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## Abstract

Prior literature on the diversification discount and the relative efficiency of internal versus external capital markets provides decidedly mixed results. We argue that transactions cost economics are useful in understanding this puzzle. According to transactions cost economics, diversified firms should outperform single-segment firms in industries with higher external transaction costs (e.g., emergent industries). Similarly, single-segment firms should outperform diversified firms in industries with low external transactions costs and high agency and other internal costs (e.g., some mature industries). This paper provides empirical evidence supporting these contentions.

# The Diversification Discount Puzzle: Empirical Evidence for a Transactions Cost Resolution

## 1. Introduction

There is conflicting evidence regarding the value of diversification, i.e., are diversified firms valued more or less than their stand alone counterparts? While some studies show a significant diversification discount, others have contended that there is no such discount and that prior studies suffer from measurement problems with the discount disappearing when these errors are corrected. This study proposes an alternative explanation to this puzzle: we argue that the value of diversification depends on segmenting firms based on the balance between transactions costs in internal versus external capital markets.

Capital for investments can be allocated internally by diversified firms or can be allocated to undiversified "pure play" firms by external capital markets. We contend that diversification can be value enhancing if external capital markets face large transactions costs relative to internal costs of allocating capital, and diversification can be value destroying if internal allocation costs exceed external financing transactions costs. We find that in "emergent" industries, where companies face relatively higher external market transaction costs, diversified firms perform better and trade at a premium compared to single-segment firms. Further, underperforming units of diversified firms are more likely to be shut down than underperforming single-segment firms in these industries. In contrast, in "mature" industries, where companies face relatively higher internal transactions costs but low external transactions costs, diversified firm perform worse and trade at a discount compared to single-segment firms. These findings are consistent with the transactions cost theory. Our findings imply that future studies of the diversification discount should segment firms based on the balance between internal versus

external transactions costs; otherwise firms with a positive diversification effect will offset firms with a negative effect confounding the net results with the net diversification affect depending on the sample distribution.

The paper is organized as follows. Section 2 is a very brief review of transactions costs economics and firm boundaries; Section 3 describes the research design and data used, Sections 4 and 5 present empirical results and discuss the robustness of these results, respectively. Finally, Section 6 offers conclusions.

## 2. Diversification, transactions costs, and firm boundaries

### *2.1. The diversification value controversy*

Many studies have examined the effect of diversification on firm value, finding a diversification discount (e.g., Lang and Stulz, 1994; Berger and Ofek, 1995; and Burch and Nanda, 2003). In response to these findings, two strands of research emerge.

One strand tries to identify the costs and benefits of internal versus external markets. Some authors have noted the managerial incentive problems in the efficient allocation of capital. For example, Jensen (1991) and Holmstrom and Costa (1986) explain that due to information costs and managerial incentives (that differ from shareholder incentives), optimal internal control systems in firms are imperfect and may lead to varying degrees of internal capital mis-allocation. Ozbas (2005) notes that, in diversified firms, managers may have the incentive to exaggerate the payoffs of their projects to obtain funding, reducing allocational efficiency. Other studies argue that agency and other costs of internal capital allocation will lead to resource mis-allocation and subsidization of poor investments in internal markets and such firms will suffer from a diversification discount (e.g. Lang and Stulz, 1994; Rajan, Servaes, and Zingales, 2000).

On the other hand, some studies have identified advantages of internal markets over external markets. The advantages are related to the information advantage and control rights. In other words, segment managers are less likely to be able to hide embarrassing facts from their supervisors as easily as they can from outside shareholders, and internal capital markets can better keep sensitive data away from competitors. Matsusaka and Nanda (2002) develop a model that shows that while using internal markets to allocate capital has an option value of avoiding the deadweight costs of using external capital markets, doing so also raises the costs of managerial overinvestment. In their model, this tradeoff between overinvestment costs and the deadweight costs of external markets determines if there is a diversification premia or discount. They further show that differences in control rights between internal and external providers of capital can also lead to diversification discounts or premia (corporate management in a diversified firm can terminate non-performing projects more efficiently than managers of single-segment firms). Gertner, Scharfstein, and Stein (1994) makes a similar argument in favor of internal markets. (These models apply to both vertically and horizontally diversified firms.) Diversified firms can also be more valuable because they can share valuable non-tradable resources and because of economies of scope and market power (Teece,1982; Tirole,1995; Williamson, 1998). Based on reported standard deviations of the diversification discount/premia, prior empirical work seems to indicate that between a third and forty percent of diversified firms trade at a premium compared to their stand alone counterparts (e.g., Lang and Stulz,1994; Berger and Ofek, 1995; Rajan, Servaes, and Zingales, 2000). Indeed, this literature concludes that diversification seems to create value and that internal capital markets may be efficient (e.g., Schipper and Thompson, 1983; Matsusaka, 1993; Servaes,1996; Hubbard and Palia,1999; Klein, 2001; Khanna and Tice, 2001; Maksimovic and Phillips, 2002; Villalonga, 2004).

In contrast, the second strand of research in response to the empirical regularity of diversification discount tries to identify the methodological problem in these studies, namely, whether it is diversification that causes value discount, or it is poor performance that causes firms to diversify. For example, Campa and Kedia (2002), and Villalonga (2004) argue that the diversification discount seems to disappear when corrections for selection bias are applied.

This paper belongs to the first strand of research and we use transactions costs theory to resolve the controversy in the finance literature regarding the positive or negative impact of diversification.

*2.2. Transactions costs and firm boundaries*

Transactions cost economics (TCE) focuses on the notion that when the transactions costs of market exchange are high, it may be less costly to coordinate production through a formal organization than through a market, i.e., it may be cheaper in many cases to use hierarchy to reduce contracting problems and costs (Williamson, 1998). Transactions costs involved in market exchange arise chiefly from efforts to reduce the uncertainties surrounding contractual relationships (Hart, 1995). Such transactions costs depend on a number of factors including uncertainty, frequency, and asset specificity. These factors contribute to the costs associated with market exchange, such as search costs, costs of developing and delineating choices and options, costs of designing, negotiating, and enforcing market exchange contracts, and costs of other economically valuable activities that facilitate economic exchange.

According to TCE (Coase, 1988; Williamson, 2000), firms should internalize operations when external markets are relatively inefficient, i.e., when a firm faces higher transactions costs in external compared to internal markets. In other words, a firm is likely to find it optimal to internalize operations in businesses that face external market transactions costs that are higher

than agency and other internal transactions costs. Thus, according to TCE, the balance between internal and external transactions costs determines the boundaries of a firm (Hart, 1995; Holmstrom and Roberts,1998).

Transaction costs may be high for two reasons: difficulty in designing the optimal contract because of problems of information asymmetry and the difficulty in implementing the contracts because of a lack of control rights. Therefore, internalization of independent organizations is likely to be particularly beneficial in industries where there is a severe problem of information asymmetry and where the exercise of control rights in resource shifting is especially important. Emergent high-tech industries fit these descriptions.

Numerous studies report that firms with much research and development (R&D) tend to high information asymmetry (e.g., Aboody and Lev, 2000; Chan, Lakonishok and Sougiannis, 2001; Coff and Lee, 2003). The information asymmetry stems from the high degree of uncertainty in payoffs from R&D activities (Mansfield, Romeo, Villani, Wagner, and Husic, 1977; Harhoff, Narin, Scherer, and Vopel,1999) and because many R&D assets are firm-specific and hard-to-transfer tangible and intangible assets. Disclosure about such assets may be limited since it is likely to give rise to greater free-rider and externality problems as competitors may be able to infer valuable technical knowledge from such disclosures. Further, many intangible assets are unrecorded in corporate accounts (Lev and Sougiannis, 1996; Boone and Raman, 2001). Therefore, firms in emergent high-tech industries are difficult for outsiders to evaluate and monitor. In other words, significant difficulties in external monitoring and contracting in the high-tech industry raise transactions costs for external providers of capital.

