STRATEGIC INVESTMENT CHOICES AND IPO FIRM SURVIVAL

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Abstract

We empirically examine the impact of firm-level strategic investment choices on post-issue operating performance and survival of initial public offerings (IPOs). The relationship between variables associated with strategic investment choices and the probability of occurrence and timing of post-IPO failure is modeled using the Cox Proportional Hazard Model. Our results indicate that while issuing firm's investment in R&D above industry norms is negatively associated with post-issue operating performance, it is positively related to probability of survival and time to failure. Further, the extent of diversification is positively associated with post-IPO operating performance and both probability of survival and time to failure. Overall, our results indicate that investments by issuing firms in expanding the breadth of their product line and in R&D expenditures enhance the ability of IPO issuing firms to remain viable for longer periods of time, and thereby allow them time to adjust to the structural and often destabilizing changes that occur as a result of going public. Our study provides new insights on the impact of managerial investment decisions on subsequent performance of newly public firms.

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I. Introduction

In this paper, we examine the impact of strategic investment choices of initial public offering (IPO) firms on their post-issue operating performance and survival. The ability of entrepreneurial firms to raise risk capital relatively easily in the IPO market has presumably played an important role in the development of several new and emerging industries as well as the revitalization of mature industries. The extant empirical evidence, however, indicates that although initial public offerings (IPOs) often provide spectacular short-run stock return performance (usually limited to the first few days of trading), they exhibit poor long-run operating and investment performance with approximately one in every three firms either failing or being acquired within five years of the IPO (see, for example, Jain and Kini (1994), Loughran and Ritter (1995), and Jain and Kini (1999)). The poor long-term performance of IPOs raises questions regarding the effectiveness of the strategic investment choices made by IPO issuing firms and the productivity of capital raised at the IPO. Although the impact of variables related to firm and offering characteristics, ownership structure, governance mechanisms, venture capital participation, and investment bank prestige on post-IPO performance have been widely studied, the extant literature provides few insights into the impact of managerial strategic investment decisions such as extent of investments in R&D, capital expenditures, and advertising as well as the breadth of the product line on post-IPO performance and survival.

Strategic investment decisions of issuing firms have the potential to influence post-IPO outcomes in two different ways. The first is its impact on post-IPO operating and investment performance. The extent of investments in tangible and intangible assets are likely to have a

direct impact on product development, market share gains, cost structure, development of brand equity, profit margins, etc. These, in turn, influence post-IPO operating and stock based measures of performance. The second important avenue by which investment decisions affect post-IPO outcomes is through their ability to influence the occurrence and timing of post-IPO failure. In the immediate post-IPO period, survival represents one of main and basic challenge facing IPO issuing firms.

The transition from private to public ownership is often a difficult one and represents a destabilizing period in the history of the firm as it makes an attempt to adjust to various structural changes (Jain and Kini (2000)). As a consequence of going public, issuing firms undergo changes in ownership structure and governance mechanisms, are subject to increased market monitoring and pressure to meet analyst expectations, and are faced with challenges related to product market competition and technological change. In addition, issuing firms are faced with risks related to changes in capital market conditions since investor sentiment can turn against certain products or technologies, thereby making it harder for these firms to obtain additional financing to support growth and continue to operate. Since issuing firms often go public when their cash flows are negative, a slowdown in capital markets can threaten their survival. For instance, recent research on the impact of financing constraints on firm survival has generally concluded that financing constraints lower survival probabilities and result in higher exit among small firms (Cooley and Quadrini (2001), Cabral and Mata (2003)). Additionally, since IPOs represent a form of staged financing, opportunistic price cutting behavior by rivals in periods when capital markets are weak and financing constraints are high can further undermine the economic viability of IPO firms (Bolton and Scharfstein(1990), Lerner (1995)).

Therefore, an effective investment policy that can help shield issuing firms from the

various financing and product market risks faced during the post-IPO phase is likely to increase both the probability of survival and the duration between the IPO and when failure occurs. Since the risk of failure is particularly high during the early stages of the post-IPO phase, the ability of investment choices to positively influence survival time is a vital source of value added since it allows issuing firms sufficient time to adjust to the various structural changes that result from going public. The longer an issuing firm remains viable during the early post-IPO phase, the greater will be its ability to outlast periods when financing constraints are high, and the better are the odds that the firm can grow and survive in the long term. Therefore, identifying the extent to which variables associated with strategic investment choices are related to the duration of survival provides useful insights into the appropriate resource allocation decisions for issuing firms.

In this study, we address this issue by specifically examining the relationship between the extent of investment by IPO issuing firms in areas such as R&D, advertising, capital expenditures, and product scope on post-IPO operating performance and survival. This study is conducted on a large sample of 3837 firms representing a broad range of industries that went public during the period 1980-1997. The relationship between investment choice variables and post-IPO operating performance is evaluated through a cross-sectional regression analysis. In order to model the relationship between investment choices and duration between IPO and occurrence of failure, we employ hazard analysis using the Cox proportional hazard model. Hazard analysis allows us to evaluate both the likelihood of occurrence and timing of failure.

We find that issuing firm investments in R&D above industry norms are significantly negatively related with the five-year post-IPO operating performance. These results stand in contrast to studies using samples of more seasoned firms that find that R&D investments are

value enhancing in high technology environments but generally wasteful in low technology environments. Since payoffs from R&D investments are not realized immediately and the personal cost to the managers may be lower even if the R&D project is unsuccessful than with failed regular investments, these results are consistent with attempts by managers of IPO firms to entrench themselves or hide their poor ability by overinvestment through higher R&D expenditures (Holmstrom and Costa, (1986), Meulbroek et al. (1990)). An alternative explanation for this result is that the negative relationship simply reflects the fact that R&D expenditures are expensed and the positive payoffs from R&D are reflected in firm performance after the five year window over which we measure firm operating performance. Consistent with this latter interpretation, we find that the probability of survival is higher and time to failure longer for issuing firms that choose to invest in R&D above industry norms. Specifically, issuing firms that invest below industry norms in R&D are one and a half times more likely to fail in the post-IPO period compared to issuing firms that outspend their industry peers on R&D. Therefore, a conservative interpretation of our results is that investments in R&D are productive at least in the sense that they improve the odds of post-IPO survival.

Furthermore, we find that increased diversification by issuing firms as measured by the breadth of product line is positively associated with post-IPO operating performance, probability of survival, and time to failure. With the addition of each new line of business by the IPO issuing firm, the risk of failure declines by approximately 18.40%. Therefore, our results indicate that highly focused issuing firms in single product lines are more likely to experience poor post-issue operating performance and are at a higher risk of early failure. Our results of higher risk of post-IPO failure for undiversified IPO firms complement those reported by Lerner (1995) who showed that undiversified firms in the disk drive industry are the target of aggressive price

behavior from rivals during periods of tight financing, thereby undermining their ability to survive. Thus, it appears that diversification provides a safety net to IPO issuing firms against the various potential uncertainties during the pre-IPO phase in areas such as technological innovation, competitive pricing pressure, product demand, cash flows, price competition, and capital market conditions.

Finally, while we find that investments above industry norms in advertising and capital expenditures are positively associated with post-IPO operating performance, probability of survival, and time to failure, the estimated coefficients are generally insignificant. These results indicate that investments in marketing and brand building efforts or capital expenditures do not appear to translate into improved profit margins or lower the risk of early post-IPO failure. Since IPO firms typically belong to high growth industries and are usually smaller than their established counterparts, investments in brand building or efficiency measures above industry norms are not likely to be productive. Established industry players are more likely to have built up a brand advantage and achieved scale economies that newly public IPO firms are not likely to be able to match.

The remainder of the paper is organized as follows. In Section II, we provide our predictions regarding the direction of relationship between variables that measure strategic investment choices of issuing firms with post-IPO performance and survival. Section III contains a description of our sample, variable selection, and methodology. We present our results in Section IV. Section V concludes the paper.

II. Investment Decisions and Post-IPO Operating Performance and Survival

In this section, we provide predictions for the empirical tests that follow. Specifically, we

attempt to hypothesize the relation between strategic investment choices of issuing firms on post-IPO operating performance and duration of post-IPO survival. We focus on four key resource allocation decisions faced by issuing firms: breadth of product line, R&D expenditures, advertising expenses, and capital investments.

Corporate Diversification.

