Public Market Staging:
The Timing of Capital Infusions in Newly Public Firms*

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Abstract

We examine the financing activities of newly public firms for evidence on the staging of capital in the public equity market. Staging, or sequential financing, can increase issuance costs, but can also control the overinvestment problem that might arise when funds are provided to firms for which there is uncertainty about the value of future investment opportunities. We find that the amount of capital raised at the Initial Public Offering (IPO), relative to the level of recent investment expenditures, is smaller for firms with more intangible assets and more R&D intensive firms. We also find that the time from a firm's IPO to its first post-IPO capital infusion decreases with the ratio of intangible to total assets and R&D intensity. This evidence is consistent with the hypothesis that staging helps control the overinvestment problem in public firms and adds to our understanding of the optimal level of cash holdings and the timing of capital raising activities.

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I. Introduction

The extent to which managers of a firm should have access to cash beyond that needed to fund current operating and investment requirements, or excess cash, is an important question in finance. A large empirical literature addresses this question by examining the cross-sectional determinants of the level of cash holdings in firms. This literature is motivated by theoretical arguments suggesting that firms can benefit from holding precautionary cash balances to protect against underinvestment or possible default on debt obligations that can arise due to adverse cash flow shocks or capital market conditions that make it difficult to raise capital. Alternatively, agency theory arguments suggest that holding excess cash can lead to wasteful overinvestment that is detrimental to stockholders. Although not uniformly in agreement, evidence from empirical studies suggests that both precautionary motives and agency concerns affect the level of cash holdings at firms.

A related literature focuses on how firms manage their cash balances. One line of inquiry examines how dividend and capital structure policies can be used to limit the ability of managers to use excess cash in ways that destroy stockholder value (see, for example, Easterbrook, 1984 and Jensen, 1986). In effect, these studies consider how disbursements in the form of dividends or interest payments can be used to manage cash levels. While it provides useful insights, this literature does not consider how cash balances are affected by capital infusions. There has been little research on how the trade-

off between the need for precautionary balances and agency concerns affects the capital raising activity of public firms. We investigate these issues in this study.

Researchers have examined the use of staging, the provision of capital through a series of investments which are conditional on performance, by venture capitalists (Gompers, 1995). Venture capitalists stage capital infusions for young, high growth, private firms which have severe information asymmetries and/or uncertainty about their future investment prospects. Since the potential for agency costs of overinvestment are high in such firms, providing capital in stages helps to control these costs by limiting the amount of capital that managers (entrepreneurs) might use for overinvestment if anticipated growth opportunities do not materialize.

Staging can also be used to control agency costs in public firms.[1] For example, it can help control the overinvestment problem in high-growth public firms just as it does in the young private firms that raise venture capital. By limiting the amount of capital they can raise at one time, staging can also limit the ability of managers of mature public firms to use fundraising activities to reduce the effectiveness of dividend and capital structure policies that are designed to control free cash flow problems and force these managers to periodically submit to the discipline of the capital markets (Easterbrook, 1984; Jensen, 1986).[2]

[1] Public equity market staging can be viewed more broadly as capital "rationing" in the traditional framework of supply and demand for capital. In principle, suppliers of IPO funds recognize the potential for agency problems and the costs associated with these problems are built into the supply curve of funds that a particular firm faces. Rationing occurs because suppliers put a ceiling on how much of this risk they are willing to accept and, more importantly, because the provision of funds endogenously raises the risk of this agency problem. Thus, for example, an entrepreneur with uncertain prospects who would be willing to pay more for funds for the option of continuing a failed mission in the future is effectively screened from this activity. See Stiglitz and Weiss (1981).

[2] In fact, recent evidence suggests that managers of public firms might be gaining access to excess cash through their financing activities. Kim and Weisbach (2008) show that, four years after an IPO (SEO), issuing firms still hold an average of 39 percent (32 percent) of the IPO (SEO) proceeds in cash. More

We investigate staging in the public capital markets by examining the relations between firm attributes and the quantity of funds that firms raise in their IPOs. We do this in two ways. We first examine relations between firm attributes and the total amount of capital that firms raise in their IPOs, measured relative to their capital requirements in the year prior to the IPO, for evidence of a relation between the severity of potential agency costs and the amount of capital raised in an IPO. We then examine relations between firm attributes and the length of time between a firm's IPO and its first post-IPO financing. If there is staging in the public equity markets, we would expect to observe that the time to follow-on financings is systematically shorter for firms where agency costs of overinvestment are likely to be especially severe.

We focus on newly public firms for several reasons. First, they are more likely to be candidates for staging than other public firms because there is less public information about them and there is greater uncertainty about their future investment prospects. Second, focusing on IPOs provides a common starting point. Using later rounds of financing would result in a number of methodological challenges associated with not having a common frame of reference across firms. Finally, other studies document considerable cross-sectional variation in the length of time before newly public firms obtain additional funding (see, for example, Helwege and Liang, 1996; and Jegadeesh, Weinstein, and Welch, 1993). Our focus on newly public firms should facilitate informative tests for all of these reasons.

Evidence from a sample of 4,054 firms that completed an IPO from 1990 through

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recently, McLean (2009) finds that during the 1970s, 23 percent of the funds raised through equity issues remain in corporate cash balances. Over the last decade, the corresponding ratio was 60 percent. These studies suggest that capital structure and dividend policies might not be sufficient to control managerial access to excess cash.

2005 indicates that staging of capital, similar to that observed for venture capital financings, is present in the public equity market. Firms with more intangible assets prior to their IPO and firms that invest more heavily in research and development (R&D) activities raise less money at their IPO and raise additional capital sooner after their IPO. This evidence is consistent with the public equity market placing greater limits on the availability of capital to managers of firms that are more subject to agency problems associated with excess cash. We also find evidence suggesting that firms which delist within two years of their IPO tend to be firms that were subject to staging at the time of the IPO, but that did not have sufficient prospects to merit a second round of public financing.

To obtain direct evidence on the extent to which concerns about staging are important contributors to decisions about funding at the time of the IPO, we examine the discussion and analysis sections of IPO prospectuses for a subsample of our firms. This examination reveals that the majority of firms acknowledge that the funds raised at the time of the IPO will be insufficient to fund their expected future investments and that a return to the capital markets is anticipated. Of the firms acknowledging the need to return to the capital markets, the median expected time before additional financing is needed is 12 months.

Overall, our study suggests that important determinants of the time to first post-IPO capital infusions are known at the time of the IPO. The public markets appear to use this information to price capital so as to limit managerial access to cash where agency problems with excess cash are likely to be most severe. These results have important implications for our understanding of the effectiveness of the various mechanisms for

controlling these problems as well as providing insights for the broader literatures on the level and management of cash balances. Our results also have significant implications for the literature that examines how post-IPO firm and market conditions affect the timing of subsequent capital infusions.

The remainder of the paper is organized as follows. Section II discusses staging, the agency costs of cash, and the timing of capital infusions to firms. Section III describes our sample and Section IV presents our findings. Section V concludes.

II. Cash Holdings, Staging, and the Timing of Capital Infusions

Firms can manage cash levels using capital structure and dividend policies that affect *cash disbursements* and through capital raising activities that result in *cash infusions*. This paper focuses on cash infusions by considering the extent to which the amount of external capital raised in an IPO should fund future operating and investment requirements of the firm. Our analysis builds upon two strands of literature. First, we add to the literature on the staging of capital infusions by providing evidence on how concerns regarding managerial access to cash affect decisions about the size of equity infusions to public firms. Second, since firm characteristics that have been associated with greater precautionary balances (e.g., R&D intensity) are also positively related to the potential for agency problems, we add to the literature on the determinants of precautionary cash balances. In this section, we develop our analytical framework by discussing the relevant earlier work, beginning with the literature on cash holdings.

