence, however, that diversification is a value-destroying strategy, since the predictions of value-increasing theories are also supported. For instance, there is partial support for the resource-based theory of diversification in that firms seem more likely to diversify into industries with a higher synergy potential for vertical, customer-based, and marketing synergies, and

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<sup>9</sup> Also significant, and with the expected negative sign, was the percentage of a firm's stock owned by blockholders. However, because this measure has a 0.5 correlation with insider ownership, which may raise multicollinearity concerns, it has been omitted from the final specifications. None of the estimates reported are materially affected by this exclusion, and the explanatory power of the model is slightly increased by it, as is the number of non-missing observations that remain available for the estimation.

when they have the financial resources to do so.<sup>10</sup> The evidence regarding technological synergies based on the two different measures included is mixed, however, as are the results from earlier research on this issue.<sup>11</sup> There is also evidence, consistent with earlier findings by MacDonald (1985), that firms that diversify are in industries with a high degree of concentration, as required for any market power prediction to hold. Whether those predictions are actually supported, however, is something that cannot be established a priori by looking at a firm's propensity to diversify.

Perhaps the most important result from the probit model, given this paper's objective, is the confirmation that diversified firms trade at a discount *prior to diversification*, and that the discount is statistically significant. This is consistent with the findings of Lang and Stulz (1994), Servaes (1996), and Hyland (1997), although the former two do not find this prior discount to be statistically significant for their samples. On the other hand, both Lang and Stulz (1994) and Hyland (1997) find that firms that diversify tend to be in low  $q$  industries, although Hyland does not find statistical significance for this result. Like Lang and Stulz (1994), I also find the origin industry's average  $q$  to be significant and negative. Therefore, in my sample, the "pre-diversification discount" turns out to be *both* a firm and an industry effect. I believe this result on its own provides enough justification for revisiting the idea that the "diversification discount" is caused by diversification. Its meaning is discussed in more detail in the

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<sup>10</sup> The two synergy measures computed using Input-Output data (vertical and customer-based) have a 0.6 correlation. Again, to avoid potential problems of multicollinearity, only one of these measures has been included in the final specification. As may be expected, however, results are very similar if the other is used instead; a positive significant coefficient obtains for either of these variables.

<sup>11</sup> More specifically, the positive sign of technological synergies, when measured as absolute differences in R&D intensity between origin and target industries, runs contrary to both the resource-based predictions and prior findings by MacDonald (1985), Montgomery and Hariharan (1991), Rondi et al. (1996), and Silverman (1999). It is consistent, however, with Hyland's (1997) and Campa and Kedia's (1999) finding of a negative sign for firm R&D on a more similar sample to mine—which contrasts with the findings of the former studies for the same variable. On the other hand, the measure of technological synergies derived from Scherer's technology input-output matrix does yield the positive sign predicted by the theory, but it is not statistically significant. My results are thus in agreement with Silverman's (1999) argument and evidence that R&D-based measures are not very good indicators of a firm's

following subsections.

Among the other control variables, two are significant and have the expected signs: size, and the target industry's operating performance. The positive sign on size suggests that firms expand within their core activities before exploring other avenues for growth. The positive sign on the target industry's return on assets confirms the intuition that firms seek to enter the more profitable industries. The broader indicator of target industry's incentives for inward diversification, however, has a negative sign, contrary to what might be expected. Two other variables, the origin industry's incentives for outward diversification, and target industry  $q$ , also have opposite signs to those expected, but are statistically insignificant. In contrast, of the 2-digit level dummies included in the model, all except one are significant. This suggests that, for one reason or another, different industries are more or less likely to attract diversifying entrants, and to foster diversification on the part of their incumbents.