While a generally negative relation between corporate diversification and value-based measures has been documented in the literature (Berger and Ofek (1995), Comment and Jarrell (1995), Lang and Stulz (1994)), the evidence with accounting-based measures is less conclusive (Chatterjee and Wernerfelt (1991)). Some recent studies, however, suggest a negative relation between diversification and accounting-based performance measures. For instance, Capozza and Seguin (2001) find that project level cash flows are higher for focused firms. They, however, suggest that higher level of administrative and interest expenses may offset these gains. These studies have focused on established firms rather than entrepreneurial firms in the early stages of their growth. Since the likelihood of failure for more established firms is relatively low (Caves (1998)), the relationship between diversification and risk of failure has remained largely unexplored. However, the likelihood of failure is fundamentally different for IPO issuing firms since they are typically smaller, riskier, and faced with considerably higher levels of uncertainty with regard to industry, product market, and capital market conditions compared to more established firms. In addition, the typical entering (exiting) firms are smaller and with lower survival probabilities compared to established incumbents (Caves (1998)) and more vulnerable to aggressive pricing behavior by competitors. Therefore, the nature of the relationship between diversification and performance for IPO firms is likely to differ from that faced by more established firms.

We argue that IPO diversification provides IPO firms with a safety net against the various uncertainties faced by them as they make the transition from private to public ownership. Firms often issue IPOs in order to pursue investment opportunities that arise as a result of product or process breakthroughs in their industries. However, not only are the risks high in terms of uncertainties regarding product demand and acceptance but in many cases the viability of the firm's industries itself is often in question. In pursuing technological innovation, firms face the risk that they do not have winning technologies and may be forced out by rivals who either improve on the existing technology or develop new technology that supplants the existing technology (Maksimovic and Pichler (2001)). In a study of the disk drive industry that provided the settings for an active IPO market in the early 1980s, Christensen (1993) showed that through three revolutions of technology and waves of entry, 41 of 68 IPO firms subsequently failed. In addition, undiversified firms face the risk of aggressive price behavior by rivals during periods when capital market conditions are weak. In another study of the disk industry, Lerner (1995) showed that in periods of tight financing, competitors priced similar drives 20% lower than their undiversified rivals, while the pricing was comparable during favorable capital market conditions. Therefore, as a result of aggressive opportunistic pricing behavior by rivals, undiversified IPO firms face a higher risk of failure during periods particularly when financing is tight.

In addition to the risk of aggressive pricing behavior by rival, IPO issuing firms that go public on the basis of involvement in a single line of business or narrow product lines particularly in the high technology domain face substantially high risks of technological obsolescence, uncertain cash flows, and outright failure relative to firms that are more diversified at the time of going public. Firms often go public on the promise of profitability within a

reasonable time frame after the IPO. However, in many rapidly evolving industries and product markets, new technologies and new entrants depress profit margins and delay the ability of IPO issuing firms to turn profitable. As earnings visibility diminishes and attainment of profitability becomes uncertain, capital market sentiment can quickly turn negative against a particular technology or line of business, thereby resulting in a virtual shutdown of external financing sources for IPO firms, particularly those narrowly focused in out of favor technologies. Since IPO firms are often generating negative cash flows, unfavorable capital market conditions can result in failure. Diversified IPO firms, on the other hand, are in a better position to withstand technology, product market, or financial markets shocks since they are unlikely to simultaneously impact all product lines. Since diversification reduces variability of cash flows and risk, it allows IPO firms a longer time window to adjust to the structural changes as a result of going public and also to develop products and technology that gain acceptance. Therefore, we would expect diversification to be positively related to the probability of survival and time to failure.

The direction of relationship between diversification and post-IPO operating performance is, however, less clear cut in comparison to that between diversification and post-IPO survival. In diversified firms, profitable product lines can allocate much needed capital to negative cash flow businesses during periods when it is difficult to obtain external financing. Additionally, there may also be positive synergies between the lines of businesses of the issuing firms. Under the assumptions of efficient internal capital markets and/or synergies, we would expect a positive relationship between diversification and post-IPO operating performance. For instance, Berger and Ofek (1995) provide an exposition on how corporate diversification can influence firm value. Alternatively, it has also been argued in the literature that there may be a higher

propensity for the misallocation of capital across business segments through inefficient cross-subsidization in a diversified firm (Rajan, Servaes, and Zingales (2000), Scharfstein and Stein (2000)). Under this scenario, we would expect a negative relationship between diversification and post-IPO operating performance. Overall, the direction of the relationship between diversification and post-IPO operating performance will be determined by which of these effects dominate in young, entrepreneurial firms and, thus needs to be evaluated empirically.

Resource Allocations to R&D, Advertising, and Capital Investments.

Several researchers have provided evidence to indicate that investments in R&D, advertising, and capital expenditures contribute to future economic benefits, albeit to a different degree. For instance, researchers have reported that advertising and R&D expenditures have a positive impact on the market value of a firm (Hirschey and Weygandt (1985) and Chan, Martin, and Kensinger (1990)). In the case of capital investments, researchers have mostly reported a positive relation with stock returns. The empirical evidence provided by McConnell and Muscarella (1985) indicates that announcements of increases in planned capital expenditures are generally associated with positive excess stock returns. Subsequent studies by Blose and Shieh (1997) and Vogt (1997) report a positive relation between stock market reaction to capital investment announcements and the level of new investments. Similarly, Kanatas, Grullon, and Weston (2004) find that firms with greater advertising expenditures, ceteris paribus, lower the cost of capital by expanding the investor base and improving liquidity, thereby leading to higher valuations. While the impact of investment decisions on subsequent operating and investment performance of established firms have been well studied, relatively little is known regarding either the extent of investments in tangible and intangible assets by IPO issuing firms or the impact of these investments on subsequent performance.

It is almost taken as an article of faith that investments in R&D are vital to the long-term success and survival of organizations. This is especially true of firms belonging to high technology industries. However, there is considerable evidence to indicate that not all instances of investments in R&D generate positive outcomes. For instance, Kothari, Laguerre, and Leone (2002) find that the future economic benefits from current R&D investments are far less certain than current investments in capital expenditures. Chan, Martin, and Kensinger (1990) find that R&D expenditures by high growth firms in high technology industries are value enhancing but the reverse is true for low growth firms. Overall, while there is general consensus that, on average, R&D expenditures generate future economic benefits, there is a lack of compelling evidence of future benefits to firms in every situation (Kothari, Laguerre, and Leone (2002)).

Since IPO issuing firms, especially those that receive venture capital financing typically pursue innovation, the extent of investments in R&D is likely to be an important factor in determining the post-IPO operating performance and survival. Determining the appropriate level of investment in R&D is a complicated managerial decision and needs to be carefully evaluated to avoid problems associated either with overinvestment or underinvestment. In line with the findings of Chan, Martin and Kensinger (1990), R&D investments by IPO firms should be value enhancing since IPO issuers usually fit the profile of high growth firms in high technology industries. Further, Eberhart, Maxwell, and Siddique (2004) find evidence to indicate significant long-term abnormal operating performance following increases in R&D expenditure. Consistent with the existing literature pointing to the positive influence of R&D investments on performance, we would expect superior operating performance from high R&D issuing firms compared to low R&D firms. However, since the payoffs to R&D are usually longer term, the benefits of such investment may not show up when operating performance is measured on the

basis of a three or five year post-IPO window. Therefore, a negative relationship between high R&D expenditures and post-IPO operating performance measured over a specified post-IPO period may be as a result of either overinvestment or due to the fact that R&D investments are expensed and the time window utilized was insufficient to allow the benefits of investments in R&D to accrue.[1]

While the direction of the relationship between high R&D spending and post-IPO performance is somewhat ambiguous, the impact of R&D on likelihood of occurrence and timing of subsequent failure is easier to predict. High R&D spending improves the odds of product or process breakthroughs during the post-IPO phase which in turn maintains the interest of the investment community even if the firm has still not turned profitable. The bio-technology industry is a case in point. Since many firms are constantly on the verge of achieving breakthrough products, investors have continued to pour in capital, years after the IPO, even though in many instances no concrete products have reached the market or that that the firm has turned profitable. The continued supply of capital to high R&D issuing firms allows them to continue to operate and pursue innovative products and technologies and increases the likelihood of survival during the difficult early post-IPO phase and ultimately attaining profitability. Therefore, we would expect a positive relationship between above average investments in R&D and probability of post-IPO survival. In addition, above average investments in R&D should be associated with a longer time to failure.