A. Cash Holdings

A broad literature examines the relation between excess cash and firm value.

Some of the firm characteristics that affect the value implications of cash holdings are the same characteristics that affect the likelihood of staging. This relation between the literatures on cash holdings and staging makes it important that our study consider staging in the context of previous work on cash holdings.

There is considerable evidence that providing managers with access to excess cash can be detrimental for stockholders. For example, Faulkender and Wang (2006) estimate that the unconditional marginal value of an extra dollar held as cash is about 94 cents and decreases as the cash balance increases. Dittmar and Mahrt-Smith (2007) estimate that a dollar held in cash is worth more than a dollar in a well governed firm, but is worth only between 42 and 88 cents in a poorly governed firm. They find that the low value of cash in poorly governed firms is associated with the rapid dissipation of cash reserves on projects that reduce future operating performance. Harford, Mansi, and Maxwell (2008) also show that managers of poorly governed firms tend to hold less cash, at least in part because they are quick to spend incoming cash on capital expenditures and acquisitions. Finally, DeAngelo, DeAngelo, and Wruck (2002) present evidence that excess asset liquidity allows value destruction through the inefficient continuation of poorly performing operations.[3]

In contrast to the evidence that access to excess cash can lead to value destruction, there is evidence that large cash holdings can benefit stockholders. For example, cash balances vary with cash flow volatility, suggesting that these balances provide protection against adverse cash flow shocks. Large cash balances can enable firms to continue to fund profitable investment opportunities or to make required debt payments when

[3] DeAngelo et al. (2002) consider all assets, including, for example, inventory, accounts receivable, and other components of working capital, which can easily be converted to cash.

operating cash flows are low (Opler, Pinkowitz, Stulz, and Williamson, 1999). Several recent studies have reported evidence consistent with this precautionary motive for holding cash. (See, for example, Han and Qiu, 2007; Haushalter, Klasa, and Maxwell, 2007; and Duchin, 2009). Cash balances might also vary with the relative productivity of capital; increasing when capital is less productive and declining when capital is more productive (Riddick and Whited, 2008).

The precautionary motive and the idea that cash balances vary with the relative productivity of capital suggest that cross-sectional variation in cash balances and changes in cash balances over time can reflect firm decisions that serve stockholder interests. It is worth noting that in the cash balance literature, evidence that firm risk and R&D spending are positively associated with cash holdings has been interpreted as consistent with the precautionary motive for holding cash (Opler et al., 1999). However, in the venture capital literature, consistent with the rationale for staging, the evidence shows that firms with these attributes actually receive less funding. Our focus on IPO firms allows us to provide some insight on these seemingly contradictory positions.

B. Staging and the Timing of Capital Infusions

Evidence of staging in both the private and public capital markets has been reported in the finance literature. We next discuss some of the different forms that this staging can take and relevant evidence from previous studies.

B.1. Staging in Venture Capital Investing

The staging of capital infusions is ubiquitous in venture capital investing where start-up firms are typically characterized by severe information asymmetries and uncertainties. Providing funding in stages helps to mitigate the costs associated with these

information asymmetries and uncertainties by limiting the amount of capital that managers (entrepreneurs) might use for overinvestment if anticipated growth opportunities do not materialize.

The venture capital literature distinguishes between two types of staging. The first is ex ante (within round), or milestone staging, where a venture capitalist contractually commits to provide additional funds within a financing round only if a particular financial or non-financial milestone is met. Since the firm must achieve a pre-specified milestone before receiving additional funding, this type of staging limits the amount of capital the venture capitalist has at risk if the firm's prospects turn out to be significantly lower than expected. Limiting the amount of capital that is invested in unsuccessful ventures also enables the venture capitalist to allocate capital more efficiently between successful and unsuccessful ventures. Finally, milestone staging arrangements can enable the venture capitalist to liquidate the firm if a milestone is not met, potentially accelerating the timing of the liquidation and increasing the fraction of invested capital that is recovered.

The second type of staging is ex post (between round), or round staging, in which capital is staged through independent financing decisions (rounds). With round staging, each successive capital infusion is separately negotiated, often with different investors in later rounds. Like milestone staging, round staging limits the amount of capital the venture capitalist has at risk. It also provides control benefits for investors because requiring managers to periodically raise additional capital increases the ability of investors to monitor and to liquidate a firm if performance and/or investment prospects are unsatisfactory. Because the sequential financing we consider does not involve a pre-

commitment by investors, we are focusing on round staging in this study.[4]

Gompers (1995) develops and tests predictions from agency theory that shed light on factors which affect the round staging of venture capital investments. He finds that round sizes and duration (time between rounds) both decline with (i) increases in the industry ratio of intangible assets to total assets, (ii) increases in the industry market-to-book ratio and, (iii) greater industry R&D intensity.

We examine whether factors that explain the round staging of venture capital investments also explain the staging of capital infusions in newly public firms. As in venture capital round staging, we expect the size of an IPO and the time between an IPO and a firm's next capital infusion to both decrease with R&D intensity, asset intangibility, and growth opportunities. We refer to the idea that there is round staging in the public equity market as the *staging hypothesis*.

B.2. Other Forms of Public Market Staging

The staging of capital infusions is not limited to the venture capital market. Researchers have noted that public firms enter into contractual financing arrangements that have characteristics of staging. Perhaps the simplest example involves a firm's debt maturity structure. Since managers must renegotiate with creditors in order to refund (roll over) maturing debt, shorter maturity loans increase the frequency with which lenders can review firm performance and adjust prices, or decide not to reinvest at all. This is a form of round staging in the debt market. Consistent with this idea, Barclay and Smith (1995) show that firms which have more growth options tend to use more short-term debt.

[4] Note that the model proposed by Easterbrook (1984) can be thought of as a means of forcing round staging upon managers.

Mayers (1998) demonstrates how convertible bonds, when compared to sequential financing with straight debt, can save on issue costs and still mitigate the overinvestment problem. He shows that when a firm's projects turn out to be valuable, conversion of the debt into stock leaves the funds that were raised in the firm. Alternatively, when projects are not profitable, the debt is not converted and the funds that were raised are returned to investors when the debt matures.

Schultz (1993) considers a similar mechanism in his study of unit IPOs. In a unit IPO, warrants are bundled with the common stock that is being sold. This bundling pre-commits the firm to sell more equity in the future at the strike price of the warrant. If future investment opportunities fail to materialize, the stock price will not increase enough to cause investors to exercise the warrants and the firm will not receive additional funds. Convertible bonds and unit IPOs can be viewed as forms of milestone staging in the debt and equity markets, respectively, where funds are provided when certain goals, as reflected in the stock price, are met.

Barclay and Smith (1995), Mayers (1998), and Schultz (1993) show that public markets rely on forms of both round and milestone staging. In addition to the round staging of debt, and the milestone staging associated with convertible debt and unit IPOs, we suggest that there might also be round staging of public equity investments. For example, and of particular relevance to our analysis, round staging of public equity investments might be preferable when the validity of market prices is suspect because managers can manipulate public signals or when managers are unable to effectively convey information about their firms to investors.[5]

[5] See Bienz and Hirsch (2005) for an analysis of the choice between round and milestone staging.