On the other hand, many projects in high-tech industries are still at the early, exploratory stage. Some of these projects will be successful, but most of these projects will fail (e.g.,

Mansfield, Romeo, Villani, Wagner, and Husic, 1977; Harhoff, Narin, Scherer, and Vopel,1999) Therefore, firms with high R&D spending are associated with higher levels of managerial discretion (Himmelberg, Hubbard, and Palia, 1999) and it is thus important for the owners to have the control rights to redeploy poorly-performing assets on a timely basis. However, it is difficult for outside shareholders to exercise this control right effectively because of the ownership structure in the high-tech industries. Like other industries, outside ownership is generally widely-distributed, which makes coordinated effort difficult to achieve. In addition, unlike firms in other industries, high-tech firms are generally more closely controlled by company insiders. Lorsch, Zelleke and Pick (2001) argue that this structure is deeply flawed because insiders have a strong incentive to maximize short-run returns and to engage in cash out events, and they will not do anything to sacrifice their own jobs, such as terminating unpromising projects and return cash to outside investors. All of the above creates conflicts of interests with outside shareholders. In contrast, it is much easier for the central management in the internal markets to terminate projects with bleak outlook quickly, because the central management generally has the entire control rights over a subsidiary.

As this brief review indicates, high-tech industries suffer from more severe problems of information asymmetry and external markets find firms in these emergent industries more difficult to monitor. Further, external markets often do not have the control rights to shift resources quickly between different stand alone operating units effectively, which the internal markets can do much better. According to TCE, both these factors tend to raise contractual complexities and costs (Kogut and Zander, 1996), thus leading to higher transactions costs in external markets for high-tech companies.

In contrast, internalization of independent organizations is likely to be particularly costly in cases where 1) there is a low level of information asymmetry, and 2) there is little need to shift resources between divisions, so the value of the real option to avoid dead-weight external financing costs is low, and the agency costs of internal market becomes dominant (Matsusaka and Nanda, 2002). There can be many forms of agency costs when managers seek their own goals often to the detriment of shareholders. These agency costs may include empire building, managerial entrenchment, and inefficient processing of investment opportunities. Firms in mature industries meet these conditions: high free cash flows and fewer investment opportunities, little or no R&D and little or no need for external financing. Thus, diversification should be costly and value destroying in these industries.

In summary, we contend that internal capital markets (in spite of their agency cost and resource mis-allocation problems) may be more efficient and better equipped to choose "winners" in emergent high-tech industries and in such firms we should observe better operating performance among segments and a diversification premium. We further contend that the opposite is likely to be true for firms in the mature industries where we should observe better operating performance among single-segment firms and a diversification discount.[1] To avoid confounding results, unlike prior national studies of diversification, this study identifies and examines the impact of diversification on the performance and valuation of two separate sets of US firms, i.e., firms from emergent versus mature industries with segments in both types of firms compared to their matched stand-alone counterparts.

[1] Similarly, studies of international diversification need to account for differences in transactions costs faced by firms in different countries that may have different cultures, values, and institutional structures and differences in the efficiency of financial markets.

## 3. Research design and data

Prior studies of the relative efficiency of internal versus external markets have included a wide range of industries obfuscating the empirical results regarding the efficiency of diversification. This study avoids this problem by being focused as it examines empirical evidence regarding the value of diversification and the relative efficiency of internal versus external capital markets for two sets of companies, the first in emergent high-tech industries and the second in mature low-tech industries.

### *3.1. Data and sample selection*

Firms in the emergent high-tech industries set are required to have high R&D expenses (R&D spending greater than 8% of assets - many industries have R&D intensity between 0 and 4 percent and many are at more than 8 percent, but no industry falls into the range between 5 percent and 8 percent), higher than median investment opportunities (as reflected in market-to-book ratios), and higher than median needs for external financing. In contrast, the second set of firms come from what is referred here generally as mature industries, industries where there is small information asymmetry between insiders and outsiders and relatively little uncertainty in investment results. Such firms face relatively low external transactions costs but relatively high internal agency and other costs so that they are likely to exhibit value destroying diversification. This set of firms are required to have no R&D expenses, low investment opportunities (market-to-book ratios less than 1), and no need for external financing. Application of these criteria results in eight emergent high-tech industries and seventeen mature low-tech industries. The 4-digit SIC codes for these industries and their characteristics in terms of number of observations, R&D expenses, external financing needs, market-to-book ratios, and asset size are summarized in table 1.

(Please insert Table 1 about here)

The study period is 1995-2001 as detailed segment data needed for this study are unavailable for earlier periods. It should be noted that this study period, 1995-2001, includes an extraordinary boom in technology investments and this period provides a relatively large sample of high-tech single-segment firms and diversified firm segments that are available for study. In addition, during these years the investing public was extremely enthusiastic about the potential for technology to transform business and society. During the late 1990s, equity markets attached unprecedented valuations especially to high tech companies. In this period, high-tech companies even with no record of revenue streams and with little or no profits for the foreseeable future were brought public. High-tech start-up firms were able to obtain funding in spite of the problems of operating losses and severe information asymmetries. In many such cases, relatively efficient staged-financing and strict scrutiny by venture capitalists were replaced by lump-sum IPO financing and relatively remote control by the investing public. Thus, it is possible that in this environment, external capital markets were not very efficient especially when it came to high-tech firms. However, this high-tech boom ended by the end of 1999 and the period 2000-2001 is characterized by a sharply declining market especially among high-tech firms and it would be useful to examine if the conclusions of this study hold up in both the pre- and post-1999 sub-periods.

As the summary data in Table 1 show, among the emergent industries, R&D expenses range from 8.23 to 22.65% of assets while it is zero for the mature industries. Similarly, among the emergent industries, external financing needs range from 4.42 to 74.52% of assets (all positive) while it ranges from -0.70% to -6.97% (all negative) for the mature industries.[2] The

[2] Financing deficit summarizes the gap between internal funds generated from operation and investment activities and the amount needed to finance capital expenditure, dividend payout, and other business activities. In terms of

market to book ratios range from 1.58 to 2.97 for the emergent industries and for the mature industries they range between 0.69 and 0.97. Clearly, while there are more firms in the emergent industries group, the two groups of industries have very different characteristics. (To control for the possibility that our findings are driven by different industry characteristics, rather than information asymmetry and control rights, we have examined the sample of just the manufacturing firms in both emergent and mature industries, and the results are quite similar.)

Higher R&D expenses make firms in emergent industries more risky. However, the transaction costs argument is based on information asymmetry rather than uncertainty. To make sure that information asymmetry plays a major role in the relative balance between the benefits and costs of internal markets, we also present in Panel C three measures of information asymmetry: mean analyst coverage, earnings forecast error, and forecast dispersion based on data from the I/B/E/S Detailed History Tape.