### *C. Main result: Diversification's effect on firm value*

Figure 1 shows a histogram of the propensity scores obtained from the probit model just discussed. The number of firms for which propensity scores are available from the estimation of that model is 38 diversified and 508 specialized. These are the firms on which the "raw" discount reported in the last row of Table 1 has been computed. The application of DW's algorithm leads to discard 104 control observations with a propensity score below the minimum score of the diversified firms (0.012), and none with a score above the maximum, as may be expected. The blocks defined by the quintiles of the propensity score distribution for the diversified firms are reasonably well balanced—that is, there are no significant differences between treatment and control groups within each block for most of the variables. This implies that, once the specification described is arrived at, there is no need to redefine the

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technological resources as predictors of diversification.

initial blocks, as both groups of firms are comparable within those blocks.<sup>12</sup> More importantly, the existence of this balance guarantees that the final estimate of the treatment effect is unbiased (DW).

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Insert Figure 1 about here

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The estimate of diversification's effect on firm value resulting from the specification discussed is reported below the coefficients of the specification itself, i.e. in the first column of Table 2, but in Panel B. As the table shows, when diversification motives are controlled for by matching comparable groups of diversifying and non-diversifying firms, the mean discount of  $-0.08$  reported in Table 1 turns into a statistically significant premium of  $0.34$  ( $t$ -statistic of  $2.27$ ). This is the main result of this study, which is consistent with those obtained by Campa and Kedia (1999) for the 1978–1996 period using more traditional approaches to the sample selection problem described. Both studies not only find no evidence to support the notion that diversification per se destroys value; they find evidence that it actually increases it.

This result, taken together with the finding that diversified firms trade at a discount *prior* to diversifying, seems to suggest that the direction of causality in the diversification-performance association is the reverse to the one assumed in the “diversification discount” literature. Rather than diversification causing low performance, it appears to be low performance that is causing diversification. Before arriving at this conclusion, however, a number of sensitivity analyses need to be performed.

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<sup>12</sup> It also implies that the weighted average of the within-block mean differences in value between diversified and specialized firms that has been defined as the treatment effect can equivalently be obtained by calculating one grand mean, since all blocks have the same weight. In other words, the differences between my results and those reported in Table 1 are being driven by the elimination of the irrelevant specialized firms from the control group (i.e. those below the minimum propensity threshold), rather than by the within-block comparisons.

#### *D. Sensitivity analyses*

Four different types of sensitivity analyses are conducted in order to assess the robustness of the main result. First, the use of propensity scores as a matching basis for estimating the effect of diversification on firm value may raise a concern about how sensitive the final estimates are to the specification of the probit model of the propensity to diversify. Two points must be noted in this respect: One, the fact that the fit of the model is better than that achieved in any of the earlier studies of a firm's propensity to diversify allows me to be reasonably confident that the propensity scores generated from that model are adequate summary measures of the characteristics distinguishing the treatment and control groups in my sample. Two, DW's own sensitivity analyses show that "the exact specification of the estimated propensity score is not important as long as, within each stratum, the pre-intervention characteristics are balanced across the treatment and comparison groups" (1999: 1061). Since the specification of the propensity to diversify shown in column 1 achieves this balance, the resulting estimates of the effect of diversification on firm value can be considered robust in this sense.

Nevertheless, one may still be interested in what happens when other specifications are used. For this reason, in columns 3 and 4 of the same table, I report the results from two alternative models. Both of these models include only firm and origin industry characteristics, and hence may be estimated at the firm level, as opposed to the firm-target industry level of the main specification. The first of them includes only pre-diversification (1990) industry-adjusted  $q$ , and industry  $q$ . The second alternative specification includes all the firm and origin industry characteristics from the main model. Constructing propensity scores out of these models and using them to match diversifying and non-diversifying firms yields an insignificant diversification discount of  $-0.02$  in both cases. This suggests that the finding that the diversification discount as such vanishes if a control group is constructed in a less ad hoc way than

the traditional size and industry matching is robust to the choice of specification for the propensity model. As a caveat, however, it must be emphasized that the estimation of the diversification effect based on these two alternative specifications runs counter to the spirit of DW's method, since it fails to eliminate the within-block differences in pre-diversification variables between the treatment and control groups.