Similarly, we would expect issuing firm investments in advertising and capital expenditure in excess of industry norms to be positively related to post-IPO operating performance and survival. Once again, the extant literature provides mixed results regarding the

[1.] Note that after 1985 firms in the Software industry have some discretion over their ability to expense or capitalize R&D expenditures due to the provisions in FAS 86.

benefits of investments in advertising and capital expenditures with the issue of overinvestment hanging in balance. For instance, in the case of capital investments, Titman, Wei, and Xie (2001) report a negative relation between level of capital expenditures and stock returns, and interpret this result to be consistent with the overinvestment hypothesis. Chung, Wright, and Charoenwong (1998) report that increases in capital spending positively affect stock prices for firms with valuable investment opportunities but find the opposite result for firms without such opportunities. Since above average investments in advertising and capital expenditures could either be in response to better investment opportunities or as a result of overinvestment spurred by relaxed financing constraints, their impact on post-IPO outcomes is hard to predict. We therefore, empirically examine the relationship between above average investments in advertising and capital expenditures on post-IPO operating performance and survival.

III. Sample Description, Variable Selection, and Methodology

A. Sample Description

Our initial sample consists of 6922 non-financial IPOs issued during the period 1980-1997 and identified from the Securities Data Corporation's (*SDC*) New Issues database. We end our sample at 1997 since we require five years of post-IPO operating performance data to assess long-run performance. Further, we impose the following restrictions in arriving at the final sample: (1) The offer price is at least five dollars a share and the issue raises at least 1.5 million dollars at the IPO, (2) The offerings are firm commitment, and (3) The IPO is not a spin-off, reverse LBO, unit offering, ADR, or a REIT, (4) We require that for each firm, data is available on the *Compustat* Annual and Research Tapes, and that each firm should be listed on *CRSP* immediately after the IPO. These restrictions result in a final sample of 3837 IPO firms. Table I provides a distribution of the number (percentage) of IPO issues segmented by year of IPO.

Next, we track each firm from the IPO date until the end of 2002 or until the firm is delisted, which ever is earlier. All firms that are still trading at the end of 2002 are classified as survivors. The delisted firms are separated into two groups: failed versus acquired based on the CRSP delist codes. A delisted firm is classified as a failed IPO if has a CRSP delist code greater than or equal to 300. This group includes IPO issuers who were delisted for a variety of negative reasons such as failure to meet listing standards, financial distress, liquation, insufficient capital, lack of liquidity, etc. A delisted firm is classified as acquired if its CRSP delist code is greater than 100 but less than 200. Based on the above definition, our sample of 3837 IPOs consist of 1315 survivors, 1425 acquired firms, and 1097 failed firms. The cross-sectional regression analysis examining the relationship between variables associated with strategic investment choices and post-IPO performance is conducted using the full final sample of 3837 firms. In the case of hazard analysis, firms that leave the sample as a result of being acquired before the end of tracking period are removed from the sample. Therefore, the sample for the hazard analysis consists of 2412 IPO firms that were either still trading at the end of the tracking period (survivors) or firms that were delisted prior to the tracking period for negative reasons (failed firms).

Table II provides a distribution of average five-year post-IPO operating return on assets and five-year survival rate of IPO issuing firms segmented by industry. The results are reported for all industries with at least 20 IPOs in the sample. IPOs belonging to all industries with less than 20 IPOs in the sample are classified together under the "others" category. The three industries with the largest number of IPOs in the sample are Prepackaged Software (288 firms), Pharmaceutical preparations, (110 firms), and Eating Places (100 firms). There is considerable variation in post-IPO operating performance by industry with the median five-year operating

return on assets ranging from a low of –27.53% for the In Vitro, In Vitro Diagnostics industry to a high of 19.68 for Trucking except Local industry. The five-year post-IPO survival ranges from a low of 36.11% for the Phone Communications industry to a high of 84% for the Engineering Services industry.

B. Variable Description

Operating Performance Measures. We consider two measures of operating performance. The first measure is operating return on assets (*OPRA*), which is operating income (before depreciation and taxes) divided by total assets (*Compustat* data item 13 divided by data item 6). The second measure is operating cash flow deflated by total assets (*OCFA*), which is operating income before depreciation and taxes minus capital expenditures over total assets (*Compustat* data item 13 less data item 128 divided by data item 6). We use a five-year time period to assess long-term outcomes and the performance measures are averaged over five fiscal years commencing with the year of the issue. Using average performance over five years rather than annual performance has the following two benefits: (i) it measures long-term operating performance and (ii) temporal fluctuations either due to distortions arising from accrual accounting or due to earnings management by the IPO firm are smoothed out (Christensen and Montgomery, 1981). The average is computed over the post-IPO years that data is available on Compustat. By not requiring data availability over all five post-IPO years for inclusion in our sample, we avoid inducing a survivorship bias. For purposes of brevity, the results reported in the paper are for operating return on assets. The results with operating cash flow over assets are qualitatively similar and are available from the authors upon request.

Strategic Investment Choice Variables. Consistent with Comment and Jarrell (1995), we measure extent of diversification (*DIVERSE*) by the number of four-digit SIC codes that the firm operates

in at the time of the IPO, with a larger number indicating a more diversified firm. *DUMADVA* is a dummy variable that takes on the value one if the IPO firm's advertising intensity in the pre-IPO year is above the median value for its industry, and is zero otherwise. *DUMRDA* is a dummy variable that takes on the value one if the IPO firm's R&D intensity in the pre-IPO year is above its industry median value, and is zero otherwise. Finally, *DUMCEA* is a dummy variable that takes on the value one if the firm's capital expenditure intensity is above its median industry value, and is zero otherwise.

In order to evaluate the sensitivity of our results to the choice of measures of above average investments in R&D, advertising, and capital expenditure, we re-estimate our analysis using alternative specifications. Therefore, *INDADJRDA* is the industry adjusted expenditure on R&D by issuing firm measured as the difference between R&D intensity of issuing firm minus the median R&D intensity in its industry. The variable *INDADJADVA* is the industry adjusted advertising intensity of the issuing firm and measured as the difference between firm advertising intensity and the median advertising intensity in its industry. Similarly, *INDADJCEA* is the industry adjusted capital expenditure intensity of the issuing firm and is measured as the difference between issuing firm capital expenditure intensity and the median capital expenditure intensity in its industry.

Control Variables. We include the following control variables in our multivariate analysis: IPO offer size (*LSIZE*), risk of issue (*RISK*), managerial ownership retention in the post-IPO firm (*ALPHA*), investment bank prestige (*PRESTIGE*), and venture capital participation (DVC). These variables have been identified by previous IPO studies as significant in explaining various aspects of post-IPO performance and survival (Ritter (1984, 1991), Jain and Kini (1994, 1999), Hensler, Rutherford, and Springer (1997), Carter, Dark, and Singh (1998)). Consistent with these

studies, we use the same proxies to measure the above mentioned variables. *RISK* is measured as the standard deviation of the first 30 trading days of after-market returns. *LSIZE* is measured by the *natural logarithm* of the gross proceeds raised at the IPO. We measure underwriter reputation, *PRESTIGE* by the updated Carter, Dark, and Singh (1998) nine-point reputation measure, which is based on the relative position of the investment banker on tombstone advertisements.[2] Managerial ownership retention (*ALPHA*) is measured by the fraction of the post-IPO firm retained by managers and insiders. *DVC* is a dummy variable that takes on the value one if the IPO issuing firm received venture capital financing, and is zero otherwise. In addition, we also control for differences in pre-IPO profitability of issuing firms in the hazard analysis by including the variable *ORA* which is defined as the operating return on assets of the IPO firm measured in the fiscal year prior to the IPO.

IV. Empirical Evidence

A. Summary Statistics

Table III provides descriptive statistics of variables associated with investment decisions of issuing firms as well as firm and offering characteristics. The mean (median) value of the variable *DIVERSE* is 2.31 (2.00) which indicates, on average, that IPO firms exhibit a low degree of diversification. Twenty five percent of firms in the sample go public on the basis of a single line of business. However, one in four IPO firms in the sample go public on the basis of involvement in three or more lines of business and are relatively well-diversified.

The results in Table III indicate that, on average, IPO issuing firms allocate significant

[2] The measures that we use for investment bank prestige are obtained from Jay Ritter's website at http://bear.cba.ufl.edu/ritter/rank.xls. Specifically, we use the 1980-1984 prestige ranking for the underwriter in this database if the IPO occurs during this time period, the 1985-1991 rankings if the IPO take place over this period,

resources to R&D and capital investments. For instance, the mean R&D intensity of the sample of firms is 14.86% while the mean capital expenditure intensity is 10.90%. Additionally, 39.82% of IPO issuers invest more than their industry median firms in R&D, while 59.93% of IPO issuers invest more than their industry median firms in capital expenditures. Not surprising, IPO firms, on average, are less inclined to invest in advertising. The mean advertising intensity of the sample is 2.22%, with investments in advertising representing less than 1.57% of assets for 75% of firms in the sample. Furthermore, only 23.03% of IPO firms invested more than their median industry firms in advertising.