For analyst following we use the mean number of analysts making one-year-ahead earnings forecasts in any month of the year for each firm-calendar-year. Analyst earnings forecast error is defined as the absolute value of the difference between mean earnings forecasts and actual earnings, divided by the absolute value of actual earnings. Dispersion of analyst earnings forecast is defined as the standard deviation of earnings forecast scaled by the absolute value of the mean earnings forecast. These measures have been widely used in the prior literature as measures of firms' information environment (e.g. Krishnaswami and Subramaniam, 1999; Kang and Liu, 2004; Gomes and Phillips, 2006). It is clear from this panel that emergent

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COMPUSTAT terms, it is defined as the ratio of (data113 - data109 + data128 – data107 + data129 + data127 + data236 - data123 - data124 - data125 – data126 - data106 - data123) to data6.

high-tech firms are indeed more subject to the problem of information asymmetry: they have lower analyst coverage, higher earnings forecast error, and higher earnings forecast dispersion.[3]

We select all firms that operate in the eight emergent and seventeen mature industries from the COMPUSTAT Segment NAICS file. We then separate these firms into stand-alone and diversified firms. A firm is regarded as a diversified firm if it has one or more segments operating outside the eight high-tech industries in the case of emergent industries and outside the seventeen low-tech industries in the case of the mature industries. Otherwise, firms in these eight and seventeen industries respectively are regarded as single-segment firms. However, if a firm operates in more than one high-tech industry in this study, for example, both software publishing and business support services, we classify it as a stand-alone. There are very few firms operating in more than one high tech segment. Excluding these firms from the analysis does not change the results. Further, although in principle, a firm could have a segment in both an emergent and a mature industry, no such conglomerate exists

Segment data are available from the COMPUSTAT Business Information File, which contains seven years of information for operating segments of every company. This is a revised Business Information File following the reporting changes required under SFAS 131 (issued in June 1997 and effective for fiscal years beginning after December 15, 1997). SFAS 131 requires a public corporation to report financial information about its operating segments. An operating segment is defined as "an enterprise about which separate financial information is available that

[3] It is difficult to measure agency costs because agency problems are multi-dimensional. The corporate governance literature has made an effort to examine aspects of agency problems, but this literature has shown that one (or a few) governance measure cannot capture the overall agency problem, and that although some governance mechanisms are complimentary, some are supplementary (Gillan, Hartzell, and Starks, 2006). For this reason, we choose not to include governance measures in this study. Lack of control for agency costs may induce the endogeneity problem and results may be affected.

is evaluated regularly by the chief operating decision maker *in deciding how to allocate resources and in assessing performance*."[4]

SFAS 131 also requires "reconciliation of total segment revenues, total segment profit or loss, total segment assets, and other amounts disclosed for segments to corresponding amounts in the enterprise's general-purpose financial statements." As the data in our sample are reported in accordance with SFAS 131, we expect no discrepancy between data at segment and firm levels. For 1995 and 1996 data, while we omit observations where the aggregate segment data deviates from the firm-level data by more than 10%, if there is a smaller discrepancy between data at segment and firm levels, we follow the convention of previous studies and allocate any discrepancy to each segment in proportion to their asset size.

*3.2. Statistical analysis*

*3.2.1 Summary statistics*

Since the size distribution between diversified firm segments and single-segment firms differs, we adopt a matching method. In order to control for industry and size, for each segment-year observation, we find a stand-alone firm-year observation that shares the same 4-digit NAICS code and has the closest asset size match (we report matching quality in Table 4). Since the distribution of many variables differs from the normal distribution and means for accounting ratios may be contaminated by outliers, we use non-parametric procedures comparing medians with the Wilcoxon-Mann-Whitney test. As neither market values nor replacement costs are available for segments, this study can not calculate or use Tobin's Q. Therefore, we follow Berger and Ofek (1995) and use accounting variables reported at the segment level and compare them with firm-level accounting variables for single-segment firms. It is important to note here

[4] This requirement of SFAS 131 is particularly important for this study. Since fiscal years that ended after December 15, 1977, SFAS 14 has required only that some data be reported for segments that exceed 10% of total sales (with no requirement for overall reconciliation or other details).

that only limited data is available for segments of multidivisional firms - only five accounting variables are reported at the segment level: asset size, sales, capital expenditure, operating profits, and depreciation.

Differences in operating efficiency and profitability are assessed using differences in asset turnover ratios and operating profitability (return on assets and profit margin on sales). An advantage of using operating efficiency is that it avoids possible problems with profitability measures - diversified firms may intentionally allocate more fixed-costs or overhead to low-tech segments so that high-tech segments appear artificially more profitable. Since sales and assets are not as easy to mis-allocate across segments, results using asset turnover ratios are less likely to be contaminated.[5] Finally, we compare the observed market-to-book ratios for diversified firms with imputed market-to-book ratios for the same firms. We apply the same matching method to the segments operating in other industries in these diversified firms to find their stand-alone matches. The imputed market-to-book ratios are the average market-to-book ratio of a diversified firm with the market-to-book ratio of each segment imputed the same market-to-book ratio as its matched single-segment counterpart weighted by the asset proportion of each segment.

*3.3.2 Multivariate analysis*

Various measures of operating efficiency (asset turnover), and profitability (return on assets) are examined as to how they differ between single-segment firms and diversified firm segments. Regressions are estimated for these variables as dependent variables. The list of independent variables used in these regressions reflects the limited data available for segments; and include a dummy 0,1 variable signifying a segment versus a stand-alone status (1 if a

[5] While it is possible that managers may manipulate financial reports, accounting literature shows that disclosure is generally reliable in equilibrium even though it may have some bias (see Dye, 1988; Fischer and Verrecchia, 2000).

segment, 0 if a single-segment firm), and other available variables that reflect business characteristics such as size, lagged investment ratio, and depreciation. In order to account for industry differences, the industry median of the dependent variable is also used as an independent variable.

Many of the variables in this study are ratios and are characterized by the presence of many outliers. In addition, many variables have highly skewed distributions. In order to minimize the problems associated with the presence of outliers in multivariate ordinary least squares (OLS) regressions, we use quantile regression procedures (e.g., Kroenker and Bassett, 1978; Mata and Machado, 1996; and Kroenker and Hallock, 2001). Quantile regression minimizes the absolute deviations instead of the sum of squared residuals in traditional OLS regression and the regression results are relatively robust to departures from normality.

Define q as the quantile to be estimated; the median is q = 0.5. For each observation $i$, let $r_i$ be the residual

$$r_i = y_i - \sum_j \beta_j x_{ij}$$

Define the multiplier $h_i$

$$h_i = 2q \quad if \quad r_i > 0 \quad and \quad 2(1-q) \quad otherwise.$$

Then the quantity being minimized with respect to $\beta_i$ is $\sum_i |r_i| h_i$. To cope with heterogeneity, this paper uses a bootstrapped estimate of the entire variance-covariance matrix of the estimators that is introduced by Gould (1992, 1997) and embedded in Stata, to estimate standard errors.

*3.3. Sample characteristics*

The descriptive statistics of diversified firm segments and single-segment firms during our sample period are reported in Table 2. Diversified firm segments in these diversified firms

are compared to their stand-alone peers. Diversified firm segments and single-segment firms in high-tech industries are presented in Panel A, while those in the mature industries are reported in Panel B. In total, there are 3,568 and 8,488 diversified firm segments and single-segment firms in high-tech industries, and 1,825 diversified firm segments and 1,697 single-segment firms in the mature industries. As the data in Panel A show, there are clear differences in the distribution of the sample by industry. We also find (but do not report because of space limitations) that, for the emergent industries, single-segment firms have a larger median asset size but diversified firm segments have a larger mean asset size. In terms of sales, diversified firm segments seem somewhat larger than single-segment firms. Among mature industries, single-segment firms appear to be larger in both sales and assets. Clearly, all of these size distributions for both mature and emergent industries are highly skewed. Further analysis should reflect this high degree of skewness in the data – using non-parametric techniques and perhaps by separating the analysis into size quartiles.

[Please insert Table 2 about here.]