Second, given the relative novelty of the propensity score approach followed in this paper, the skeptical reader may want to know how my results differ from those that would be obtained from more traditional methods of dealing with sample selection issues, most notably Heckman's two-stage model. Note that the primary specification of the probit model I use does not allow such a comparison to be made, since it entails different levels of analysis for the main (value) and propensity (to diversify) equations; the former is at the firm level, the latter at the firm-potential target industry pair level.<sup>13</sup> The specification reported in column 4, however, does lend itself to this comparison; therefore, I have used it as a basis for estimating the effect of diversification on firm value using Heckman's method.

The resulting estimate turns out to be an even larger discount ( $-0.29$ ) than that the  $-0.08$  obtained from OLS, although the discount is not statistically significant ( $t$ -statistic of  $-0.3$ ). The discrepancy between this figure and the  $-0.02$  I find by constructing propensity scores out of the same specification is consistent with Lalonde's findings and suggests that the difference between the  $-0.08$  OLS discount and the  $0.34$  premium I find using my preferred specification is largely due to the selection of an appropriate control group, rather than to the inclusion of a second (propensity) equation

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<sup>13</sup> The use of a propensity score methodology allows me to estimate the propensity equation at the firm-industry level (with its associated advantages of greater explanatory power and increased sample size for estimation), and then reduce the set of propensity scores in the way described to one per firm when it comes to estimating the value effect of diversification. In contrast, such a change in levels of analysis is not possible using Heckman's approach, at least in a straightforward way.

in the diversification-performance model per se. A comparison between the  $-0.29$  figure and Campa and Kedia's finding of a small and insignificant premium using Heckman's method and the measure most similar to my industry-adjusted  $q$  suggests that, were DW's method applied to their sample, it would yield a larger premium than what they find—in other words, that their estimates are biased, but conservative.

Third, the most straightforward interpretation of my findings is that the direction of causality in the diversification-performance relationship is the reverse to the one implicit in the notion of a “diversification discount”. According to my results, a “performance discount” might be a more accurate description. An alternative interpretation of these results, however, is that, if markets are efficient, the pre-diversification discount just shows that market values are taking future diversification into account. Indeed, the finding that firms with greater agency problems are more prone to diversify is consistent with the notion of the market expecting those firms to do something contrary to shareholders' interests. Whether it is diversification or some other managerial action that is being discounted, however, is yet to be established.

In this respect, it must be noted that the firms that diversify in my sample do so at different points in time between 1991 and 1997. Thus, the argument that the market is discounting diversification in advance may be more plausible for some firms than for others. Furthermore, Hyland (1997) and Campa and Kedia (1999) show that diversifying firms trade at a fairly homogenous discount during a nine-to-twenty year window around the diversification year. This seems hard to reconcile with the idea that what the market is discounting about these firms prior to their decision to diversify is actually diversification itself.

Nevertheless, to test more formally for this possibility, I repeat the previous analyses using

industry-adjusted  $q$  in 1990 (instead of 1997) as the outcome variable, and excluding it from the vector of independent variables in the propensity to diversify model. I also do this because the plausibility of the alternative interpretation mentioned more generally implies that when treatment effects refer to the effect of corporate decisions on market values, the right point in time to evaluate these effects may be prior to the treatment itself, not afterwards. In other words, if markets are efficient, the effect may paradoxically precede the cause.

The results from the probit model are not reported because they are very similar to those in column 1. The resulting estimate of diversification's *ex-ante* effect on firm value is a discount of  $-0.07$ . However, the discount is not statistically significant. In fact, about half of the within-block mean differences are actually premia. Therefore, what the market is discounting *a priori* about the diversifying firms in my sample does not seem to be their future diversification.

The fourth and last robustness check performed is the cross-sectional comparison between diversified and specialized firms, that is, regardless of when diversified firms first went through the diversification "treatment". As noted before, the analysis of diversified firms at the point in time when they become diversified is necessary for assessing the causal effect of diversification on firm value. Nevertheless, it suffers from a number of limitations.