The summary statistics related to IPO firm and offering characteristics reported in Table III are consistent with those reported in the extant IPO literature. The mean (median) proceeds raised at the IPO is $33.89 ($21.15) million while the mean (median) initial returns of the sample is 13.11% (6.25%). The mean (median) ownership retention by managers and insiders in the post-IPO firm is 67.71% (69.92%). Forty three percent of firms in the sample received venture capital financing. Further, IPO firms generally display low levels of leverage with mean (median) long-term debt-to-asset ratio of 25.17% (12.58%).

B. Cross-Sectional Regression Analysis

In this section, we estimate regression models to assess the impact of strategic investment choices of issuing firms on post-IPO performance after controlling for IPO offering and firm characteristics. The dependent variable is the average five-year post-IPO operating return on assets. The variance inflation factor (*VIF*) values are examined to detect any potential multicollinearity problems. In all models reported, the *VIF* values are always below 1.5 indicating multicollinearity is not a significant issue in our analysis.

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and the 1992-2000 rankings if the IPO occurs during this period.

The results of the regression analysis are reported in Table IV. The results of two models are reported. In the first model, above industry investments in R&D, advertising, and capital expenditures are measured by the dummy variables *DUMRDA*, *DUMADVA*, and *DUMCEA*, respectively. In the second model, alternative specifications of measures of above industry investments in R&D, advertising, and capital expenditures are included, i.e., *INDADJRDA*, *INDADJADVA*, and *INDADJCEA*, respectively. The control variables are typically significant in the expected direction in both the models. Specifically, issuing firms that are larger, less risky, with higher insider ownership, and underwritten by more prestigious investment bankers are associated with higher post-IPO operating return on assets. Venture capital participation is, however, negatively related to post-IPO operating performance.

The results in Model 1 indicate that above average industry investments in R&D by issuing firms (*DRDA*) is negatively related to post-IPO operating performance and the result is significant. In addition, the coefficient associated with *DIVERSE* is positive and significant. This result suggests that diversified IPO firms at the time of the IPO will subsequently demonstrate superior operating performance compared to their focused counterparts. However, above average industry investment in advertising by IPO issuing firms (*DADVA*) is positively but not significantly related to post-IPO performance. Finally, there is a positive and significant relationship between above average industry investment in capital expenditure (*DCEA*) and post-IPO operating performance.

In Model 2, we employ measures of above average industry investments in R&D, advertising, and capital expenditures as continuous rather than dummy variables. The results are similar to those reported in Model 1 with one exception. Once again, while the coefficient associated with *DIVERSE* is positive and significant, above average investment in R&D

INDADJRDA) is negative and significant. In addition, above average investments in advertising is unrelated to post-IPO operating performance. However, unlike Model 1, above average investments in capital expenditure (*INDADJCEA*) is not significantly related to post-IPO performance. Therefore, the relationship between above average capital expenditures and post-IPO performance is sensitive to the choice of measure.

Overall, our results provide strong evidence to indicate a relationship between issuing firm investments in R&D and breadth of product line on post-IPO operating performance. In addition, investments above industry norms in advertising or capital expenditure are generally not productive in terms of post-IPO operating performance. Our findings of a positive relationship between the extent of diversification and post-IPO operating performance are indicative of either efficiently functioning internal capital markets and/or synergies across business segments in the diversified firm. The negative relation between above average investment in R&D and post-IPO performance is indicative of overinvestment. However, as discussed earlier, the results could be as a consequence of the benefits of investment in R&D requiring a longer time to materialize and are, therefore, not reflected in profit margins. This issue is further addressed later in the paper.

C. Cox Proportional Hazard Models

Hazard analysis, often referred to as survival analysis, duration analysis, or event history analysis is a statistical technique used to study the timing and occurrence of events and has been employed in a variety of business applications such as corporate endurance, bank failure, audit applications, exit from bankruptcy, IPO survival, adoption of stock options, hiring of top executives, and employee turnover (Lane, Looney, and Wansley (1986), Bandopadhyaya (1994), Somers (1996), Hensler et al. (1999), Louwers, et al. (1999), Jain and Kini (2000), and Hellman

and Puri (2002)). The common feature among all these applications is the study of the timing of an event of interest. An event represents a change of state and the duration of time between states is referred to as failure or event time (LeClere (2000)). Hazard analysis can be used to model the probability of a change of state as function of covariates. The primary benefits of hazard analysis over regression analysis or qualitative response models lies in their ability to explicitly account for time and handle censored observations and time varying covariates (LeClere (2000), Shumway (2001)). Censoring refers to the situation where the event has not as yet occurred at the end of the observation period or the firm has left the sample for reasons other than failure prior to the end of the observation period. Therefore, the time spent by the firm or individual in the origin state is incomplete and the duration until event is known for only a portion of the sample (LeClere (2000)). The issue of censored observations is particularly relevant to an application such as post-IPO survival since at any point in time a significant proportion of firms have not yet experienced failure.

Hazard models use estimation techniques that incorporate information from both censored and uncensored observations to provide consistent parameter estimates (Allison(2000)). Furthermore, Shumway (2001) argues that hazard models are both theoretically and empirically preferable to static models and cites three main econometric reasons for preferring them to alternatives such as static models. The first reason is that static models fail to control for each firm's period at risk which is an important issue when the sampling periods are long. The second reason to prefer hazard models as pointed out earlier is their ability to incorporate time-varying covariates. Finally, the third reason to prefer hazard models is that the may produce better out of sample forecasts by utilizing much more data.

We conduct a semi-parametric analysis and estimate Cox Proportional Hazard (CPH)

models to assess the extent variables associated with strategic investment choices of issuing firms influence the timing and occurrence of post-IPO failure. The Cox regression procedure is a combination of the hazard model and the maximum partial likelihood estimation procedure (Cox (1972), Allison (2000)). The CPH model provides several advantages over other hazard models. The major attraction of the CPH model over other hazard models is that the baseline hazard function does not have to be pre-specified and can take any functional form including that of a step function (Lane, Looney, and Wansley (1986), Allison (2000)). In addition, the CPH model makes it relatively easy to incorporate time dependent variables (Allison (2000), LeClere (2000)). Additional advantages include ability to easily adjust for periods of time when an individual or firm is not at risk of an event and ability to readily accommodate both discrete and continuous measurement of event times (Allison (2000)). A detailed description of the Cox proportional hazard models is provided in Cox (1972).

The number of months from the IPO date to either the end of 2002 or failure date is computed for each IPO firm. The dependent variable is the logarithm of the hazards ratio. The hazard is defined as the risk of instantaneous failure. Since the dependent variable is the logarithm of hazard, negative coefficients indicate that failure is less likely to occur and the survival times are longer. Further, the risk ratio for each variable is computed as the exponentiated coefficient for the variable. The risk ratio measures the increase in instantaneous risk of failure for every unit increase in the value of the independent variable (Hellman and Puri(2002)). For indicator variables, the risk ratio represents the ratio of the estimated hazard for those with value 1 to the estimated hazard for those with value 0. For continuous covariates, 100 x (risk ratio-1) gives the estimated percent change in the hazard rate for each unit increase in the covariate (Allison (2000)). Risk ratios greater than 1 indicate a more rapid time to failure, while

risk ratios less than one indicate a slower time to failure and risk ratios equal to one indicate that the variable has no impact on survival time (Teachman (1983), LeClere (2000)).

The results of the estimation of Cox proportional hazard models are reported in Table V. Consistent with our earlier regression analysis, we report the results of two models using alternative specifications of measures of above industry average investments in R&D, advertising, and capital expenditures. In addition to the five control variables employed in the regression analysis, we include an additional control variable measuring pre-IPO performance in the hazard analysis. Our rationale for including pre-IPO performance as a control in the hazard analysis is related to the argument that post-IPO survival is likely to be influenced by pre-IPO profitability levels. Issuing firms that are either already profitable or close to profitability at the IPO are in a better position to withstand the turbulence during the post-IPO period and, as a result, more likely to survive. Similarly, firms that are unprofitable at the time of the IPO are in a more vulnerable position with regard to the ability to withstand product and capital market shocks, and are more likely to experience failure.