## 4. Empirical results

### *4.1. Informational efficiency*

This section investigates relative informational efficiency of internal versus external capital markets. Because of differences in informational asymmetry and control rights between mature and emergent industries, internal capital markets may or may not be better at choosing higher-quality projects depending on the balance between internal and external transactions costs.[6] In case of emergent industries, internal capital markets may be better able to find and

[6] There is no clear reason to believe that operating managers are, on average, more capable in either diversified firm segments or single-segment firms. Therefore, we assume that any differences in operating efficiency ratios would mainly stem not from operating efficiency, but instead from the quality of the projects chosen.

channel funds to more profitable and operationally efficient projects while in mature industries internal capital markets are likely to be less efficient than external markets resulting in lower operational efficiency for segments of diversified firms. Tables 3 and 4 report the three measures of efficiency for diversified firm segments and their matched stand-alone counterparts. Table 3 reports the results for the emergent industries and Table 4 reports the results for the mature industries.

[Please insert Table 3 about here.]

[Please insert Table 4 about here.]

For the emergent industries, diversified firm segments have an unambiguously higher asset turnover ratios compared to their single-segment counterparts (and the difference is statistically highly significant). Further, segments of diversified firms in emergent high-tech industries are more profitable than their single-segment counterparts. In contrast, as shown in Table 4 for the mature industries, segments of diversified firms generally have lower asset turnover, lower profit margin, and lower return on assets compared to their single-segment counterparts. Segments of diversified firms in mature industries are less efficient and less profitable than their matched single-segment counterparts. The comparison results presented in this table clearly support our transactions costs-based contention regarding the value of diversification.

Maksimovic and Phillips (2002) finds differences in behavior between peripheral and main segments. Therefore, it is important to check if our results are contaminated by differences in relative sizes of segments in diversified firms. We measure relative segment size position by asset weight, which is segment asset size as a proportion of total firm size. We break our sample into four quartiles; the smallest asset weight quartile is comprised of peripheral segments, while

the largest asset weight quartile consists of main segments. We then compare the same efficiency and profitability ratios across different asset weight quartiles in Table 5. The results show that, across different asset weight quartiles, diversified firm segments are more efficient and more profitable than single-segment firms in the emergent industries and less profitable than single-segment firms in the mature industries. Therefore, it seems that our results are not driven by different behavior between peripheral and main segments.

[Please insert Table 5 about here.]

*4.2. Multivariate determinants of performance*

Table 6 presents the results of multivariate quantile regression analysis with the segment dummy (diversified firm segments as 1 and single-segment firms as 0) for the overall period, 1995-2001, and sub-periods, 1995-1997, 1998-1999, 2000-2001. Panels A, B, and C present regression results for the asset turnover ratio, profit margin, and return on assets as dependent variables respectively. As the regressions in Panel A show, after controlling for other relevant variables, diversified firm segments have significantly higher asset turnover ratios for the emergent industries but for mature industries the results are mostly not significant for asset turnover ratios. As the regressions presented in Panels B and C show, both profit margins and return on assets are significantly lower for diversified firm segments in the mature industries and significantly higher for diversified firm segments in the emergent industries. Once again, these contrasting results strongly and clearly support our transaction costs-based contentions.

An alternative explanation for the above finding may be differences in life-cycle stages between diversified firm segments and single-segment firms in the high-tech industry, as Borghesi, Houston, and Naranjo (2007) argue that firm age explains a significant proportion of diversification discount. In other words, single-segment firms may be at an earlier stage of their

lifecycles compared to diversified firm segments, so it might not be surprising that diversified firm segments have better operating performance. To address this concern, we examine year-by-year increases in diversified firm segments and single-segment firms. We find that in the high tech industry the proportion of new entrants as single-segment firms does not seem to be higher than the proportion of new diversified firm segments. Because of the SFAS rule change, the number of diversified firm segments in 1998 is not comparable to that before 1998. From 1998 to 2000 (the peak of high-tech bubble), there is an increase of 57% in the number of new high-tech segments, from 520 to 818. In contrast, there is an increase of 36% in the number of single-segment firms, from 1,166 to 1,591. It is thus clear that there are more new entrants to high-tech among diversified firm segments. So this alternative life cycle explanation is not likely to hold.

[Please insert Table 6 about here.]

*4.3. Likelihood of project termination*

We have argued that a lack of control rights may be one of the reasons why internal markets seem to outperform external markets in emergent industries. This section tries to provide empirical evidence in this regard. Emergent high-tech firms generally raise large amounts of equity from IPOs or SEOs, and then sit on the cash for the next few years. During the period, outside investors are not able to withdraw financing from the firms even though it may later be found that the firms have chosen bad projects. This is highlighted by the "deathwatch" of many dot.coms after March 2000, when analysts were estimating when these dot.coms would go bankrupt given their monthly "burn rate" and existing financial resources. On the contrary, high-tech diversified firm segments can only obtain staged-financing from their head offices and are evaluated on a regular basis. The head offices have the power to quickly stop financing if

conditions deteriorate. As a result, it would be interesting to inspect the survival rate for loss-making diversified firm segments and single-segment firms.

Our focus here is not the actual survival rate of a diversified firm segment or a single segment firm when incurring losses. Instead, our goal is to investigate whether there is any statistical difference in survival rate for loss-making diversified firm segments and single-segment firms. We use the semi-parametric Cox proportional hazard model (Cox, 1972) for this purpose. This model assumes a linear parametric form for the effects of the explanatory variables, but allows an unspecified form for the underlying survival functions. This model is widely used in the analysis of censored survival data to explain the effect of explanatory variables on survival times. Specifically, we investigate the model

$$H(t_{(i)}) = H_0(t_{(i)})e^{\beta x}$$

where $H(.)$ is the hazard function, which describes the rate at which a loss-making operating unit deceases after duration $t_{(i)}$, given that they last at least until $t_{(i)}$. $H_0(t_{(i)})$ is the underlying survival function that is unspecified. $x$ is a dummy variable, equal to 0 for single-segment firms, and to 1 for diversified firm segments. We test if the estimate of β is significantly different from zero. A β estimate not statistically different from zero suggests that diversified firm segments and single-segment firms are equally likely to survive. A positive β implies that loss-making diversified firm segments face lower survival rates than single-segment firms.

We only include loss-making diversified firm segments and single-segment firms when carrying out this test. In total, there are 556 loss-making diversified firm segments and 1,237 loss-making single-segment firms. Cox proportional hazard model shows that the estimate of β is significantly different from zero ($\widehat{\beta}$=1.5258, standard error = 0.08177, $p$-value <0.0001),

implying that the survival probability is significantly lower for loss-making diversified firm segments. In comparison, loss-making single-segment firms have more time to perhaps ultimately become profitable. These findings are clearly supportive of the contention that internal capital markets have a control rights advantage as non-performing projects can be terminated relatively quickly by corporate management in a diversified firm as compared to non-performing single-segment firms.

Furthermore, the median first-year ROA is -37.44 percent for these loss-making diversified firm segments and -53.88 percent for the single-segment firms. Consequently, it seems that although these diversified firm segments and single-segment firms both start in the red, the financial losses of the diversified firm segments are less severe. Upon exit time or censor time, the median ROA is -33.22 percent for diversified firm segments (maximum = 1078.44 percent, and minimum = -282.64) and -43.77 percent for single-segment firms (maximum = 61.78 percent and minimum = -30581.04). This data indicate that the median loss is higher for single-segment firms. However, it can be argued that these medians are not very relevant since businesses with very negative ROAs are eventually eliminated. It is more important to investigate the diversified firm segments and single-segment firms that are given a chance to survive to examine whether internal markets terminate loss-making diversified firm segments efficiently.