Most notably, it does not address situations of cumulative and/or persistent diversification. For instance, it could be that a diversification discount exists, but only beyond a certain threshold which the diversifying firms in my sample have not yet reached. This possibility is unlikely, however, given that the discount of diversified firms is only significant between one and two-segment firms, but not between two-segment firms and firms with larger numbers of segments. This result, found by Lang and Stulz (1994) and later studies, is also observed in my sample. For example, a pooled regression of the

industry-adjusted  $q$  on a constant and dummies for diversified firms with two, three, four, and five or more segments yields the following coefficients ( $t$ -statistics in parentheses): Single-segment firms, i.e. the intercept:  $-0.16$  ( $-12.84$ ); two segment firms:  $-0.11$  ( $-3.19$ ); three segment firms:  $-0.06$  ( $-1.4$ ); four-segment firms:  $-0.07$  ( $-1.14$ ); five and more segment firms:  $0.02$  ( $0.26$ ).

Nevertheless, it could also be that the discount only affects firms that have been diversified for a number of years greater than my sample period, i.e. that there is a lag between attaining the “diversified” status and being penalized by the market for such status. In addition, the analysis of diversifying firms-only leads to a considerable reduction in the sample size, and hence in its comparability to the samples used in prior studies of the “diversification discount”.

For all these reasons, I repeat the previous analysis on the larger sample described in the Appendix, which has been selected like those in prior studies and includes firms with higher degrees of diversification than those in the diversifying firms subsample. The propensity score method can also be applied to this case, but a different interpretation is in order. Thus, for any given year, diversified and specialized firms are matched on the propensity score, thereby ensuring that both groups of firms are fully comparable. However, the scores are now indicative of a firm’s probability *to be diversified*.

The specification used for the probit model is similar to that in column 1 of Table 2, and is estimated for each year separately to keep the dataset tractable. Column 5 of the same table reports the estimates for 1997. For estimation purposes, a firm’s primary industry is considered as its origin industry, and all other industries in which it is present, if any, are considered as actual target industries. As before, the set of potential target industries is defined by the set of “target” industries in which the diversified firms in the sample operate in any given year. Thus, the dependent variable in this model equals one for diversified firms, for each industry in which the firm is present in addition to its primary

industry, and zero for all other firm-potential target industry combinations. After matching on the propensity score, the effect of diversification on firm value is computed as before, but for the same year in which the independent variables are measured. Accordingly, the pre-diversification industry-adjusted  $q$  is excluded from the set of independent variables.

As shown in Panel B, the estimate of diversification's effect on firm value that results from this last robustness check for 1997 is a premium of 0.08. The premium is statistically insignificant, but it stills differs considerably from the statistically significant discount of  $-0.13$  yielded by OLS estimation and reported in Table 1. Although not reported here, the results for other years are similar, even for those in which OLS estimation yielded a larger (more negative) discount. Thus, the results of this last set of analyses confirm that the diversification discount as such also disappears when highly and persistently diversified firms are considered.

#### **IV. Conclusion**

This study shows that the finding that diversified firms trade at a discount cannot be attributed to diversification itself. First, I argue why this attribution on the basis of previous results is problematic from the point of view of statistical causal inference. One problem is that firms do not diversify at random but choose to do so or not based on their characteristics, on the characteristics of their origin and potential target industries, and on the relationships between these two. As a result, estimates of the effect of diversification on firm value obtained from single-equation models—univariate or multivariate regressions estimated by ordinary least squares or fixed effects—suffer from a sample selection bias. Another problem is that, since diversified firms differ from specialized firms in multiple characteristics, the construction of a control group of specialized firms that are comparable to the diversified firms of

interest *in size and industry only* introduces another source of bias. This bias affects the estimates that can be obtained *from both single and two-equation models* using standard econometric methods—including instrumental variables and Heckman’s two-step sample selection model. I also explain how the propensity score method followed in this study allows me to deal with both problems and thus obtain unbiased estimates of the effect of diversification on firm value.