B.3. Other Explanations for the Timing of Capital Infusions

A number of studies document considerable variation in the length of time before newly public firms return to the capital market for additional funding (see, for example, Helwege and Liang, 1996; and Jegadeesh, Weinstein, and Welch, 1993). Explanations for this variation include the *signaling hypothesis* in Allen and Faulhaber (1989), Grinblatt and Hwang (1989), and Welch (1989), the *market-discovery* pooling explanations in Allen and Faulhaber (1989) and Welch (1989), the *market-feedback* hypothesis in Jegadeesh, Weinstein, and Welch (1993), and, more broadly, *market-timing* explanations that are driven by post-IPO market conditions (sentiment, market liquidity, etc.) and/or aggregate levels of asymmetric information (e.g., the *windows of opportunity hypothesis* discussed by Bayless and Chaplinsky (1996)). These studies suggest that the time to first post-IPO financing is related to post-IPO stock returns and market conditions. In contrast to these explanations, the *staging hypothesis* predicts that important determinants of the time to the first post-IPO financing are known *prior* to the time of the IPO.

III. Sample Selection and Data Description

In this section we discuss the construction of our sample, data sources, and key sample characteristics.

A. IPOs and Subsequent Capital Infusions

We construct our sample by first identifying all firms in the SDC Platinum database that completed an IPO from 1990 through 2005 and for which the offer price exceeded $1.00 per share. We exclude utility firms (SIC codes 4900-4999), financial firms (SIC codes 6000-6999), ADRs, closed-end funds, and unit IPOs. This results in an

initial sample of 4,330 firms. We drop 195 of these firms because there are insufficient data on CRSP or COMPUSTAT and 81 firms whose IPO is actually a reverse LBO.[6]

For each of the remaining 4,054 firms, we identify all capital infusions in the two-year period following its IPO.[7] Public equity and debt offering data are obtained from the SDC Platinum database. Private equity and debt offering data are obtained from Sagient Research and from the sample of private placements compiled by Hertzel, Lemmon, Linck, and Rees (2002). The debt offerings include both straight and convertible issues. Bank loan data are obtained from DealScan. We refer to all firms that raise new capital within two years of their IPOs, regardless of the type of capital, as *issuers*.

Table 1 presents statistics that describe the post-IPO financing activities for the full sample and for industry subsamples. The statistics for the full sample are in the first row. While a large number of firms return to the capital market at least once during the two-year period following their IPO (1,922 firms, or 47.4 percent of the sample), 44.6 percent of the sample firms do not receive capital infusions during the two-year post-IPO period and yet are still trading. The remaining firms are either taken over (5.3 percent) or delist (2.8 percent). The last column in the table reports the average length of time between the IPO and a firm's next capital infusion for those firms that raised more capital within two years of their IPO. Throughout the paper we refer to this time period as the duration or spell length. The average duration for firms that return for a capital infusion

[6] These are firms that have market prices for their equity in a period prior to the IPO date. We drop these firms because they are fundamentally different than firms which are going public for the first time.

[7] We choose a two-year period because, as suggested in Table 2, among those firms that acknowledge that the capital they are raising will only last a limited period, the vast majority expect the capital to last less than two years (Of the 576 firms that express an intent to return to capital markets, 95 percent predict a return within two years, 99 percent predict a return with three years, and only one firm predicts that it will be more than five years (62 months) before it requires additional capital.). However, we have also performed the subsequent empirical analysis using cut-off periods of three years, four years, and five years. The empirical evidence is qualitatively the same, regardless of the length of the cut-off period.

within two years is 0.88 years and approximately one half of those firms have a duration of less than 0.79 years.[8]

--Insert Table 1 here--

The industry breakdowns in Table 1 are based on the Fama/French 48 industry classification. We report separate results for the 18 Fama/French industries that have at least 50 IPOs in the sample period. Several results are worth noting. First, the table shows that there is significant cross-industry variation in the percentage of firms that raise additional capital in the two-year period following their IPO. Firms in the petroleum and natural gas industry have the highest frequency of post-IPO financing activity (60.0 percent) whereas firms in the medical equipment industry return relatively infrequently (36.5 percent).

There is also variation in durations across industries. On average, firms in the petroleum and natural gas industry that raise additional capital do so sooner than firms in other industries. The average duration for petroleum and natural gas firms is 0.71 years and approximately one-half of the firms in this industry have durations of less than 0.66 years. Firms in the medical equipment industry have the longest durations in our sample. The average (median) duration in this industry is 1.10 (1.15) years. The cross-industry variation in the duration is statistically significant.

Finally, we note that there is very little correlation between the proportion of industry firms returning for funding and the average duration. For example, like petroleum and natural gas firms, pharmaceutical firms return for additional financing

[8] By comparison, the average duration for firms that raise additional capital within five years is 1.42 years and approximately one half of those firms have a duration of less than 1.04 years.

relatively frequently (59.7 percent raise additional capital within two years). However, pharmaceutical firms come back more slowly with an average (median) duration of 0.98 (0.90) years as compared to 0.71 (0.66) years for petroleum firms.

Two aspects of the industry comparisons are relevant for our analysis. First, the cross-industry variation in the percentage of firms returning for funding and the variation in the time to the first post-IPO capital infusion provide preliminary evidence on the *staging hypothesis*. This hypothesis suggests that industry differences are important determinants of staging decisions at IPOs because the potential for agency problems associated with excess cash varies across industries with, for example, differences in industry growth opportunities. In contrast, the alternative explanations for the timing of post-IPO capital infusions do not predict variation across industries in the likelihood or the timing of return trips to the capital market.

The industry comparisons also suggest that staging decisions can be usefully thought of as reflecting the outcomes from two processes. The first process determines whether or not a firm's financing should be staged. Conditional on the decision to stage financing, the second process determines the length of time for which funding is provided. This latter process considers how long it will take to reduce uncertainty about the firm's prospects. To see the relevance of this for our analysis, consider a stylized example in which pharmaceutical and petroleum firms are equally suitable candidates for staging. If it takes longer to determine the success or failure of drug trials than of oil exploration projects, durations for pharmaceutical firms should be longer than for petroleum firms. This highlights why it is important to control for industry in our cross-sectional analysis. It also motivates tests of the *staging hypothesis* that examine whether firms do or do not

raise additional capital in addition to tests examining the durations of those that do raise additional capital.

B. IPO Prospectus Data

We examine IPO prospectuses to obtain additional insights on the importance of staging concerns at the time of an IPO as well as differences in the characteristics of staging across industries. In particular, we examine two sections in the IPO prospectuses for evidence that firms acknowledge their need for post-IPO capital infusions. The first section outlines risk factors associated with the offering and the second section provides a description of the firm's liquidity and capital resources. In these two sections we find discussions concerning whether managers of issuing firms anticipated returning to the capital markets and, if so, approximately how long they thought the IPO proceeds would last. For example, Millennium Pharmaceuticals' prospectus states:

> "*The Company believes that the net proceeds from this offering, existing cash and investment securities and anticipated cash flow from existing strategic alliances will be sufficient to support the Company's operations for at least the next 24 months*".