Since the survival rate is significantly lower in internal capital markets, if diversified firm segments with profit potential are randomly or wrongly eliminated, the percentage of diversified firm segments that emerge as profitable in the end should be lower than that of single-segment firms. Nevertheless, we find that 57 diversified firm segments (10.25 percent) turn profitable, compared with 110 single-segment firms (8.89 percent); and 23 (4.13 percent) diversified firm

segments improve their ROA to more than 20 percent in the end, compared with only 9 (0.73 percent) single-segment firms. Therefore, it can be concluded that loss-making diversified firm segments are under greater pressure to improve their performance and internal capital markets do make the right decision to eliminate those diversified firm segments with unpromising futures but retain those with promising futures.

*4.4. Value of diversification*

Table 7 reports observed versus imputed market valuations for diversified firms in both the mature and emergent industries. This table shows that observed valuations for diversified firms in mature industries are significantly lower than their imputed valuations – clearly indicating a significant diversification discount. In contrast, imputed valuations are significantly higher than observed valuations for diversified firms in emergent industries – clearly indicating a diversification premium.

[Please insert Table 7 about here.]

**6. Conclusions**

While internal capital markets have some informational advantages in allocating capital, they also have some limitations in the form of agency costs where managers can manipulate the process to fund projects that are economically less valuable for shareholders but provide higher managerial benefits. Thus, it is fairly widely contended that internal capital markets are generally less efficient than external capital markets and there is a significant diversification discount with much empirical literature confirming these contentions. However, others disagree, with some empirical literature showing that internal capital markets may not be inefficient. Currently, the literature is divided and there seems to be controversy regarding the nature and extent of the diversification discount. To move the debate forward, based on transactions cost economics, this

paper shows that diversification is likely to be value enhancing when external capital markets are relatively inefficient (as in the case of emergent high-tech industries), and diversification is likely to be value destroying when internal capital markets suffer from agency and other costs that are higher relative to costs in external capital markets (as in mature firms).

The empirical evidence based on the performance of firms in eight emergent high-tech industries and eleven mature industries support these transactions costs based contentions. This paper shows that diversified firm segments in high-tech industries are more efficient than their single-segment counterparts while the reverse is true for mature industries. Compared to imputed valuation based on their single-segment counterparts, observed values of diversified high-tech firms are higher while observed values are lower for diversified firms in mature industries.

These results support our contention that the value impact of diversification depends on the balance between internal and external transactions costs. These findings help clarify the reasons for the mixed evidence on the diversification discount found in prior literature. Future research on firm diversification is likely to find it useful to separate firms based on the balance between internal versus external transactions costs to avoid confounding and offsetting diversification effects.

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## Table 1: Industry characteristics and sample distribution

We define emergent industries as those whose R&D expense are above 8% of total assets, market-to-book ratio and financing needs are above the medians for all industries combined. Total assets are in 1995 constant dollars. We require mature industries to have no reported R&D expenses and that they have market-to-book ratio below one and negative financing needs. Need for external financing is defined as the ratio of (data113 - data109 + data128 - data107 + data129 + data127 + data236 - data123 - data124 - data125 - data126 - data106 - data123) to data6. During the period from 1995 to 2001, the median market-to-book ratio is 1.23 and the median deficit is 2.6%, for all industries combined. During this period, 45% of firm years do not report R&D expenses. For those firms that report R&D expenses, the median ratio of R&D (data46) to assets (data6) is 4.9%. This table is based on the primary NAICS codes at the firm level and covers the period, 1995-2001.

**Panel A: Emergent industries**

| Four digit NAICS industry | Num. of obs. | R&D as percent of assets | Operating and investment deficit | Market-to-book ratio | Asset size |
|---|---|---|---|---|---|
| 3254: Pharmaceutical and medicine manufacturing | 3,201 | 22.65% | 50.97% | 2.97 | 39.76 |
| 3341: Computer and equipment manufacturing | 1,775 | 12.70% | 11.70% | 1.74 | 52.56 |
| 3342: Communications equipment manufacturing | 1,573 | 11.20% | 4.42% | 1.60 | 58.87 |
| 3345: Instrument manufacturing | 2,223 | 10.92% | 3.23% | 1.58 | 38.10 |
| 5112: Software publishers | 3,584 | 17.28% | 23.54% | 2.33 | 53.69 |
| 5141: Information services | 1,396 | 8.23% | 74.52% | 2.07 | 51.68 |
| 5415: Computer systems design and services | 1,945 | 9.62% | 9.36% | 1.67 | 42.30 |
| 5417: Research and development services | 402 | 20.14% | 47.43% | 2.62 | 24.08 |

**Panel B: Mature industries**

| Four digit NAICS industry | Num. of obs. | R&D as percent of assets | Operating and investment deficit | Market-to-book ratio | Asset size |
|---|---|---|---|---|---|
| 2212: Natural gas distribution | 452 | 0 | -1.44% | 0.85 | 861.72 |
| 2332: Residential building construction | 325 | 0 | -6.97% | 0.82 | 154.65 |
| 3152: Cut and sew apparel manufacturing | 475 | 0 | -5.79% | 0.96 | 143.67 |
| 3219: Millwork | 155 | 0 | -6.63% | 0.97 | 201.84 |
| 4211:Motor vehicle and parts wholesalers | 120 | 0 | -2.77% | 0.92 | 87.28 |
| 4217: Hardware, and plumbing and heating equipment and supplies wholesalers | 127 | 0 | -0.88% | 0.79 | 99.83 |
| 4218: Machinery and equipment wholesalers | 239 | 0 | -2.94% | 0.85 | 132.59 |
| 4229: Misc. non-durable goods wholesalers | 108 | 0 | -2.80% | 0.94 | 45.34 |
| 4431: Electronics and appliance stores | 139 | 0 | -1.22% | 0.83 | 213.48 |
| 4451: Grocery stores | 369 | 0 | -0.70% | 0.92 | 742.22 |
| 4511: Sporting goods, hobby, and musical stores | 154 | 0 | -2.47% | 0.69 | 155.00 |
| 4521: Department stores | 141 | 0 | -3.00% | 0.79 | 1514.39 |
| 4529: Other general merchandise stores | 217 | 0 | -3.76% | 0.92 | 645.80 |
| 4811: Scheduled air transportation | 282 | 0 | -0.83% | 0.82 | 672.90 |
| 4821: Rail transportation | 151 | 0 | -2.85% | 0.76 | 1209.27 |
| 4831: Sea, coastal, and lakes transportation | 154 | 0 | -1.48% | 0.81 | 484.75 |
| 4841: General freight trucking | 287 | 0 | -4.45% | 0.83 | 157.06 |

**Panel C: Measures of information asymmetry**

| | Emergent industry | Mature industry | difference | T-stat |
|---|---|---|---|---|
| Mean number of analyst coverage | 1.63 | 2.11 | -0.48** | -9.08 |
| (S.E.) | (2.25) | (2.48) | | |
| Mean earnings forecast error | 27.03 | 18.98 | 8.05** | 6.26 |
| (S.E.) | (66.67) | (58.29) | | |
| Mean earnings forecast dispersion | 15.60 | 9.77 | 5.83** | 8.82 |
| (S.E.) | (38.35) | (28.74) | | |

** indicates significance at the 5% level

**Table 2: Diversified firm segments and single-segment firms in emergent and mature industries**

We define emergent industries as those whose R&D expense are above 8% of total assets, market-to-book ratio and financing needs are above the medians for all industries combined. We require mature industries to have no reported R&D expenses and that they have market-to-book ratio below one and negative financing needs. Need for external financing is defined as the ratio of (data113 - data109 + data128 - data107 + data129 + data127 + data236 - data123 - data124 - data125 - data126 - data106 - data123) to data6. During the period from 1995 to 2001, the median market-to-book ratio is 1.23 and the median deficit is 2.6%, for all industries combined. During this period, 45% of firm years do not report R&D expenses. For those firms that report R&D expenses, the median ratio of R&D (data46) to assets (data6) is 4.9%. This table is based on the primary NAICS codes at the firm level.