The results in Model 1 indicate that the coefficient of *DIVERSE* is negative and significant indicating that failure is less likely for diversified IPO firms and that survival time is longer. The hazard ratio for *DIVERSE* is 0.816 which indicates that for every additional line of business that an IPO issuing firm is involved in at the time of the IPO, the risk of failure is reduced by 18.40%. In addition, the results indicate that above average investments in R&D increase the probability of survival and the time to failure. The hazard ratio for *DUMRDA* is 0.699 which can be interpreted as the risk of failure of high R&D firms being 70% of the risk of failure of low R&D firms. Alternatively, the risk ratio for *DUMRDA* could be interpreted as the risk of post-IPO failure for low R&D firms is approximately 1.43 times that of high R&D issuing

firms. The results in Model 1 indicate that above average investments in advertising increase the likelihood of failure and reduce the time to failure. The risk ratio for *DUMADVA* indicates that that above industry average investments in advertising by issuing firm makes it 1.21 times more likely that these firms will fail relative to IPO firms with below industry average investments in advertising. Above industry average investments in capital expenditure are not significantly related to the likelihood of post-IPO failure or survival time. In addition, the results in Model 1 indicate that probability of failure is lower and time to survival is higher for issuing firms that raise more proceeds at the IPO, are characterized by higher insider ownership post-IPO, are marketed by more prestigious underwriters, and are more profitable at the IPO. Further, the probability of failure is higher and survival time shorter for riskier firms.

The hazard analysis results in Model 2 with alternative specifications for measures of above average investments in advertising, R&D, and capital expenditure is similar to the results in Model 1 with a few exceptions. Once again, the results indicate significantly higher probability of survival and longer survival times for diversified IPO firms and firms with above average investments in R&D. Unlike Model 1, above average investments in advertising is not significantly related to probability of survival or survival time, while above average investments in capital expenditure is significantly positively related to probability of post-IPO survival and survival time. Therefore, the relationship between investments above industry norms in advertising and capital expenditure with probability of survival and survival time is sensitive to the choice of measure of above average investments. The relationship between VC participation and probability of survival and failure time is weak with the relationship being significantly positive in Model 2 and positive but insignificant in Model 1.[3]

[3] We conduct a similar hazard analysis for firms that are acquired versus those that survive after the IPO. We find that if the firm invests above its industry median value in R&D or is more diversified then its probability of being

D. Plots of Survival Functions

In order to assess the impact of investments in R&D and breadth of product line on the probability of survival over time, we construct survival functions for high versus low R&D firms, and diversified versus focused IPO firms. The survival plots are shown in Figures 1 and 2. The survival functions indicate the likelihood that a randomly selected firm will survive longer than a specified period of time.

In Figure 1, the survival functions of high and low R&D IPO firms is shown. Consistent with the hazard analysis, the survival function of the high R&D firms is consistently above that of low R&D firms across time and the test of significance of difference in the survival functions of the two groups is significant. The survival function indicates that the likelihood that a high R&D firm will survive longer than 36 months after the IPO is 90.76% compared to 87.71% for low R&D firms. Therefore, high R&D firms have a 3% higher probability of surviving at least three years after the IPO compared to low R&D firms. Similarly, Figure 1 indicates that the likelihood that a high R&D firm will survive at least 72 months after the IPO is 76.58% compared to 66.68% for the low R&D firms. As such, high R&D firms have a 9.9% higher probability of surviving more than 6 years after the IPO compared to low R&D firms. Therefore, the beneficial influence of R&D on probability of survival increases as the IPO firms become more seasoned.

Figure 2 provides similar insights regarding survival probabilities for diversified (*DFOCUS* = 0) versus focused (*DFOCUS* =1) IPO firms. Thus, *DFOCUS* is defined as a dummy variable that takes on the value of one if the firm operates in only one four-digit SIC code, and is zero otherwise. The survival function for the diversified group is consistently higher than the focused group and the likelihood test of difference in significance of survival functions between the two

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acquired is lower and time to acquisition is longer. On the other hand, larger IPO proceeds and venture capitalist backing makes the probability of acquisition greater and time to acquisition shorter.

groups is significant. Figure 2 indicates that a diversified IPO firm has a 91.49 percent probability of surviving at least three years after the IPO compared to 83.28 % for a focused firm. Therefore, diversified firms have an 8.21 percent higher probability of surviving at least 3 years after the IPO. Similarly, diversified firms have a 75.95% probability of surviving at least six years after the IPO compared to 59.17% for a focused firm. As such, diversified firms have a 16.78% higher probability of surviving at least six years after the IPO compared to focused firms.

V. Discussion and Conclusions

This study examines the impact of strategic investment decisions of issuing firms on their post-IPO operating performance and survival after controlling for IPO firm and offering characteristics. We argue that investment choices of IPO firms have the potential to influence operating performance as well as timing and occurrence of post-IPO failure. Since survival represents a major challenge for IPO issuing firms particularly during the early post-IPO years, managerial actions that extend the post-IPO survival time provide significant value added. We focus on the impact of investment choices in areas such as breadth of product line, and extent of investments in tangible and intangible assets such as R&D, advertising, and capital investments.

Our results indicate that diversified IPO issuing firms provide superior post-IPO operating performance and also have a higher probability of survival and longer time to failure. We find that each additional line of business pursued by issuing firms at the time of IPO lowers the risk of subsequent failure by 18.40%. We, however, find a differential impact of above industry average investments in R&D on post-IPO operating performance and survival. While above industry average investments in R&D is negatively related to post-IPO operating performance, it is positively related to probability of survival and time to failure. Taken by itself,

the negative relationship between above average investment in R&D and post-IPO performance is suggestive of overinvestment by IPO firms. However, as generally recognized in the literature the payoffs from R&D investments are unlikely to be immediately realized and have a long gestation period. Our results of a positive relationship between high R&D investments by IPO issuing firms and probability of post-IPO survival and survival time provides evidence to support arguments in favor of R&D investments and are consistent with the notion that R&D investments are productive. Further, the ability of high R&D investments to lower the risk of failure and extend survival time is an important contribution to the IPO market since the risk of failure is particularly high during the early post-IPO phase. By increasing the ability of firms to be viable for a longer period of time after the IPO provides an opportunity for issuing firms to adjust to the structural changes that occur as a result of going public as well as to be able to raise external financing to fund their growth prospects.

We, however, find no consistent evidence to indicate that above average investments in advertising and capital expenditure has a significant positive influence either on post-IPO operating performance or survival. The relationship between variables measuring IPO firm and offering characteristics and post-IPO operating performance and survival documented in this study are generally consistent with the extensive IPO literature.

Overall, our study adds to the understanding of the impact of investment decisions by IPO issuing firms on their subsequent performance and survival. Our results indicate that managers of issuing firms need to carefully evaluate their resource allocation decisions to avoid problems associated with overinvestment. While investments in expanding product lines and R&D efforts are productive, high levels of investments in advertising or capital expenditure do not produce payoffs either in terms of operating performance or increasing the likelihood of post-

IPO survival. Our study has important policy implications for the strategic investment choices to be pursued by managers of newly public firms.

References

Allison, P.D., 2000, "Survival Analysis Using the SAS System: A Practical Guide", SAS Institute Publishing.

Bandopadhyaya, A., 1994, "An Estimation of the Hazard Rate of Firms Under Chapter 11 Protection", *Review of Economics and Statistics* 76, 346-350

Berger, P.G., and E. Ofek, 1995, "Diversification's Effect on Firm Value," *Journal of Financial Economics* 37, 39-65.

Blose, L.E., and J.C.P Shieh, 1997, "Tobin's Q and Market Reaction to Capital Investment Announcements," *Financial Review* 32, 449-476.

Bolton, P and D. Scharfstein, 1990, "A Theory of Predation Based on Agency Problem in Financial Contracting," *American Economic Review* 80, 93-106.

Cabral, L., and J. Mata, 2003, "On the Evolution of the Firm Size Distribution: Facts and Theory," *American Economic Review* 93, 1075-1090.

Capozza, D.R., and P.J. Seguin, 2001, "Why Focus Matters?" University of Michigan Working Paper.

Carter, R. B., F.H. Dark, and A.K. Singh, 1998, "Underwriter Reputation, Initial Returns, and the Long-run Performance of IPO Stocks," *Journal of Finance* 53, 285-311.

Caves, R., 1998, "Industrial Organization and New Findings on the Turnover and Mobility of Firms", *Journal of Economic Literature* 36, 1947-1982.

Chan, S.H., J.D. Martin, and J.W. Kensinger, 1990, "Corporate Research and Development Expenditures and Share Value, *Journal of Financial Economics* 26, 255-276.

Chatterjee, S., and B. Wernerfelt, 1991, "The Link between Resources and Type of Diversification: Theory and Evidence," *Strategic Management Journal* 12, 33-48.

Chung, K.H., P. Wright, and C. Charoenwong, 1998, "Investment Opportunities and Market Reaction to Capital Expenditure Decisions," *Journal of Banking and Finance* 22, 41-60.

Cooley, T., and V. Quadrini, 2001, "Financial Markets and Firm Dynamics", *American Economic Review* 91, 1286-1310.