Another example comes from Brilliant Digital Entertainment Inc. Its prospectus states:

> *"The Company believes that the net proceeds from the Offering combined with the Company's current resources will be sufficient to enable the Company to meet its operating and capital needs as required by its present business plan for approximately 12 months."*

In a more systematic analysis, we examine IPO offering prospectuses for sample firms in the 10 Fama/French industries that had at least 50 IPOs during the 1994 to 2005

period.[9] For industries with more than 100 IPOs, we randomly select 100 firms and use those firms to represent the industry. For all of the firms for which we are able to find prospectuses, we tabulate the frequency with which firms indicate that they expect to return to the capital market and the expected timing of the return.

The results from this investigation, which are presented in Table 2, show that the prospectuses for a majority of the firms in each industry acknowledge that the capital raised in their IPO is not expected to be sufficient to fund anticipated future investments. The fraction of prospectuses indicating that management anticipates returning to the capital markets ranges from 50.9 percent for firms in the transportation industry to 88.0 percent for firms in the pharmaceutical products industry.

--Insert Table 2 here--

We also tabulate the anticipated time to the next financing. The average anticipated duration ranges from 13.2 months for firms in the electronic equipment industry to 21.5 months for firms in the pharmaceutical products industry. The median expected duration is 12 months in eight of the ten industries. The median expected duration for the medical equipment industry and for the pharmaceutical products industry are longer at 18 and 21 months, respectively. If uncertainty in the medical equipment and pharmaceutical products industries takes longer to resolve than in other industries, these cross-industry differences are consistent with staging decisions reflecting how long it will take for uncertainty to be resolved.

[9] This period begins in 1994, instead of 1990, because IPO prospectuses are not available on the Edgar database before 1994.

IV. Empirical Evidence on Staging in Public Markets

In this section we present evidence on the relations between firm characteristics at the time of the IPO and (i) the size of the IPO, (ii) how quickly a firm returns to the capital market, and (iii) whether it returns. In our analysis we use a scaled measure of the size of the IPO that is intended to capture the number of years of funding provided by the IPO. This measure, which we also refer to as the *cash burn rate*, equals the difference between the funds used for investment by a firm and the funds it generates from operations in the year prior to the IPO, scaled by the total dollars raised in the IPO. In effect, the cash burn rate is the inverse of the number of years of funding provided by the IPO assuming that the firm continues to burn capital at the same rate it did in the year before its IPO.[10]

A. Test and Control Variables

Before discussing our empirical analysis and results, we define the test and control variables that we use in that analysis.

A.1. Test Variables

As discussed earlier, Gompers (1995) reports evidence on venture capital staging from an examination of the relations between round size and duration (time between financing rounds) and *industry level* measures of (i) the ratio of intangible to total assets, (ii) R&D intensity, and (iii) the market-to-book ratio. In our analysis, we use *firm level* measures of the ratio of intangible to total assets and R&D intensity, estimated using

[10] We do not divide the IPO proceeds by the difference between investment and funds from operations (in other words, compute the number of years of funding directly) to avoid the potential for division by zero.

values from the fiscal year immediately preceding the year of the IPO. This pre-IPO information is obtained from each firm's first post-IPO 10-K filing. We measure R&D intensity using the ratio of R&D to sales.[11] We are unable to construct a pre-IPO measure of the market-to-book ratio at the firm level and therefore do not include one in our analysis. However, all of our results are robust to the inclusion of an industry-level market-to-book ratio.

We expect a larger ratio of intangible to total assets to be associated with higher expected agency costs arising from inefficiently keeping a failing business operating because this ratio should be negatively related to the liquidation value of the firm. Information asymmetries should also be larger at firms with more intangible assets. For both of these reasons, staging should be more important at firms with more intangible assets. As a result, we expect that the amount of capital raised at the IPO and the time to the first post-IPO capital infusion (duration) are negatively related to the ratio of intangible to total assets.

The value of growth options, as a proportion of total firm value, tends to be greater at R&D intensive firms than at firms that invest less in R&D. The assets at R&D intensive firms are also more likely to be firm-specific. For these reasons we expect that uncertainty, information asymmetries, and expected agency costs associated with overinvestment will tend to be larger at high R&D firms. Therefore, we expect to observe a negative relation between R&D intensity and both the size of the IPO and duration.

A.2. Control Variables

We include control variables for firm, deal, and market characteristics in the

[11] The empirical evidence is qualitatively similar when we scale R&D by book assets.

empirical analysis.

Firm and deal characteristics: Our control variables for firm and deal characteristics include firm age, total primary capital raised in the IPO, the cash burn rate, capital expenditures, the percentage of total IPO proceeds attributable to secondary sales, and whether the firm received venture capital prior to the IPO.

We control for firm age because the amount of uncertainty about the prospects of a firm is likely to decrease as firm age increases.[12] Total capital raised is included as a control variable because the extent to which the capital provided to a firm is staged might vary with the total amount (dollar value) of capital that the firm is raising.

We also include the cash burn rate, the dependent variable in the IPO size regressions, as a firm-specific control variable in our analysis of the timing and likelihood of a subsequent capital infusion. Under the *staging hypothesis* the cash burn rate should be a good indicator of the length of time before a firm will need new capital. Alternatively, under the null hypothesis of no staging, firms are provided with enough capital to meet their planned investments.[13] In this situation the amount of funding, relative to the rate at which a firm is using cash immediately before its IPO, should not influence either the likelihood or timing of a post-IPO capital infusion.

We use the ratio of capital expenditures to assets in the year prior to the IPO as an additional measure of the level of each firm's capital outlays. As is the case with the cash burn rate, there should be no relation between the time to the first post-IPO capital infusion and capital expenditures under the null hypothesis of no staging.

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[12] We thank Jay Ritter for making available on his web page the founding dates used to calculate firm age (web http://bear.warrington.ufl.edu/ritter/FoundingDates.htm).

[13] This is consistent with Hart's (1993) suggestion that in the absence of agency costs entrepreneurs would raise as much money as they wanted and decide whether to continue their projects or return capital to investors.

We include the percentage of total IPO proceeds attributable to secondary sales as a control variable because the *staging hypothesis* only concerns primary sales. The fraction of total sales in the IPO that is represented by secondary sales is related to the likelihood of staging. In the extreme case where the firm is not selling any shares (e.g., the IPO consists only of secondary sales), there can be no staging. An IPO involving both primary and secondary sales could be a more likely candidate for staging than an IPO with similar primary sales, but no secondary sales, if the secondary sales further reduce the proportionate ownership of the insiders and exacerbate the agency problems associated with holding excess cash. On the other hand, if the likelihood and magnitude of secondary sales is negatively related to uncertainty about firm prospects, firms with secondary sales might be less likely candidates for staging.

We control for whether the firm received venture capital prior to the IPO because there are reasons to believe that the presence of a venture capitalist will affect the likelihood of staging. For example, Megginson and Weiss (1991) find that the presence of venture capitalists lowers the total cost of an IPO and helps maximize the net proceeds to a firm. This is consistent with venture capital investors serving a certification function that reduces the extent to which funding of a venture-backed firm is staged at the time of its IPO. On the other hand, if less mature firms tend to rely on venture capital financing, we might observe that staging of capital is greater at firms with venture financing despite any certification the venture capitalists provide.

Market Characteristics: The market characteristics that we control for include IPO underpricing, post-IPO return and trading volume over the first 20 days following the IPO, and measures of the total level of IPO activity in the market.

As discussed earlier, prior research offers several explanations for the observed cross-sectional variation in the time between a firm's IPO and its next capital infusion including the *signaling hypothesis*, the *market-feedback* and *market-discovery* hypotheses, and, more broadly, the *market-timing* hypotheses that are driven by post-IPO market conditions (sentiment, market liquidity, etc.) and/or aggregate levels of asymmetric information.