**Panel A: Distribution of diversified firm segments and single-segment firms in emergent industries**

| | Diversified firm segments | | Single-segment firms | |
|---|---|---|---|---|
| **4 digit NAICS code** | **Number** | **Percentage** | **Number** | **Percentage** |
| 3254 | 401 | 11.24% | 1853 | 21.83% |
| 3341 | 342 | 9.59% | 1053 | 12.41% |
| 3342 | 485 | 13.59% | 868 | 10.23% |
| 3345 | 719 | 20.15% | 1175 | 13.84% |
| 5112 | 431 | 12.08% | 1860 | 21.91% |
| 5141 | 396 | 11.10% | 543 | 6.40% |
| 5415 | 604 | 16.93% | 896 | 10.56% |
| 5417 | 190 | 5.33% | 240 | 2.83% |
| Total | 3,568 | 100% | 8488 | 100.00% |

**Panel B: Distribution of diversified firm segments and single-segment firms in mature industries**

| | Diversified firm segments | | Single-segment firms | |
|---|---|---|---|---|
| **4 digit NAICS Code** | **Number** | **Percentage** | **Number** | **Percentage** |
| 2212 | 403 | 22.08% | 73 | 4.30% |
| 2332 | 161 | 8.82% | 95 | 5.60% |
| 3152 | 113 | 6.19% | 268 | 15.79% |
| 3219 | 128 | 7.01% | 56 | 3.30% |
| 4211 | 64 | 3.51% | 46 | 2.71% |
| 4217 | 57 | 3.12% | 57 | 3.36% |
| 4218 | 164 | 8.99% | 111 | 6.54% |
| 4229 | 76 | 4.16% | 49 | 2.89% |
| 4431 | 26 | 1.42% | 75 | 4.42% |
| 4451 | 86 | 4.71% | 158 | 9.31% |
| 4511 | 36 | 1.97% | 85 | 5.01% |
| 4521 | 39 | 2.14% | 63 | 3.71% |
| 4529 | 86 | 4.71% | 114 | 6.72% |
| 4811 | 35 | 1.92% | 172 | 10.14% |
| 4821 | 76 | 4.16% | 47 | 2.77% |
| 4831 | 90 | 4.93% | 72 | 4.24% |
| 4841 | 185 | 10.14% | 156 | 9.19% |
| Total | 1,825 | 100.00% | 1697 | 100.00% |

## Table 3: Comparison of efficiency and profitability of diversified firm segments and single-segment firms in emergent industries

This table compares the asset turnover ratio, profit margin and ROA for diversified firm segments and single-segment firms in emergent industries. These industries are chosen according to criteria established in Table 1. A firm is regarded as a diversified firm if it has one or more segments operating outside the mature or emergent industries in this study. Otherwise, it is regarded as a stand-alone. We omit firm observations where the aggregate segment data deviates from the firm-level data by more than 10%. If there is discrepancy between data at segment and firm levels, we follow the convention of previous studies and allocate any discrepancy between firm and segment level to each segment in proportion to their segment asset size. For each segment-year observation, we find a firm-year observation which shares the same 4-digit NAICS code and has the closest asset size. Panel A presents the comparison of efficiency and profitability ratios for diversified firm segments and single-segment firms in emergent industries, while Panel B reports those for mature industries. Panel C reports efficiency and profitability ratios for other industry segments and single-segment firms. Medians and the Wilcoxon-Mann-Whitney tests are used here. Numbers in parentheses are *p*-values.

| | Asset turnover | | | Profit margin | | | ROA | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Diversified firm segment** | **Single-segment firms** | **Difference** | **Diversified firm segment** | **Single-segment firms** | **Difference** | **Diversified firm segment** | **Single-segment firms** | **Difference** |
| Panel A: By size quartile | | | | | | | | | |
| 1st quartile | 1.68 | 1.09 | 0.59 | -17.47% | -103.73% | 86.26% | -24.90% | -100.40% | 75.51% |
| 2nd quartile | 1.24 | 0.82 | 0.42 | -2.10% | -38.21% | 36.11% | -2.33% | -29.00% | 26.67% |
| 3rd quartile | 0.99 | 0.76 | 0.23 | 5.08% | -2.80% | 7.88% | 5.36% | -2.53% | 7.89% |
| 4th quartile | 0.98 | 0.85 | 0.13 | 8.55% | 11.19% | -2.64% | 8.29% | 10.56% | -2.28% |
| Panel B: By year | | | | | | | | | |
| 1995 | 1.19 | 0.98 | 0.21 | 5.42% | 5.16% | 0.26% | 6.32% | 6.16% | 0.16% |
| 1996 | 1.10 | 0.99 | 0.11 | 4.59% | 1.85% | 2.74% | 4.51% | 1.38% | 3.14% |
| 1997 | 1.07 | 0.93 | 0.14 | 4.84% | -0.29% | 5.13% | 5.50% | -0.36% | 5.86% |
| 1998 | 1.12 | 0.98 | 0.14 | 3.72% | -6.73% | 10.44% | 4.10% | -7.35% | 11.45% |
| 1999 | 1.19 | 0.82 | 0.37 | 2.98% | -11.93% | 14.90% | 2.96% | -9.89% | 12.84% |
| 2000 | 1.13 | 0.75 | 0.38 | -0.55% | -32.27% | 31.71% | -0.46% | -18.93% | 18.47% |
| 2001 | 1.10 | 0.72 | 0.38 | 1.71% | -25.69% | 27.40% | 1.85% | -19.03% | 20.88% |
| Overall | 1.13 | 0.85 | 0.28 | 3.05% | -11.53% | 14.58% | 3.11% | -10.37% | 13.47% |
| (p-value) | | | (<.0001)** | | | (<.0001)** | | | (<.0001)** |

** indicates significance at the 5% level.

## Table 4: Comparison of efficiency and profitability of diversified firm segments and single-segment firms in mature industries

This table compares the asset turnover ratio, profit margin and ROA for diversified firm segments and single-segment firms in mature industries. These industries are chosen according to criteria established in Table 1. A firm is regarded as a diversified firm if it has one or more segments operating outside the mature or emergent industries in this study. Otherwise, it is regarded as a stand-alone. We omit firm observations where the aggregate segment data deviates from the firm-level data by more than 10%. If there is discrepancy between data at segment and firm levels, we follow the convention of previous studies and allocate any discrepancy between firm and segment level to each segment in proportion to their segment asset size. For each segment-year observation, we find a firm-year observation which shares the same 4-digit NAICS code and has the closest asset size. Panel A presents the comparison of efficiency and profitability ratios for segments and single-segment firms in emergent industries, while Panel B reports those for mature industries. Panel C reports efficiency and profitability ratios for other industry segments and single-segment firms. Medians and the Wilcoxon-Mann-Whitney tests are used here. Numbers in parentheses are *p*-values.