I then verify that the diversified firms in my sample trade at a similar discount to that found in earlier studies, and show that those firms differ from specialized firms in a number of pre-diversification characteristics. I find that diversified firms trade at a significant industry-adjusted discount *prior to diversification*, and that they are present in industries with a lower  $q$  than those of their non-diversifying counterparts. I also find that, as predicted by agency theory, diversified firms prior to diversifying have a smaller percentage of their stock owned by institutions and insiders, a higher risk, and are likely to diversify into industries with a lower leverage than their own. I find support for the resource-based theory of diversification as well in that firms are more likely to diversify when faced with opportunities for exploiting potential synergies and when they have enough financial resources to do so. As required for market power-based theories of diversification to hold, firms that diversify are present in industries with higher levels of concentration. More generally, certain industries appear to lend themselves more than others to either inward or outward diversification.

Finally, I find that, once these differences are controlled for by matching groups of diversifying and non-diversifying firms on a summary measure of their differential characteristics—the propensity score—the diversification discount as such disappears. In fact, on average, there is a statistically significant premium to the act of diversifying. The disappearance of the diversification discount proves to be robust to (1) the specification used to estimate a firm’s propensity to diversify, (2) the use of

Heckman's two-stage method as an alternative to propensity scores, (3) the possibility that diversification is being discounted before it actually happens, and (4) situations of persistent or cumulative diversification. Therefore, in answer to my research question, it seems fair to conclude that diversification does *not* cause the "diversification discount".

## **Appendix: Data and variables**

### *A. Data and sample*

The main sources of data for this study are Standard and Poors' Compustat company and segment-level files. These sources are complemented with several others for the probit estimation of firms' propensity to diversify, as described in Table A-1. The firms in the sample have been selected by applying the screening criteria in Lang & Stulz (1994) and Berger & Ofek (1995) to Compustat for the period 1990–1997, as follows. For any given year, firms in the sample have: (1) data in both the company and segment Compustat files; (2) main industry different from financial services (SIC 6000–6999), regulated utilities (between 4900 and 4999), “government, excluding finance” (SIC 9100–9199), and “non classifiable establishments” (SIC 9900–9999); (3) no missing data for any of the following variables: end-of-year stock price, number of shares of common stock, assets, and sales; (4) total (firm) sales greater than \$20 million. In addition, sample firms have at least two years of data, and, on average over all years for which they have data, total assets greater than \$100 million. This yields a total of 2,558 different firms which have data on two or more years of the 1990–1997 period. This is the sample used at the end of Section IV.D to compare *diversified* and *specialized* firms, and that on which the OLS estimates reported in Table 1 are based (except for those in the last row).

For the comparison between diversifying and non-diversifying firms, the following additional eliminations are carried out: (1) Selecting the firms that are present in 1990. There are 1,359 out of the total 2,558 mentioned; (2) eliminating ADRs (American Depositary Receipts). This leaves 1,274 firms; (3) selecting those firms that are specialized in 1990. After eliminating segments within a firm that have a common 4 digit-SIC code, and segments labeled as “corporate”, “other”, or equivalent names, there

are 698 single-segment (or specialized) firms; (4) selecting those firms that have data for all eight years in the sample period. There are 687 such firms, of which 69 become multi-segment after 1990 and 618 stay specialized; (5) eliminating those multi-segment firms that later decrease their number of segments and thus become specialized again by 1997. This leaves 64 firms that are still multi-segment in 1997; (6) selecting as diversifying firms only the 54 firms for which I am able to confirm, using Lexis-Nexis, that the increase in the number of segments corresponds to actual diversification moves.

The “diversifying firms” subsample thus includes 672 firms (54 diversifying + 618 controls). The 54 diversifying firms added 70 new segments from 65 different target industries between 1991 and 1997. These 65 industries form the set of potential target industries where the firms in the sample are considered to have had the choice to diversify into. A total of 123 out of the 618 control firms, and three of the diversified firms, were already present in 1990 in industries within that set. Thus, the number of observations available for the probit analyses is 43,554 ( $672 \times 65 - 126$ ). As Table 2 shows, however, the number of observations actually used differs, depending on the amount of missing data for the variables in each probit specification.