We include initial underpricing, post-IPO returns, and trading volume over the 20 days following the IPO to control for possible signaling or market-timing, feedback, or discovery effects. We measure IPO underpricing as the ratio of the closing price on the first day of trading to the offering price. Following Jegadeesh et al. (1993), we measure the post-IPO return over the first 20 trading days, excluding underpricing. We note that in contrast to the explanations above, the *staging hypothesis* predicts that important determinants of the length of time to the first post-IPO financing are known *prior* to the time of the IPO.

We also control for the volume of aggregate IPO activity at the time of each IPO. For each IPO we count the total number of IPOs occurring in the window from 15 days before the IPO to 15 days after the IPO.[14] We then identify each of the IPOs in our sample as having occurred during periods of high, medium, or low IPO activity based on the surrounding aggregate IPO activity. High and low activity levels correspond to the first and third terciles of IPO activity. The average (median) number of IPOs in the high, medium, and low activity periods are 61 (59), 38 (38), and 18 (18) respectively.

There are at least two possible theories concerning how aggregate IPO activity can affect the level of staging activity. First, to the extent that human capital is limited,

[14] We look ahead 15 days on the assumption that investors know the schedule of pending offers.

investors who are faced with a large volume of IPO activity might not be able to engage in appropriate levels of due diligence (Khanna, Noe, and Sonti, 2008). If this is true, the *staging hypothesis* suggests that, since the absence of proper due diligence should be associated with greater uncertainty, investors will provide individual firms with less capital. In contrast, during periods of low IPO activity, investors do not need to substitute staging for due diligence. These arguments suggest that we should observe smaller IPOs and shorter durations during periods of high IPO activity.

The second theory suggests the opposite relation. This theory holds that periods of high IPO activity are periods in which investors are "chasing deals" and providing firms with too much cash (Gompers and Lerner, 2000). In contrast, periods of low IPO activity tend to be periods in which less capital is available. These arguments suggest that we should expect to observe more staging and correspondingly smaller IPOs and shorter durations during periods of low IPO activity when less cash is available.

We include Fama/French 12-industry industry dummy variables and year dummy variables in our specifications to control for other factors that could affect the length of time to the first post-IPO financing. As suggested by Whited (2006), differences in competitiveness, the type of capital employed, and the level of technology can all affect investment decisions and, thereby, the time between financings. Year dummy variables allow us to control for macro factors such as business and capital market cycles. For example, firms might face limits on the funds they are able to raise in periods when money is tighter, reducing the observed time to the next financing.

B. Univariate Comparisons

Table 3 provides univariate comparisons of duration, firm and IPO characteristics, and market characteristics for subsamples of firms partitioned by whether they return for financing in the two years following their IPO. The first column reports statistics for firms that raised capital within two years of their IPOs. The remaining three columns report statistics for firms that did not raise funds within two years of the IPO. Columns (2), (3), and (4) report results for firms that were still trading, firms that delisted, and firms that merged, respectively.

--Insert Table 3 here--

We begin by comparing firms that raised additional capital with firms that did not raise additional capital, but which were still trading after two years (columns (1) and (2)). As shown in the first row of Table 3, the sub-sample of 1,922 firms that raised additional capital within two years of their IPO have an average (median) duration of 0.88 (0.79) years. The 1,807 firms that did not complete a post-IPO financing and were still trading after two years have a mean (median) duration of 2.00 (2.00) years. Comparison of these two subsamples reveals several differences that are consistent with round staging in the IPO market.

First, the evidence on intangible assets is consistent with the *staging hypothesis*. Intangible assets comprise an average of 9 percent of total assets for firms that returned for financing within two years. In contrast, intangible assets represent an average of only 6 percent of total assets in firms that did not raise additional capital within two years. This difference is statistically significant at the 1 percent level.

Also consistent with the *staging hypothesis*, the average ratio of R&D to sales is significantly larger for firms that raised additional capital. The average of this ratio is 2.33 for firms that raised additional financing and 1.20 for firms that did not. This difference is also statistically significant at the 1 percent level. However, it is worth noting that the median values of this variable are statistically indistinguishable.

Third, a comparison of the cash burn rates across the two groups is also consistent with the *staging hypothesis*. Firms that return for financing have an average (median) cash burn rate of 0.17 (0.09). This indicates that these firms, on average, spent an amount equal to 17 percent of the IPO proceeds in the year prior to the IPO. Continued spending at this rate implies that the proceeds will last 5.95 years. In contrast, firms that were still trading, but that did not raise additional capital, had significantly lower mean and median cash burn rates of 0.075 and 0.035, respectively. This suggests that, on average, these firms received 13.33 years of funding at their pre-IPO burn rates. In the absence of agency costs, we would expect firms to raise as much money as they need at the time of their IPO (Hart, 1993) and we would not observe the negative relation between the cash burn rate and whether firms return within two years for additional financing.

The last two columns in Table 3 present statistics for firms that delisted or merged within two years of the IPO and prior to obtaining a post-IPO capital infusion. We are particularly interested in the delisted firms and include the merged firms mainly for completeness. The *staging hypothesis* posits that firms obtain sufficient capital to see them through to a point where their performance can be re-evaluated by investors for the purpose of deciding whether they should commit more capital. Some staged firms will clear the hurdle and receive another capital infusion while others will not clear the hurdle

and will fail. This suggests that both firms that raise additional capital and firms that delist are likely to have been staged and therefore should have similar characteristics at the time of their IPOs.

Comparison of columns (1) and (3) in Table 3 reveals that delisted firms are indistinguishable, in terms of their intangible asset and R&D/sales ratios, from firms that return to the market within two years. An exception to the similarity is that the median cash burn rate of delisting firms is significantly larger than that of issuers. Firms that delisted were given fewer years of financing (1/0.16 = 6.25 years), relative to their pre-IPO investment intensity, than firms that raised additional capital within two years (1/0.10= 10.00 years).[15]

Comparison of the market characteristics in Table 3 reveals that the level of underpricing in the IPOs of firms that raised capital again within two years is similar to that of firms that did not raise capital again and yet were still trading after two years. In contrast, stock returns over the twenty trading days immediately following the IPO were higher for firms that raised additional capital. This difference is consistent with the evidence in Jegadeesh et al. (1993) and it supports the *market-discovery*, *market-feedback,* and *market-timing* hypotheses. All three of these hypotheses predict that higher post-IPO prices will lead a firm to raise additional capital.[16] Finally, the post-IPO trading volume for firms that raised capital within two years of their IPO is similar to that for firms that were still trading, but that did not raise additional capital, and significantly lower than the

[15] The mean and median cash burn rates of delisters are significantly greater than those of firms that still trade, but have not raised additional capital and firms that merge within two years of their IPO.

[16] These hypotheses are all often used to explain the dynamics of raising equity. However, while the *market-timing hypothesis* suggests that the follow-on form of financing will be equity, the *market-discovery* and *market-feedback* hypotheses make no such prediction. The latter two hypotheses simply posit that the market or the firm learns that the firm's projects are good and therefore that the firm can productively use more cash.

trading volumes for firms that merged or delisted within two years of their IPO.