| | Asset turnover | | | Profit margin | | | ROA | | |
|---|---|---|---|---|---|---|---|---|---|
| | Segment | Single-segment firms | Difference | Diversified firm segment | Single-segment firms | Difference | Diversified firm segment | Single-segment firms | Difference |
| **Panel A: By size quartile** | | | | | | | | | |
| 1st quartile | 1.61 | 1.68 | -0.07 | 2.80% | 4.02% | -1.23% | 5.54% | 8.62% | -3.09% |
| 2nd quartile | 1.42 | 1.32 | 0.11 | 5.29% | 6.96% | -1.67% | 7.09% | 7.01% | 0.08% |
| 3rd quartile | 0.96 | 1.02 | -0.06 | 8.06% | 9.26% | -1.20% | 7.31% | 9.39% | -2.08% |
| 4th quartile | 0.97 | 0.91 | 0.06 | 8.25% | 9.18% | -0.92% | 8.08% | 8.46% | -0.38% |
| **Panel B: By year** | | | | | | | | | |
| 1995 | 1.20 | 1.20 | -0.01 | 6.51% | 8.19% | -1.68% | 7.68% | 8.03% | -0.35% |
| 1996 | 1.12 | 1.16 | -0.04 | 6.38% | 8.12% | -1.73% | 8.23% | 8.52% | -0.30% |
| 1997 | 1.15 | 1.09 | 0.06 | 6.56% | 7.45% | -0.89% | 7.80% | 8.69% | -0.89% |
| 1998 | 1.24 | 1.38 | -0.14 | 6.68% | 8.25% | -1.57% | 7.07% | 8.32% | -1.26% |
| 1999 | 1.26 | 1.25 | 0.00 | 6.45% | 7.34% | -0.89% | 7.26% | 8.93% | -1.67% |
| 2000 | 1.34 | 1.25 | 0.09 | 5.44% | 7.03% | -1.59% | 7.17% | 8.23% | -1.06% |
| 2001 | 1.34 | 1.23 | 0.11 | 3.39% | 6.77% | -3.38% | 6.09% | 7.68% | -1.59% |
| Overall | 1.26 | 1.25 | 0.01 | 6.11% | 7.31% | -1.20% | 7.29% | 8.43% | -1.14% |
| (p-value) | | | (0.2918) | | | (<.0001)** | | | (0.0002)** |

** indicates significance at the 5% level.

## Table 5: Efficiency and profitability of diversified firm segments and single-segment firms: Across different asset weight quartiles

This table compares the efficiency and profitability of diversified firm segments and single-segment firms across different asset weight quartiles. The emergent and mature industries are chosen according to criteria established in Table 1. A firm is regarded as a diversified firm if it has one or more segments operating outside the mature or emergent industries in this study. Otherwise, it is regarded as a stand-alone. We omit firm observations where the aggregate segment data deviates from the firm-level data by more than 10%. If there is discrepancy between data at segment and firm levels, we follow the convention of previous studies and allocate any discrepancy between firm and segment level to each segment in proportion to their segment asset size. For each segment-year observation, we find a firm-year observation which shares the same 4-digit NAICS code and has the closest asset size. We calculate asset weight as the proportion of the segment asset as total firm asset. Panel A presents the comparison of efficiency ratios for segments and single-segment firms in emergent industries, while Panels B and C reports profitability ratios. Medians and the Wilcoxon-Mann-Whitney tests are used here. Numbers in parentheses are *p*-values.

| | Emergent industries | | | Mature industries | | |
|---|---|---|---|---|---|---|
| **Panel A: Efficiency (asset turnover ratios)** | | | | | | |
| Smallest asset weight quartile | 1.27 | 1.31 | -3.54% (0.66) | 1.98 | 1.85 | 0.14 (0.20) |
| 2nd quartile | 1.14 | 0.81 | 32.71% (<0.01)** | 1.78 | 2.25 | -0.48 (<0.01)** |
| 3rd quartile | 0.91 | 0.78 | 13.69% (<0.01)** | 1.34 | 1.33 | 0.01 (0.41) |
| Largest asset weight quartile | 0.90 | 0.82 | 8.36% (0.04)** | 1.02 | 0.99 | 0.02 (0.69) |
| **Panel B: Profitability (profit margin – profit as a percent of sales)** | | | | | | |
| Smallest asset weight quartile | -19.89% | -59.79% | 39.90% (<0.01)** | 0.88% | 3.10% | -2.23% (0.09) |
| 2nd quartile | -4.12% | -40.77% | 36.64% (<0.01)** | 3.10% | 2.64% | 0.45% (0.87) |
| 3rd quartile | 4.68% | -4.69% | 9.36% (<0.01)** | 4.92% | 6.68% | -1.75% (<0.01)** |
| Largest asset weight quartile | 8.65% | 8.71% | -0.06% (0.60) | 7.87% | 8.98% | -1.10% (<0.01)** |
| **Panel C: Profitability (return on assets)** | | | | | | |
| Smallest asset weight quartile | -32.82% | -76.36% | 43.54% (<0.01)** | 2.34% | 10.15% | -7.82% (0.68) |
| 2nd quartile | -6.78% | -32.30% | 25.53% (<0.01)** | 5.92% | 8.23% | -2.31% (0.51) |
| 3rd quartile | 3.11% | -4.19% | 7.30% (<0.01)** | 6.69% | 7.57% | -0.89% (0.06)* |
| Largest asset weight quartile | 6.66% | 9.11% | -2.46% (0.17) | 7.80% | 8.53% | -0.73% (<0.01)** |

* indicates significance at the 10% level. ** indicates significance at the 5% level.

## Table 6: Performance Determinants: Quartile regressions by time periods

This table shows results from quartile regressions for three sub-periods and one overall period as there was an accounting rule change in 1997 and the equity market changed directions in 2000. The emergent and mature industries are chosen according to criteria established in Table 1. A firm is regarded as a diversified firm if it has one or more segments operating outside the mature or emergent industries in this study. Otherwise, it is regarded as a stand-alone. We omit firm observations where the aggregate segment data deviates from the firm-level data by more than 10%. If there is discrepancy between data at segment and firm levels, we follow the convention of previous studies and allocate any discrepancy between firm and segment level to each segment in proportion to their segment asset size.

### Panel A: Efficiency (asset turnover ratios)

| | Emergent industries | | | | Mature industries | | | |
|---|---|---|---|---|---|---|---|---|
| **Variables** | **1995-1997** | **1998-1999** | **2000-2001** | **1995-2001** | **1995-1997** | **1998-1999** | **2000-2001** | **1995-2001** |
| **Segment (dummy)** | 0.22 | 0.24 | 0.33 | 0.30 | 0.05 | 0.05 | 0.01 | 0.05 |
| | (0.04)** | (0.04)** | (0.03)** | (0.02)** | (0.03)* | (0.04) | (0.02) | (0.02)** |
| **Size (log sales)** | 0.02 | 0.03 | 0.05 | 0.04 | 0.03 | -0.24% | 0.02 | 0.02 |
| | (0.72%)** | (0.71%)** | (0.42%)** | (0.27%)** | (0.01)** | (0.01) | (0.01)** | (0.38%)** |
| **Industry median** | 0.88 | 1.07 | 0.75 | 0.91 | 1.03 | 1.01 | 0.97 | 1.02 |
| | (0.09)** | (0.08)** | (0.05)** | (0.03)** | (0.02)** | (0.03)** | (0.02)** | (0.01)** |
| **Lagged investment ratio** | -0.08 | -0.02 | -0.51% | -0.70% | -0.09 | -0.21 | -0.72 | -0.10 |
| | (0.03)** | (0.10) | (0.03%)** | (0.02%)** | (0.01)** | (0.16) | (0.12)** | (0.01)** |
| **Lagged depreciation** | 2.31 | 3.12 | 0.48 | 0.71 | -0.93 | -0.84 | 2.55 | -0.04 |
| | (0.23)** | (0.25)** | (0.03)** | (0.02)** | (0.50) | (0.39)** | (0.24)** | (0.19) |
| **Intercept** | -0.11 | -0.40 | -0.15 | -0.22 | -0.19 | 0.03 | -0.12 | -0.14 |
| | (0.09) | (0.08)** | (0.05)** | (0.03)** | (0.05)** | (0.08) | (0.04)** | (0.03)** |
| **Pseudo R2** | 0.09 | 0.09 | 0.11 | 0.10 | 0.34 | 0.30 | 0.26 | 0.29 |