## *B. Variables*

The two most important variables for this study are diversification and industry-adjusted  $q$ . Following all prior studies of the discount, diversification is measured by a dummy variable that equals 1 when the firm reports two or more segments in Compustat, and zero otherwise.<sup>14</sup>  $q$  is computed as the ratio of the market value of common equity plus the book value of preferred stock and debt to total

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<sup>14</sup> This dichotomous measurement of diversification, albeit standard in this literature, is more simplistic than the multi-category (e.g. related vs. unrelated), discrete (e.g. number of segments) or continuous (e.g. Herfindahl and entropy indices) measures that are common in the strategy literature. However, in the context of the diversification *discount*, a dichotomous measurement is justified by the abovementioned fact that the discount of diversified firms is only significant between one and two-segment firms, but not at higher degrees of diversification.

assets.<sup>15</sup> I then follow Lang and Stulz's (1994) "chop shop" approach to adjust this measure for industry effects. Thus, industry-adjusted  $q$  is the difference between a firm's  $q$  and the asset-weighted average of the hypothetical  $qs$  of its segments, where a segment's hypothetical  $q$  is the average of the specialized firms in the industry in each year.

Unlike prior studies, I use all single-segment firms in Compustat, and not just those in my sample, to compute the industry averages. In addition, I consider any firm in the Compustat *company*-level files that does not report more than one segment in the segment files as specialized. Thus, I do not assume that the only specialized firms in Compustat are those that appear as such in the industry segment files. As a result, the industry-adjusted  $qs$  of the single-segment firms in my sample do not average zero by construction, as they do in prior studies. The average difference in industry-adjusted  $q$  between the two groups of firms, which is what is interpreted in prior studies as a measure of the diversification discount, is not materially affected by this modification. The industry averages on which the results reported are based have been computed at the 4 digit-SIC code level, resorting to 3 or 2 digit averages when the more precise ones are not available. Similar results are obtained when using 3-digit SIC-based industry averages. Also, firms whose *unadjusted*  $q$  is greater than 10 have been excluded from the estimation. The independent variables used to estimate a firm's propensity to diversify into a given industry are defined in Table A-1. All variables are measured in 1990.

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Insert Table A-1 about here

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<sup>15</sup> This measure is being increasingly used to avoid the arbitrary assumptions about depreciation and inflation rates that more sophisticated measures of  $q$  require (e.g. Shin and Stulz, 1995) Chung and Pruitt (1994) find that this proxy explains *at least* 96.6% of the variability of Lindenberg and Ross's (1981) measure of Tobin's  $q$ .

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TABLE 1—REPLICATING PRIOR STUDIES: ONE-STEP ESTIMATES OF THE DIVERSIFICATION DISCOUNT

Year	Specialized firms				Diversified firms				Discount (Difference)	
	N	Mean	Median	STD	N	Mean	Median	STD	Mean	Median
1990	742	-0.12	-0.11	1.07	499	-0.18	-0.13	0.73	-0.06	-0.02
1991	811	-0.17	-0.13	1.28	488	-0.39	-0.26	0.99	-0.22 ***	-0.12 **
1992	911	-0.06	-0.11	1.15	517	-0.30	-0.25	1.06	-0.24 ***	-0.14 ***
1993	1075	-0.13	-0.15	1.16	541	-0.32	-0.29	1.04	-0.19 ***	-0.13 ***
1994	1221	-0.08	-0.12	0.99	586	-0.19	-0.19	0.75	-0.10 **	-0.06 **
1995	1359	-0.22	-0.19	1.42	525	-0.42	-0.32	0.98	-0.21 ***	-0.12 ***
1996	1568	-0.25	-0.24	1.56	573	-0.42	-0.32	0.99	-0.17 ***	-0.08 *
1997	1559	-0.18	-0.20	1.30	562	-0.31	-0.25	1.12	-0.13 **	-0.05
All	9246	-0.16	-0.16	1.28	4291	-0.31	-0.24	0.97	-0.16 ***	-0.08 ***
<i>Diversifying firms subsample</i>										
1997	508	-0.19	-0.21	1.14	38	-0.27	-0.27	1.04	-0.08 ***	-0.06 ***