C. Multivariate Analysis

The univariate analysis in the previous section provides evidence consistent with the *staging hypothesis*. We next perform a series of multivariate analyses to see if this evidence is robust to controls and alternative models. We first present evidence on the relations between firm characteristics and the amount of capital raised in the IPO relative to the firm's pre-IPO investment spending. We then present results from a hazard analysis of the relation between firm characteristics and the time to the first post-IPO capital infusion. Third, we report results from a probit analysis which provides evidence on the relations between pre-IPO firm characteristics and the likelihood of a subsequent financing. Finally, we present results from a multivariate logit analysis. This allows us to compare the factors that affect whether a firm raises additional capital, remains a listed firm without a subsequent financing, delists, or merges, and provides an internal consistency check by allowing a direct comparison of the impact that pre-IPO characteristics have on the likelihood of issuing and delisting.

C.1. Firm Characteristics and the Amount of Capital Raised in the IPO

Our first test of the *staging hypothesis* considers how factors the theory predicts to be associated with the staging of capital infusions affect the amount of funding provided at the IPO. The dependent variable in this analysis is the cash burn rate which, as mentioned earlier, is equivalent to the inverse of the length of time that the IPO proceeds would meet the firm's needs if the dollar burn rate continued at the level observed in the year before the IPO.

Table 4 presents coefficient estimates from ordinary least squares regressions. Whether included separately (Models (1) and (2)) or together (Model (3)) the coefficients on intangibles assets and R&D/sales are both positive and highly significant. Consistent with the *staging hypothesis*, these results indicate that firms with more intangible assets and firms with greater R&D intensity are associated with a higher cash burn rate, which implies that they receive less funding at their IPO relative to their pre-IPO dollar burn rate. If the lower funding received by these firms is related to staging, we should also observe these firms raising additional capital sooner than firms with more tangible assets and lower R&D intensity. We investigate these relations in the next section.

--Insert Table 4 here—

The coefficient estimates for both the *percentage secondary* and *venture backed* variables are highly significant in all three models in Table 4. The negative relation between the percentage of the IPO sales that are secondary sales and the cash burn rate indicates that firms with a larger proportion of secondary sales in their IPOs tend to receive more funding. This is consistent with the idea that the proportion of secondary sales is negatively related to uncertainty about the firm's prospects.

The positive coefficient estimate for *venture backed* indicates that venture-backed firms are more likely to be staged. This is consistent with the idea that the effect of any certification provided by venture capitalists on the likelihood of staging is more than offset by other factors unique to the types of firms that venture capitalists invest in.

C.2. Hazard Analysis of the Time to Post-IPO Capital Infusions

To examine the relations between firm characteristics and the length of time to the first post-IPO financing, we next perform a multivariate analysis using a semi-parametric hazard model of the form

$$h_i(t) = \left(h_0(t) \exp\left(x_i(t)' \beta \right) \right) \alpha_i \qquad (1)$$

where t is the length of the spell (the duration), $h_0(t)$ is the baseline hazard, $x_j(t)$ is a vector of covariates, and β is the corresponding unknown parameter vector. We model the effect of omitted covariates with the term α_i. In hazard analysis, the α_i term models frailty, or the tendency of observations to fail more or less often than predicted by the covariates.

We estimate the baseline hazard, $h_0(t)$, as a step function in time where the steps are at six-month intervals. For example, suppose a firm completes an IPO on February 1, 2001 and then raises additional capital on June 1, 2001. Its spell length is five months and it is in a group of firms that have a similar baseline hazard (i.e., the baseline hazard associated with raising capital in the first six months following the IPO). Suppose there is a second firm that completes an IPO on February 1, 2001 and a subsequent fundraising on November 1, 2001. This firm's spell length is nine months and it is in a group of firms with a similar baseline hazard (i.e., the baseline hazard for firms that raise capital in the second six-month period following the IPO) and this baseline hazard is not the same as the baseline hazard for firms that raise capital in the first six months.

In interpreting our results, we note that the focus of our analysis is not on the shape of the hazard function per se, but on how our variables of interest (i.e. the firm,

IPO, and market characteristics) affect the hazard rate (the likelihood of a capital infusion). Intuitively, the results can be interpreted in a fashion similar to a regression analysis: the baseline hazard is a measure of the hazard function when all covariates (regressors) are zero; variation in the covariates (both time-series and cross-sectional) results in shifts in the hazard rate, accelerating or decelerating the time to next financing depending on the sign of the estimated coefficient.

We estimate equation (1) assuming that the hazard rate follows an exponential distribution using an accelerated failure time form.[17] The results are presented in log expected time parameterization so that the model gives the logarithm of the expected time to the next capital infusion for a given covariate. Thus, negative coefficient estimates imply shorter durations (accelerated time to failure, or issue) positive coefficients imply longer durations (decelerated time to failure).[18] We analyze our test variables individually since the sample size falls considerably when we only include firms that have all data items available. We present the model using all variables for comparison. The coefficient estimates of the baseline hazard and of industry and year dummy variables are not tabulated.

--Insert Table 5 here--

Table 5 presents the results of the hazard analysis. When considered individually, in Models (1) and (2), the evidence for both of our test variables is consistent with the *staging hypothesis*. Firms with higher ratios of intangible to total assets prior to their IPO

[17] Estimation of a Cox proportional hazard model yields similar results.

[18] An alternative approach is to present hazard ratios which compare hazards associated with the covariates to a baseline rate such that a hazard ratio greater than one implies a hazard rate greater than the baseline rate. With such an approach, a higher hazard rate implies a greater likelihood of a capital infusion and thus a *shorter* duration of financing inactivity.

return more quickly for post-IPO capital infusions. To quantify this difference, a one standard deviation increase in the intangible asset ratio decreases the time to the first post-IPO capital infusion by 8.6 percent. Firms with a higher R&D to sales ratio in the year before their IPO also return for post-IPO capital infusions more quickly. A one standard deviation increase in the ratio of R&D to sales decreases the estimated duration by 7.6 percent. Both of these results suggest that the costs associated with providing excess funds to firms that have more uncertain investment opportunities, and therefore greater potential for agency problems, outweigh the costs to these firms of having to return to the market for additional capital or of the possibility of having to forgo a future investment opportunity. This is consistent with the *staging hypothesis*, but inconsistent with the theory of precautionary cash balances which predicts that attributes such as these would lead to greater funding and therefore longer durations.

When both test variables are included in the model together, the relation between the ratio of intangible to total assets and duration is still negative, but it is no longer statistically significant (p-value = 0.175) while the relation between the intangible asset ratio and duration is still negative and significant. We attribute the loss of statistical significance for the intangible asset ratio to the loss of observations involving firms for which we do not have data on R&D expenditures. Examination of the data for the observations that we use to estimate Model 1, but that are dropped when we require data for both the intangible asset ratio and R&D/sales, reveals that these dropped firms have significantly more intangibles assets (9 percent of assets versus 5 percent of assets, p-value=0.01) and greater cross-sectional variation in intangible assets (standard deviation of 17 percent versus 12 percent, p-value=0.01) than the firms that are used to estimate

Model 3. In summary, the relations between ex-ante firm characteristics and duration in Models (1) through (3) in Table 5 support the *staging hypothesis*.

The models in Table 5 include the controls for sample firm pre-IPO spending levels as reflected in the cash burn rate and capital expenditures. The coefficient estimates for these variables are also consistent with the *staging hypothesis*. The negative coefficient estimates for the cash burn rate variable imply that firms that raise small amounts of capital relative to their pre-IPO spending return to the market for additional funding more quickly. A one standard deviation increase in the cash burn rate results in an 11.9 percent reduction in the expected time to first post-IPO capital infusion. Furthermore, like firms with high cash burn rates, firms with high levels of pre-IPO capital expenditures return faster (Model (4)). A one standard deviation increase in capital expenditures is associated with a 7.0 percent reduction in duration. If firms are not staged at the time of their IPO, but instead are provided all the capital they need to fund future investments, we would expect to see no relation between pre-IPO spending and the time to first post-IPO capital infusion.