**Table 6: Performance Determinants: Quantile regressions (continued)**

**Panel B: Profitability (profit margin – profit as a percent of sales)**

| | Emergent industries | | | | Mature industries | | | |
|---|---|---|---|---|---|---|---|---|
| **Variables** | **1995-1997** | **1998-1999** | **2000-2001** | **1995-2001** | **1995-1997** | **1998-1999** | **2000-2001** | **1995-2001** |
| **Segment (dummy)** | 0.03 | 0.08 | 0.13 | 0.09 | -0.83% | -0.67% | -0.18% | -0.59% |
| | (0.01)** | (0.02)** | (0.02)** | (0.01)** | (0.40%)** | (0.36%)* | (0.08%)** | (0.25%)** |
| **Size (log sales)** | 0.05 | 0.06 | 0.12 | 0.07 | 0.50% | 0.40% | 0.68% | 0.56 |
| | (0.23%)** | (0.37%)** | (0.33%)** | (0.22%)** | (0.10%)** | (0.09%)** | (0.02%)** | (0.06%)** |
| **Industry median** | 0.19 | 0.50 | 1.15 | 0.80 | 1.00 | 1.00 | 0.95 | 1.01 |
| | (0.03)** | (0.04)** | (0.03)** | (0.02)** | (0.05)** | (0.04)** | (0.01)** | (0.03)** |
| **Lagged investment ratio** | 0.06 | -0.02 | -0.20 | -0.19 | 0.28% | 0.55% | 0.05 | 0.27% |
| | (0.01)** | (0.05) | (0.01%)** | (0.02%)** | (0.20%) | (1.48) | (0.40%)** | (0.22%)** |
| **Lagged depreciation** | -1.34 | -1.67 | -0.34 | -0.99 | 0.02 | -0.23 | -0.21 | -0.20 |
| | (0.06)** | (0.13)** | (0.01)** | (0.02)** | (0.07) | (0.04)** | (0.01)** | (0.03)** |
| **Intercept** | -0.13 | -0.27 | -0.70 | -0.36 | -0.02 | -0.82% | -0.04 | -0.02 |
| | (0.01)** | (0.02)** | (0.02)** | (0.01)** | (0.01)** | (0.66%) | (0.14%)** | (0.046%)** |
| **Pseudo R2** | 0.02 | 0.00 | 0.00 | 0.00 | 0.23 | 0.20 | 0.05 | 0.09 |

**Table 6: Performance Determinants: Quantile regressions (continued)**

**Panel C: Profitability (return on assets)**

| | Emergent industries | | | | Mature industries | | | |
|---|---|---|---|---|---|---|---|---|
| **Variables** | **1995-1997** | **1998-1999** | **2000-2001** | **1995-2001** | **1995-1997** | **1998-1999** | **2000-2001** | **1995-2001** |
| **Segment (dummy)** | 0.05 | 0.08 | 0.12 | 0.09 | -0.46% | -0.99% | -1.34% | -0.81% |
| | (0.02)** | (0.01)** | (0.02)** | (0.01)** | (0.34%) | (0.28%)** | (0.37%)** | (0.23%)** |
| **Size (log sales)** | 0.05 | 0.06 | 0.06 | 0.05 | 0.86% | 0.69% | 0.74% | 0.77% |
| | (0.28%)** | (0.20%)** | (0.29%)** | (0.18%)** | (0.09%)** | (0.07%)** | (0.08%)** | (0.06%)** |
| **Industry median** | 0.18 | 0.14 | 0.49 | 0.38 | 1.49 | 0.77 | 0.69 | 0.95 |
| | (0.08)** | (0.05)** | (0.07)** | (0.04)** | (0.12)** | (0.10)** | (0.12)** | (0.08)** |
| **Lagged** | 0.04 | -0.12 | -0.19% | -0.21% | 0.43% | 0.41% | 0.07 | 0.35% |
| **investment ratio** | (0.01)** | (0.03)** | (0.01%)** | (0.01%)** | (0.17%)** | (1.12) | (0.02)** | (0.20%)** |
| **Lagged** | -2.42 | -2.75 | -1.98 | -1.98 | -0.02 | -0.31 | -0.63 | -0.39 |
| **depreciation** | (0.09)** | (0.07)** | (0.67%)** | (0.59%)** | (0.06) | (0.03)** | (0.03)** | (0.03)** |
| **Intercept** | -0.12 | -0.17 | -0.27 | -0.22 | -0.08 | -0.01 | 0.47% | -0.02 |
| | (0.02)** | (0.01)** | (0.02)** | (0.01)** | (0.01)** | (0.01) | (0.11%)** | (0.01)** |
| **Pseudo R2** | 0.14 | 0.16 | 0.28 | 0.23 | 0.08 | 0.04 | 0.03 | 0.04 |

* indicates significance at the 10% level, while ** indicates significance at the 5% level.

## Table 7: Comparison of the observed versus imputed valuations for diversified firms

This table examines the actual versus the imputed market-to-book ratios for diversified firms in mature and emergent industries. The emergent and mature industries are chosen according to criteria established in Table 1. A firm is regarded as a diversified firm if it has one or more segments operating outside the mature or emergent industries in this study. Otherwise, it is regarded as a stand-alone. We omit firm observations where the aggregate segment data deviates from the firm-level data by more than 10%. If there is discrepancy between data at segment and firm levels, we follow the convention of previous studies and allocate any discrepancy between firm and segment level to each segment in proportion to their segment asset size. Market to book ratios are used as proxies for market valuation in this table. To calculate the imputed market-to-book ratio, for each segment, we use the market-to-book ratio of a stand-alone in the same 4-digit NAICS industry with the closet asset size. The imputed market-to-book ratio is weighted by segment asset size. In Panel A, we compare the imputed market-to-book ratio versus the actual market-to-book ratio. Medians and the Wilcoxon-Mann-Whitney tests are used here. Numbers in parentheses are *p*-values.

| | **Diversified firms in mature industries** | | | **Diversified firms in emergent industries** | | |
|---|---|---|---|---|---|---|
| | **Median observed market-to-book ratio** | **Median imputed market-to-book ratio** | **Median diversification discount** | **Median observed market-to-book ratio** | **Median imputed market-to-book ratio** | **Median diversification premium** |
| **1995** | 0.83 | 0.94 | -11.85% | 1.15 | 1.04 | 10.99% |
| **1996** | 0.83 | 0.94 | -12.17% | 1.17 | 1.07 | 9.43% |
| **1997** | 0.92 | 1.07 | -13.97% | 1.34 | 1.12 | 19.77% |
| **1998** | 0.83 | 0.98 | -14.76% | 1.28 | 1.07 | 19.54% |
| **1999** | 0.76 | 0.93 | -17.64% | 1.50 | 1.44 | 4.73% |
| **2000** | 0.77 | 0.85 | -9.79% | 1.09 | 1.07 | 1.67% |
| **2001** | 0.78 | 0.88 | -11.45% | 1.19 | 0.98 | 22.27% |
| **Overall (p-value)** | 0.81 | 0.93 | -12.41% (<.0001) | 1.24 | 1.10 | 12.68% (<.0001) |

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