Christensen, C.M., 1993, "The Rigid Disk Drive Industry: A History of Commercial and Technological Turbulence", *Business History Review* 67, 531-588.

Christensen, H.K., and C.A. Montgomery, 1981, "Corporate Economic Performance: Diversification Strategy Versus Market Structure," *Strategic Management Journal* 2, 327-343.

Comment, R., and G.A. Jarrell, 1995, "Corporate Focus and Stock Returns," *Journal of Financial Economics* 37, 67-87.

Cox, D.R., 1972, "Regression Models and Life Tables", *Journal of the Royal Statistical Society*, B34, 187-220.

Eberhart, A.C., W.F. Maxwell, and A.R. Siddique, 2004, "An Examination of Long-Term Abnormal Stock Returns and Operating Performance Following R&D Increases," *Journal of Finance* (Forthcoming).

Hellman, T., and Puri, M., 2002, "Venture Capital and the Professionalization of Start-Up Firms: Empirical Evidence", *Journal of Finance* 57, 169-197.

Hensler, D.A., Rutherford, R.C., and Springer, T.M., 1997, The Survival of Initial Public Offerings in the Aftermarket", *Advances in Quantitative Analysis of Finance and Accounting* 4, 77-103.

Hirschey, M., and J. Weygandt, 1985, "Amortization Policy for Advertising and Research and Development Expenditures," *Journal of Accounting Research* 23, 326-385.

Holmstrom, B., and R. Costa, 1986, "Managerial Incentives and Capital Management," *Quarterly Journal of Economics* 101, 835-860.

Jain, B. A., and O. Kini, 1994, "The Post-issue Operating Performance of IPO Firms," *Journal of Finance* 49, 1699-1726.

_____, 1999, "On Investment Bank Monitoring in the New Issues Market," *Journal of Banking and Finance* 23, 49-84.

_____, 2000, "Does the Presence of Venture Capitalists Improve the Survival Profile of IPO Firms?" *Journal of Business Finance and Accounting* 9 & 10, 1139-1176.

Kanatas, G., G. Grullon, and J. Weston, 2004, "Advertising, Breadth of Ownership, and Liquidity", *Review of Financial Studies* (Forthcoming).

Kothari, S.P., T.E. Laguerre, and A.J. Leone, 2002, "Capitalization versus Expensing: Evidence on the Uncertainty of Future Earnings from Current R&D Investments," *Review of Accounting Studies* 7, 355-382.

Lane, W.R., S.W. Looney, and J.W. Wansley, 1986, "An Application of the Cox Proportional Hazards Model to Bank Failure," *Journal of Banking and Finance* 10, 511-531.

Lang, L.H., and R.M. Stulz, 1994, "Tobin's Q, Corporate Diversification, and Firm Performance," *Journal of Political Economy* 102, 1248-1280.

Lerner, J., 1995, "Pricing and Financial Resources: An Analysis of the Disk Drive Industry, 1980-88", *Review of Economics and Statistics* 77, 585-598.

LeClere, M.J., 2000, "The Occurrence and Timing of Events: Survival Analysis Applied to a Study of Financial Distress," *Journal of Accounting Literature* 19, 158-189.

Loughran, T., and J.R. Ritter, 1995, "The New Issues Puzzle," *Journal of Finance* 50, 23-52.

Louwers, T.J., F.M. Messina, and M.D. Richard, 1999, "The Auditor's Going Concern Disclosure as a Self-Fulfilling Prophecy: A Discrete Time Survival Analysis," *Decision Sciences* 30, 805-824.

Maksimovic, V., and P. Pichler, 2001, "Technological Innovation and Initial Public Offerings", *Review of Financial Studies* 14, 459-494

McConnell, J.J., and C.J. Muscarella, 1985, "Corporate Capital Expenditure Decisions and the Market Value of the Firm," *Journal of Financial Economics* 14, 399-422.

Meulbroek, L., M. Mitchell, J.H. Mulherin, J. Netter, and A.B. Poulsen, 1990, "Shark Repellents and Managerial Myopia: An Empirical Test," *Journal of Political Economy* 98, 1108-1117.

Rajan, R., H. Servaes, and L. Zingales, 2000, "The Cost of Diversity: The Diversification Discount and Inefficient Investment," *Journal of Finance* 55, 35-80.

Ritter, J. R., 1984, "The Hot Issue Market of 1980," *Journal of Business* 57, 215-241.

_____ , 1991, "The Long-run Performance of Initial Public Offerings," *Journal of Finance* 46, 3-27.

Scharfstein, D.S. and J.C. Stein, 2000, "The Dark Side of Internal Capital Markets: Divisional Rent-Seeking and Inefficient Investment, *Journal of Finance* 55, 2537-2564.

Shumway, T., (2001), "Forecasting Bankruptcy More Accurately: A Simple Hazard Model," *Journal of Business* 74, 101-124.

Somers, M., 1996, "Modeling Employee Withdrawal Behavior Over Time: A Study of Turnover Using Survival Analysis," *Journal of Occupational and Organizational Psychology* 69, 315-323.

Titman, S., K.C.J. Wei, and F. Xie, 2001, "Capital Investments and Stock Returns," University of Texas Working Paper.

Vogt, S.C., 1997, "Cash Flow and Capital Spending: Evidence from Capital Expenditure Announcement," *Financial Management* 26, 44-57.

Table I. Frequency Distribution of IPO Sample by Year for the Sample Period 1980-1997
The sample consists of 3837 IPO issuing firms that went public during the 1980-1997 period. The sample excludes best efforts offerings, unit offerings, spin-offs, reverse LBOs, ADRs and REITs. In addition, we require that for each firm data is available on Compustat Annual and Research Tapes and that that firm is listed on CRSP immediately after the IPO.

Year	Frequency (Percentage)
1980	55 (1.43)
1981	153 (3.99)
1982	59 (1.54)
1983	326 (8.50)
1984	136 (3.54)
1985	104 (2.71)
1986	255 (6.65)
1987	183 (4.77)
1988	75 (1.95)
1989	87 (2.27)
1990	69 (1.80)
1991	179 (4.67)
1992	236 (6.15)
1993	351 (9.15)
1994	299 (7.79)
1995	373 (9.72)
1996	553 (14.41)
1997	344 (8.97)
Total	3837 (100.00)

Table II. Industry Distribution and Post-IPO Operating Performance by Industry of Sample of IPO Issuing Firms.

The table presents the distribution by industry for all those industries with at least 20 IPOs over the sample period. The overall sample consists of 3,837 IPOs between the years 1980-1997. The five-year post-IPO operating return on assets (*OPRA*) is the average of operating income before depreciation and taxes divided by total assets over the five fiscal years including the year of the IPO.

SIC Code	Industry Name	# of IPOs in Sample	% of IPOs in Sample	Mean *OPRA* (%)	% Survive five-years
1311	Crude Petroleum & Natural Gas	45	1.17%	7.46%	55.56%
2834	Pharmaceutical Preparations	110	2.87%	-26.08%	80.00%
2835	In Vitro, In Vivo, Diagnostics	30	0.78%	-27.53%	76.67%
2836	Biological Pds., Except Diagnostics	44	1.15%	-26.77%	65.91%
3571	Electronic Computers	70	1.82%	-1.13%	68.57%
3572	Computer Storage Devices	37	0.96%	3.70%	75.68%
3577	Computer Peripheral Equipment	80	2.08%	5.45%	72.50%
3661	Telephone & Telegraph Apparatus	64	1.67%	4.24%	79.69%
3663	Radio, TV Broadcast, Communications	43	1.12%	1.06%	76.74%
3669	Communications Equipment	33	0.86%	4.52%	72.73%
3672	Printed Circuit Boards	20	0.52%	10.06%	65.00%
3674	Semiconductor, Related Devices	96	2.50%	7.36%	82.29%
3679	Electronic Components	40	1.04%	11.80%	70.00%
3841	Surgical, Medical Instruments, Apparatus	87	2.27%	-20.70%	67.82%
3842	Ortho., Prosth., Surgical Apparatus	30	0.78%	-3.69%	70.00%
3845	Electromedical Apparatus	56	1.46%	-20.13%	69.64%
4213	Trucking Except Local	38	0.99%	19.68%	73.68%
4512	Air Transport, Scheduled	28	0.73%	4.67%	53.57%
4812	Radiotelephone Communications	37	0.96%	-3.86%	48.65%
4813	Phone Communications Except Radiotelephone	36	0.94%	1.57%	36.11%
4841	Cable & Other Pay TV Services	20	0.52%	-1.80%	55.00%
4953	Refuse Systems	36	0.94%	6.74%	66.67%
5045	Computers & Software – Wholesale	40	1.04%	0.26%	67.50%
5812	Eating Places	100	2.61%	7.74%	54.00%
5961	Catalog, Mail-Order Houses	24	0.63%	12.45%	83.33%
7011	Hotels & Motels	34	0.89%	9.15%	55.88%
7359	Equipment Rental & Leasing	21	0.55%	18.03%	76.19%
7371	Computer Programming Service	65	1.69%	4.33%	52.31%
7372	Prepackaged Software	288	7.51%	0.18%	62.15%
7373	Comp. Integrated Systems Design	97	2.53%	-0.58%	59.79%
7374	Comp. Processing, Data Prep. Services	30	0.78%	11.68%	63.33%
7375	Information Retrieval Services	37	0.96%	-7.30%	59.46%
7389	Business Services	44	1.15%	6.62%	54.55%
7812	Motion Picture, Videotape Production	28	0.73%	6.10%	64.29%
8011	Offices of Medical Doctors	42	1.09%	1.70%	42.86%
8099	Health & Allied Services	30	0.78%	0.73%	53.33%
8711	Engineering Services	25	0.65%	8.91%	84.00%
8731	Coml. Physical, Biological Research	70	1.82%	-22.59%	74.29%
Other		1,782	46.44%	7.18%	66.22%
Total		3,837	100.00%	2.58%	65.99%