Note: Asterisks indicate significance at the 10% (\*), 5% (\*\*), and 1% (\*\*\*) levels. The significance of the difference in medians is based on nonparametric median tests.

TABLE 2—DETERMINANTS OF THE PROPENSITY TO DIVERSIFY AND RESULTING ESTIMATES OF THE EFFECT OF DIVERSIFICATION ON FIRM VALUE <sup>a</sup>

<i>A. Results from probit estimation of the propensity to diversify</i>					
	Diversifying firms subsample				Full sample, 1997
	Main specification <sup>b</sup>		Alternative specifications		Coefficients (5)
	Coefficients (1)	Marginal effects (2)	Coefficients (3)	Coefficients (4)	
Constant	- 3.24 *** (- 27.17)	- 0.28 *** (- 26.15)	- 1.16 *** (- 4.58)	- 1.19 ** (- 1.94)	1.68 *** (43.42)
Institutions	- 0.01 *** (- 16.60)	- 1.04E- 3 *** (- 16.30)		- 0.01 *** (- 2.61)	- 2.51E- 3 *** (- 13.15)
Insiders	- 5.68E- 3 *** (- 9.52)	- 4.97E- 4 *** (- 9.41)		- 8.08E- 3 *** (- 1.98)	2.45E- 3 *** (9.59)
Risk	9.66 *** (8.96)	0.85 *** (8.75)		10.11 (1.55)	- 1.71 (- 1.45)
Leverage differential between target industry and firm	- 0.02 *** (- 6.67)	- 1.51E- 3 *** (- 6.67)			- 0.03 *** (- 21.08)
Firm profitability	3.17 *** (20.12)	0.28 *** (19.30)		1.68 (1.55)	2.23 *** (32.22)
Potential technological synergies	0.28 (0.97)	0.02 (0.97)			0.04 (0.23)
Potential customer-based synergies	0.09 * (1.91)	0.01 * (1.91)			- 0.44 *** (- 25.03)
R&D intensity differential of origin and target industries	0.27 *** (14.29)	0.02 *** (14.15)			- 0.02 *** (- 17.57)
Advertising intensity differential of origin and target industries	- 0.64 *** (- 3.30)	- 0.06 *** (- 3.39)			- 0.08 *** (- 5.75)
Origin industry concentration	1.36 *** (18.96)	0.12 *** (18.96)		0.20 (0.51)	- 0.42 *** (- 18.84)
Industry-adjusted $q$	- 0.12 *** (- 7.41)	- 0.01 *** (- 7.38)	- 0.11 (- 1.02)	- 0.17 (- 1.23)	
Size	0.07 *** (6.59)	0.01 *** (6.58)		0.05 (0.78)	- 0.25 *** (- 71.03)
Origin Industry $q$	- 0.13 *** (- 4.30)	- 0.01 *** (- 4.26)	- 0.19 (- 1.21)	- 0.22 (- 1.19)	4.55E- 3 (0.53)
Origin industry's incentives for outward diversification	- 0.15 (- 1.52)	- 0.01 (- 1.52)		0.04 (0.08)	- 0.74 *** (- 35.54)
Target industry $q$	- 2.27E- 3 (- 0.11)	- 1.99E- 4 (- 0.11)			0.02 *** (3.34)
Target industry profitability	0.13 * (1.88)	0.01 * (1.88)			- 0.12 *** (- 4.01)
Target industry's incentives for inward diversification	- 0.20 *** (- 2.69)	- 0.02 *** (- 2.69)			- 0.01 (- 0.64)
Number of observations	35,482		607	607	107,498
Adjusted Likelihood Ratio Index	0.20		0.03	0.12	0.09
McKelvey & Zavoina's Pseudo-R <sup>2</sup>	0.41		0.23	0.28	0.58