The models in Table 5 also include all of the market characteristic variables described earlier. Controls for underpricing and post-IPO stock returns are important because the decision to return for post-IPO financing can be affected by underpricing (*signaling hypothesis*) and post-IPO returns (*market-discovery*, *market-feedback*, and *market-timing* hypotheses). Since the variables we use to predict staging could simply be good predictors of post-IPO performance, including underpricing and post-IPO returns in our models reduces the likelihood that we are simply picking up such spurious relations.

IPO underpricing is negatively related to duration as predicted by the *signaling*

hypothesis and is statistically significant in all four specifications. We note that this finding contrasts somewhat with results in Jegadeesh et al. (1993) that show only limited support for the *signaling hypothesis*. The return measured over the 20-day window following the IPO is also negatively related to duration and statistically significant in all four specifications. This evidence is consistent with the *market-discovery*, *market-feedback,* and *market-timing* hypotheses. Taken together, these findings highlight that the staging effects we document are incremental to alternative explanations of the timing of post-IPO capital infusions that rely on post-IPO (as opposed to pre-IPO) firm and market characteristics.

Consistent with the idea that high IPO activity is associated with investors chasing deals, we observe shorter durations for IPOs undertaken during periods of low IPO activity. The tabulated result shows that the durations for firms going public during periods of low IPO activity are shorter than the durations for firms going public during medium levels of IPO activity. Untabulated univariate results show a greater and statistically significant difference between durations for IPOs during high and low levels of IPO activity. This evidence suggests that staging occurs more often during periods of low IPO activity.

C.3. Probit Analysis of Whether Firms Return for Post-IPO Capital Infusions

While short durations are consistent with staging of capital infusions, we also expect to see cross- sectional variation in duration within the sample of staged firms. As discussed earlier, this is because duration is determined in part by the amount of time it takes to resolve uncertainty about future firm prospects. A staged firm whose future success depends on a short-lived uncertainty is likely to come back more quickly than a

staged firm with a long-lived uncertainty; both firms anticipate returning for post-IPO financing but they expect to have different durations.

Industry controls may not be sufficient to fully capture differences in duration that are due to the time it takes for uncertainty to be resolved. For this reason, we conduct a robustness test that focuses on the *likelihood* of a post-IPO capital infusion, instead of the *time* to first post-IPO capital infusion. We examine the determinants of post-IPO capital infusions using a probit model. In doing this we are, in effect, classifying all firms that return for funding within two years as "staged firms" and examining the extent to which the results of the hazard analysis hold up under this assumption. In this analysis we drop firms that merged or delisted within two years of their IPO and compare firms that came back to the capital markets within two years of their IPO to firms that are still trading and did not obtain a post-IPO capital infusion. As in Table 5, we analyze our test variables individually since the sample size falls considerably when we only consider firms that have all data items available. We present the model using all variables for comparison. The results of this analysis are in Table 6.

--Insert Table 6 here--

The evidence from the probit analysis is generally consistent with that from the hazard analysis. Firms with more intangible assets, higher levels of R&D expenditures, and with higher cash burn rates are more likely to return for post-IPO financing. The exception to the correspondence between the hazard and probit analyses is that there is no reliable relation between pre-IPO capital expenditures and the likelihood of obtaining a post-IPO capital infusion.

As with the hazard analysis, the evidence in the probit analysis is consistent with the *signaling*, *market-discovery*, *market-feedback,* and *market-timing* hypotheses. The return over the first 20 days following the IPO has a positive and statistically significant impact on the likelihood of raising money within two years after the IPO in all four specifications. The level of initial underpricing is also positively related to the likelihood that a firm returns to the market for more capital. Finally, consistent with the results from the hazard analysis, firms that go public during periods of low IPO activity have a significantly greater likelihood of returning for post-IPO financing.

C.4. Multinomial Logit Comparison of Issuers and Delisters

According to the staging hypothesis, two mutually exclusive outcomes are possible for firms that are subject to round staging: they are either successful or not successful at obtaining their next round of financing. In our analysis to this point, we have viewed firms that raise additional capital within two years of their IPO as staged firms that successfully obtained a second round of financing. In a similar fashion, firms that delist can be viewed as staged firms that subsequently did not have sufficient prospects to merit a second round of financing. To the extent that the firms that delist are firms that are staged at the time of the IPO but that fail to raise subsequent capital, we expect that they will have characteristics at the time of the IPO that are more similar to staged firms that return for capital than firms that are still trading that do not return for capital. In Table 7 we present evidence on the similarities of returning and delisted firms from a multinomial logit analysis where the default outcome for the dependent variable is still trading without issuing. The other outcomes are (i) a post-IPO capital infusion, (ii)

delisting, and (iii) merging.[19]

--Insert Table 7 here--

The evidence in Table 7 indicates that the intangible asset ratio and R&D intensity are positively and significantly related to the likelihood of both raising additional capital within two years of the IPO and delisting. In addition, firms with high cash burn rates (which are firms with small IPO proceeds relative to their investment needs) are more likely to return for a post-IPO capital infusion and are more likely to delist. Overall, the characteristics associated with a greater likelihood of post-IPO capital infusions are similar to those that predict post-IPO delisting.[20] This is consistent with the *staging hypothesis* wherein the characteristics that make firms candidates for staging lead to either post-IPO capital infusions or delisting.

The results in Table 7 also show that market conditions affect the likelihood of delisting and merging. Again, we focus on delisting firms. Relative to surviving and not raising more capital, the likelihood of delisting is negatively and significantly related to underpricing.[21] If high quality firms are less likely to delist, this lower incidence of delisting for firms with higher underpricing is consistent with the signaling models of Allen and Faulhaber (1989), Grinblatt and Hwang (1989), and Welch (1989) which posit

[19] The *staging hypothesis* does not suggest clear predictions about firms that merge.

[20] In untabulated analysis we directly compared issuers and delisters using a mutinomial logit model identical to the one in Table 7, except that we changed the default outcome to raising additional capital within two years of the IPO. Consistent with our interpretation of the results reported in Table 7, neither the intangible asset ratio nor R&D intensity significantly explains the difference in the likelihoods of delisting versus issuing. This analysis also shows that higher cash burn rates are associated with a greater likelihood of delisting, suggesting that the cash burn rate is an important predictor of whether a firm survives.

[21] Untabulated results show that high underpricing also makes delisting significantly less likely than raising more capital.

that only high quality firms will have high underpricing.[22] Post-IPO returns are also negatively related to the likelihood of delisting. Firms with high post-IPO returns are significantly less likely to delist rather than to still be trading after two years.[23]

Finally we note that, as was the case in the probit models, the multinomial model shows that raising additional capital within two years of the IPO is more likely when the IPO takes place at a time when IPO activity is low. We interpret this as consistent with the idea that high IPO activity reflects investors chasing deals. The positive relation between the probability of delisting and our indicator of high IPO activity reinforces this interpretation. Additionally, post-IPO delisting is more likely than issuing when IPO activity is high.