Table III. IPO Firm Investment Strategies and their Firm and Offering Characteristics

ORA is the pre-issue operating income before depreciation and taxes divided by total assets over the five fiscal years after the IPO. *FOCUS* is the number of four-digit SIC codes that the IPO firm operates in. *ADVA* (*RDA*) is a dummy variable that takes on the value 1 if the firm advertising (R&D) intensity is above the industry average, and is 0 otherwise. *CEA* is the capital expenditure intensity for the IPO firm. The variable *OP* is the offer price. The variable *SIZE* represents the gross proceeds raised by the issuing firm at the IPO. *ALPHA* represents the managerial ownership retention in the post-IPO firm. Initial returns are measured as the difference in the closing price at the end of the first day of trading and the IPO offer price divided by the IPO price measured as a percentage. The *RISK* is measured as the standard deviation of the first 30 days of aftermarket returns. *PRESTIGE* measures the reputation of the investment banker using the updated Carter, Dark, and Singh (1998) nine-point reputation scale (see http://bear.cba.ufl.edu/ritter/Rank.htm). *DVC* is a dummy variable that takes on the value 1 if the issuing firm received venture capital backing, and is 0 otherwise. *TDR* represents the total debt ratio and is measured as the ratio of the total debt divided by assets in the fiscal year prior to the IPO. *LTDR* is measured as the ratio of long term debt divided by total assets in the fiscal year prior to the IPO. *AT* represents the asset turnover and is measured as the ratio of the total assets divided by sales in the fiscal year prior to the IPO.

Variable	Mean	Median	Quartile 1	Quartile 3
Operating Return on Assets (*ORA*) (%)	6.05	15.66	1.60	25.98
Number of SIC Codes (*DIVERSE*)	2.31	2.00	1.00	3.00
R&D Intensity (*RDA*) (%)	14.86	0.00	0.00	17.04
R&D Intensity Above Industry Norm (*DRDA*) (%)	39.82	0.00	0.00	100.00
Advertising Intensity (*ADVA*) (%)	2.22	0.00	0.00	1.57
Advertising Intensity Above Industry Norm (*DADVA*) (%)	23.03	0.00	0.00	0.00
Capital Expenditure Intensity (*CEA*) (%)	10.90	6.63	3.11	13.16
Capital Expenditure Intensity Above Industry Norm (*DCEA*) (%)	59.93	100.00	0.00	100.00
Offer Price (*OP*) ($)	11.37	11.00	8.00	14.00
Gross Proceeds (*SIZE*) ($ m.)	33.89	21.15	10.40	37.40
Alpha (*ALPHA*) (%)	67.71	69.92	51.54	76.16
Initial Returns (*IR*) (%)	13.11	6.25	0.66	19.34
Risk (*RISK*) (%)	3.58	3.35	2.52	4.33
Investment Bank Prestige (*PRESTIGE*)	6.88	8.10	5.38	8.75
Venture Capital Participation (*DVC*)	0.43	0.00	0.00	1.00
Long-Term Debt Ratio (*LTDR*) (%)	25.17	12.58	1.72	35.75
Asset Turnover (*AT*)	1.61	1.46	0.77	2.14

Table IV. Cross-sectional Determinants of Post-IPO Operating Performance

This table presents cross-sectional regressions with operating performance (*OPRA*) as the dependent variable for a sample of 3,837 IPO firms over 1980-1997. *OPRA* is the average of operating income before depreciation and taxes divided by total assets over the five fiscal years after the IPO. The dependent variable is winsorized at its 5th and 95th percentile values. *DIVERSE* is the number of four-digit SIC codes that the IPO firm operates in. *DUMRDA* is a dummy variable that takes on the value 1 if the firm R&D intensity is above the industry average, and is 0 otherwise. *DUMADVA* is a dummy variable that takes on the value 1 if the firm advertising intensity is above the industry average, and is 0 otherwise. *DUMCEA* is a dummy variable that takes on the value 1 if the firm capital expenditure intensity is above the industry average, and is 0 otherwise. *INDADJRDA*, *INDADJADVA*, *INDADJCEA* measure the firm R&D intensity, advertising intensity, capital expenditure intensity relative to the median values for their industry, respectively. *ALPHA* is the proportion of equity retained by the original entrepreneurs. *PRESTIGE* is the updated Carter, Dark, and Singh (1998) measure of underwriter reputation (see http://bear.cba.ufl.edu/ritter/Rank.htm). *SIZE* is the natural logarithm of the offering amount. *RISK* is the standard deviation of after-market returns. *DVC* is a dummy variable that takes on the value 1 if the firm has venture capitalist backing, and is 0 otherwise. Values in parentheses represent t-statistics.

Variables	Model 1	Model 2
Intercept	-0.242[a]	-0.206[a]
	(-13.30)	(-10.10)
Firm Investment Strategy Variables		
DIVERSE	0.008[a]	0.007[a]
	(4.55)	(3.41)
DUMRDA	-0.051[a]	
	(-7.61)	
INDADJRDA		-0.155[a]
		(-16.52)
DUMADVA	0.003	
	(0.42)	
INDADJADVA		-0.032
		(-0.97)
DUMCEA	0.017[a]	
	(2.95)	
INDADJCEA		-0.017
		(-0.65)
Control Variables		
LSIZE	0.014[a]	0.013[a]
	(3.61)	(2.81)
RISK	-1.404[a]	-1.177[a]
	(-7.93)	(-5.86)
ALPHA	0.001[a]	0.001[a]
	(4.86)	(3.43)
PRESTIGE	0.021[a]	0.019[a]
	(11.78)	(9.34)
DVC	-0.021[a]	-0.109[a]
	(-3.33)	(2.76)
Adj. R-Square (%)	14.75	20.43
F-value	73.89[a]	79.44[a]

[a] Significant at the 1% level
[b] Significant at the 5% level
[c] Significant at the 10% level