  

<i>B. Propensity score-based estimates of the effect of diversification on firm value</i>					
	0.34 *** (2.27)		- 0.02 (- 0.13)	- 0.02 (- 0.14)	0.08 (0.17)

<sup>a</sup>  $t$ -statistics are in parentheses. Asterisks indicate significance at the 10% (\*), 5% (\*\*), and 1% (\*\*\*) levels.

<sup>b</sup> Not reported in the table, but included in the model, are dummy variables for each origin industry at the 2-digit SIC level in which there are more than 5 firms in the sample, and for each target industry in which there are more than 3 firms.

TABLE A1—PREDICTORS OF A FIRM'S PROPENSITY TO DIVERSIFY INTO A GIVEN INDUSTRY

Theory	Variable	Measure	Expected sign	Data source
Agency	Institutions	End-of-year % of total outstanding common voting shares owned by institutions	–	Compact D
	Insiders	End-of-year % of total outstanding common voting shares owned by insiders of the firm	–	Compact D
	Risk	Variance of the firm's return on assets (ROA) over the three previous years. ROA is defined as operating income after depreciation over total assets	+	Compustat
	Leverage differential between target industry and firm	Average leverage of all single-segment firms in the potential target industry minus the firm's leverage. Leverage is defined as the ratio of total debt to total equity	–	Compustat
Resources	Firm profitability	Average return on assets (ROA) over the three previous years. ROA is defined as operating income after depreciation over total assets	+	Compustat
	Potential technological synergies	For each origin-target industry pair within the manufacturing sector, corresponding coefficient from Robins and Wiersema's (1995) "similarity in patterns of technology inflow" matrix. This matrix contains the correlations between each pair of columns in Scherer's (1982) inter-industry technology flows table, which combines patent citations data with input-output tables. Equals zero for all other origin-target industry pair	+	Scherer (1982), Robins & Wiersema (1995)
	Potential customer-based synergies	For each origin-target industry pair, correlation between the corresponding pair of rows in an <i>industry-by-industry direct supplies table</i> which indicates for each industry what percentage of its total production is used by each industry. It is computed by: (1) dividing each industry's commodity in the I-O make table by that industry's total output; (2) multiplying the table from step 1 by the I-O use table; and (3) dividing each row in the table from step 2 by the sum of all rows of that table	+	Input-Output Tables (Bureau of Economic Analysis)
	R&D intensity differential of origin and target industries	Absolute value of the difference between the firm's R&D to sales ratio and the average of the same ratio for all single-segment firms in the potential target industry	–	Compustat
Market power Control variables	Advertising intensity differential of origin and target industries	Absolute value of the difference between the firm's advertising to sales ratio and the average of the same ratio for all single-segment firms in the potential target industry	–	Compustat
	Origin industry concentration	Sum of the sales of the four largest segments in the origin industry divided by the industry's total sales	+	Compustat
	Size	Natural logarithm of total sales	+	Compustat
	Origin industry $q$	Average $q$ of all single-segment firms in the origin industry. $q$ is proxied by the market value of common equity plus the book value of preferred stock and debt, divided by total assets	–	Compustat
	Origin industry's incentives for outward diversification	Percentage of segments in the origin industry that belong to multi-segment firms	+	Compustat
	Target industry $q$	Average $q$ of all single-segment firms in the potential target industry	+	Compustat
	Target industry profitability	Average ROA of all single-segment firms in the potential target industry	+	Compustat
	Target industry's incentives for inward diversification	Percentage of segments in the potential target industry that belong to multi-segment firms	+	Compustat

FIGURE 1. DISTRIBUTION OF PROPENSITY SCORES FOR DIVERSIFIED AND SPECIALIZED FIRMS