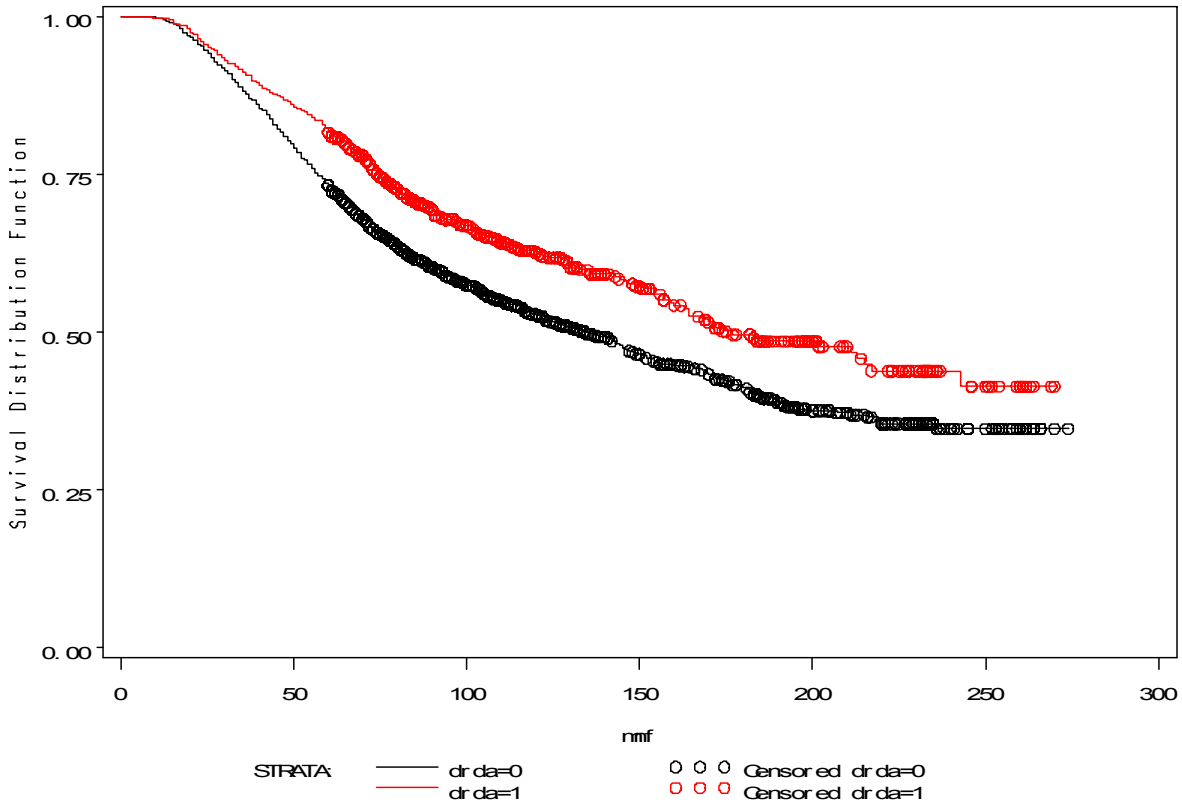
Table V. Estimation of Cox Proportional Hazard Models of Probability of Failure and Time-to-Failure

Cox Proportional Hazard models are estimated using a sample of 3,837 IPO issuers over the period January 1980 through December 1997. The time-to-failure is measured as the number of months elapsed between the IPO month and the month in which the firm is delisted from CRSP for reasons other than an acquisition (CRSP delist code of 300 or higher). The results for each model include the estimated coefficient of each independent variable and the associated p-values in parenthesis in the first column and the hazard ratio in the second column. *DIVERSE* is the number of four-digit SIC codes that the IPO firm operates in. *DUMRDA* is a dummy variable that takes on the value 1 if the firm R&D intensity is above the industry average, and is 0 otherwise. *DUMADVA* is a dummy variable that takes on the value 1 if the firm advertising intensity is above the industry average, and is 0 otherwise. *DUMCEA* is a dummy variable that takes on the value 1 if the firm capital expenditure intensity is above the industry average, and is 0 otherwise. *INDADJRDA*, *INDADJADVA*, *INDADJCEA* measure the firm R&D intensity, advertising intensity, capital expenditure intensity relative to the median values for their industry, respectively. *ALPHA* is the proportion of equity retained by the original entrepreneurs. *PRESTIGE* is the updated Carter, Dark, and Singh (1998) measure of underwriter reputation (see http://bear.cba.ufl.edu/ritter/Rank.htm). *SIZE* is the natural logarithm of the offering amount. *RISK* is the standard deviation of after-market returns. *DVC* is a dummy variable that takes on the value 1 if the firm has venture capitalist backing, and is 0 otherwise. *ORA* is the average of operating income before depreciation and taxes divided by total assets in the fiscal year prior to the IPO.

Variables	Model 1		Model 2	
	Coefficient	Hazard Ratio	Coefficient	Hazard Ratio
Firm Investment Strategy Variables				
DIVERSE	-0.204[a]	0.816	-0.203[a]	0.816
	(0.00)		(0.00)	
DUMRDA	-0.402[a]	0.669		
	(0.00)			
INDADJRDA			-0.403[a]	0.668
			(0.00)	
DUMADVA	0.201[b]	1.222		
	(0.01)			
INDADJADVA			-0.007	0.993
			(0.98)	
DUMCEA	-0.111	0.895		
	(0.11)			
INDADJCEA			0.394[c]	1.484
			(0.09)	
Control Variables				
LSIZE	-0.099[c]	0.906	-0.088[c]	0.916
	(0.05)		(0.08)	
RISK	7.056[a]	1159.956	5.861[a]	351.223
	(0.00)		(0.00)	
ALPHA	-0.005[b]	0.995	-0.006[a]	0.994
	(0.04)		(0.01)	
PRESTIGE	-0.104[a]	0.902	-0.106[a]	0.899
	(0.00)		(0.00)	
DVC	-0.080	0.923	-0.163[b]	0.849
	(0.32)		(0.03)	
ORA	-0.275[a]	0.760	-0.348[a]	0.706
	(0.00)		(0.00)	
Overall $\chi 2$	302.15		283.19	

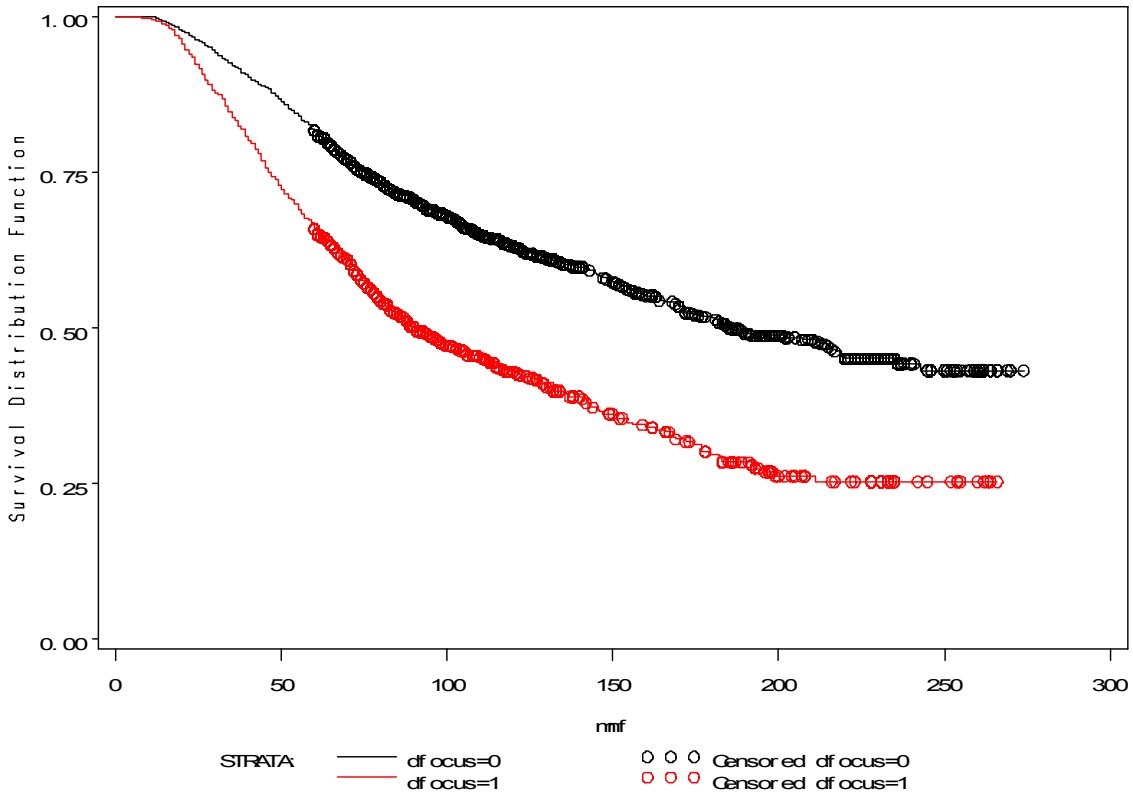
[a] Significant at the 1% level
[b] Significant at the 5% level
[c] Significant at the 10% level

FIGURE 1. SURVIVAL DISTRIBUTION FUNCTION STRATIFIED BY WHETHER THE R&D INTENSITY LEVEL IS ABOVE OR BELOW THE MEDIAN VALUE FOR ITS INDUSTRY



NOTES. The variable "nmf" represents the number of months from the IPO month to the month the firm fails. A value of DRDA = 1 implies that the R&D intensity is above the median R&D intensity for the industry. On the other hand, if DRDA = 0, the R&D intensity is equal to or below the median R&D intensity for the industry.

FIGURE 2. SURVIVAL DISTRIBUTION FUNCTION STRATIFIED BY WHETHER THE FIRM IS DIVERSIFIED OR NOT



NOTES. The variable "nmf" represents the number of months from the IPO month to the month the firm fails. A value of DFOCUS = 1 implies that the IPO firm only operates in one four-digit SIC code and we classify it as a focused firm. On the other hand, if DFOCUS = 0 then the IPO firm operates in more than one four-digit SIC code and we call it a diversified firm.