V. Summary and Conclusions

The staging of capital infusions is ubiquitous in the private equity market where venture capital investors provide funding to start-up companies that are characterized as having severe information asymmetry problems. There is also evidence of milestone and round staging of public firms in the debt markets (in the form of convertible debt and maturity structure) and of milestone staging of equity to public firms (through unit IPOs). In this study, we investigate the extent to which there is round staging in the public equity market and whether this staging can explain the timing of capital infusions in newly public firms. We frame our analysis in the context of the sequential financing problem which trades off transactions costs associated with funding in stages against agency costs

[22] In these models high quality firms recoup the cost of underpricing via higher proceeds at subsequent financings. If all high quality firms expect to return, we will see high underpricing by all high quality firms. Whether or not a high quality firm actually returns is partially determined by its post-IPO cash needs and some of them may very well not return.

[23] Untabulated results show that both underpricing and high post-IPO returns are associated with a significantly lower likelihood of delisting than raising more capital.

associated with overinvestment.

We find that factors that explain round sizes and the time between venture capital financing rounds also explain IPO size and the time from a firm's IPO to its first post-IPO capital infusion. In particular, we find that firms with higher ratios of intangible to total assets and firms with greater R&D intensity receive fewer years of funding at the time of the IPO and return more quickly for post-IPO capital infusions. Also, consistent with round staging in the equity market, we find that firms that raise less money at the IPO, measured relative to their capital requirements in the year prior to the IPO, raise additional capital more quickly. We also provide corroborating evidence from IPO prospectuses that many firms acknowledge that the funds raised at the time of the IPO will be insufficient to fund their expected future investments and that a return to the capital market is anticipated. The prospectus data indicate that concerns about staging are central to decisions about funding at the time of the IPO.

Overall, the results of our study suggest that important determinants of the time to first post-IPO capital infusions are known at the time of the IPO and that round staging exists in the public equity market as well as the private equity market. These results are interesting because the attributes that we find to be associated with staging are similar to those that predict holding precautionary cash balances. Our findings suggest that studies of cash holdings should consider the age of the firm or the stage of product development when assessing optimal cash holdings. Our analysis, which considers firm characteristics known at the time of the IPO, in addition to information revealed by the IPO and market conditions that develop following the IPO, also adds to the evidence from the literature on the timing of post-IPO capital infusions.

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Table 1: Post-IPO financing activity by industry

Post-IPO financing activity for 4,054 firms that completed an IPO between 1990 and 2005. Statistics are reported for the entire sample and for firms in the 18 (of 48) Fama-French industries with at least 50 IPOs over the 1990 to 2005 period. Reported statistics are for the number of firms and percentage of all firms in the industry that were still trading without having raised more capital within two years of their IPO or that merged, delisted, or raised more capital within two years and the mean (median) number of years following the IPO that firms which raised more capital did so.

	Did Not Raise More Capital				Raised More Capital	
	Still Trading	Merged	Delisted	Total	Total	Mean (Median) Years to Issue
All Firms	1,807 44.6%	213 5.3%	112 2.8%	2,132 52.6%	1,922 47.4%	0.88 (0.79)
Fama-French Industry						
6 Recreation	24 46.2%	0 0.0%	2 3.8%	26 50.0%	26 50.0%	0.97 (0.90)
7 Entertainment	36 48.6%	4 5.4%	4 5.4%	44 59.5%	30 40.5%	0.88 (0.87)
9 Consumer goods	23 46.0%	1 2.0%	0 0.0%	24 48.0%	26 52.0%	0.86 (0.70)
11 Healthcare	62 38.3%	6 3.7%	1 0.6%	69 42.6%	93 57.4%	0.77 (0.71)
12 Medical equipment	114 56.2%	11 5.4%	4 2.0%	129 63.5%	74 36.5%	1.10 (1.15)
13 Pharmaceutical products	103 38.4%	4 1.5%	1 0.4%	108 40.3%	160 59.7%	0.98 (0.90)
21 Machinery	45 53.6%	0 0.0%	2 2.4%	47 56.0%	37 44.0%	0.86 (0.76)
30 Petroleum and natural gas	28 35.0%	4 5.0%	0 0.0%	32 40.0%	48 60.0%	0.71 (0.66)
32 Communication	72 33.8%	12 5.6%	9 4.2%	93 43.7%	120 56.3%	0.86 (0.72)
33 Personal services	23 36.5%	1 1.6%	2 3.2%	26 41.3%	37 58.7%	1.03 (1.09)
34 Business services	498 45.6%	94 8.6%	40 3.7%	632 57.9%	460 42.1%	0.84 (0.72)
35 Computers	112 50.0%	13 5.8%	4 1.8%	129 57.6%	95 42.4%	0.88 (0.86)
36 Electronic equipment	150 50.7%	19 6.4%	4 1.4%	173 58.4%	123 41.6%	0.84 (0.71)
37 Measuring and control equipment	37 52.9%	1 1.4%	2 2.9%	40 57.1%	30 42.9%	0.89 (0.76)
40 Transportation	34 39.1%	3 3.4%	1 1.1%	38 43.7%	49 56.3%	0.92 (0.88)
41 Wholesale	66 42.3%	10 6.4%	6 3.8%	82 52.6%	74 47.4%	0.83 (0.74)
42 Retail	96 39.2%	10 4.1%	12 4.9%	118 48.2%	127 51.8%	0.83 (0.72)
43 Restaraunts, hotels, motels	41 34.7%	4 3.4%	3 2.5%	48 40.7%	70 59.3%	0.85 (0.74)
p-value from test that proportions are equal across industries					0.001	
p-value from test that mean distances are equal across industries						0.003
p-value from test that median distances are equal across industries						0.016

Table 2: Expectations concerning post-IPO financing activity at time of the IPO

This table presents summary statistics about the length of time that the issuing firm expects the IPO proceeds to last, when indicated in its IPO prospectus. Data are for a sample of 878 firms from 10 (of 48) Fama-French industries that completed an IPO between 1994 and 2005.

Fama-French Industry	Size of Sample Examined	Number of Prospectuses Found	Percent of Prospectuses Indicating that Firm is Expected to Require Additional Financing	For Prospectuses Indicating that Additional Financing is Anticipated: Months IPO Funds Are Expected to Last	
				Mean	Median
13 Pharmaceutical products	100	81	88.0%	21.5	21
12 Medical equipment	100	62	81.6%	17.6	18
40 Transportation	58	27	50.9%	16.5	12
41 Wholesale	70	37	69.8%	16.0	12
32 Communication	100	51	62.2%	15.5	12
42 Retail	100	77	83.7%	14.6	12
34 Business services	100	72	83.7%	13.5	12
43 Restaraunts, hotels, motels	50	23	60.5%	13.3	12
35 Computers	100	73	88.0%	13.2	12
36 Electronic equipment	100	73	88.0%	13.2	12

Table 3: Firm, IPO, and market characteristics by post-IPO financing activity

Data are for a sample of 4,054 firms that completed an IPO between 1990 and 2005. The sample is partitioned based upon whether the firm raised additional capital (public or private debt or equity) within two years of the IPO. Firms that did not raise more capital are partitioned based on whether they were still public (trading) two years after the IPO or whether they merged or delisted within two years. The mean (median) values and the number of observations (in {} brackets) are reported for each characteristic within each subsample. Superscripts a, b, & c indicate the the mean or median value is statitiscally different from the mean or median value in Column (1) at the 10%, 5%, and 1% level. respectively.

		Raised More Capital Within Two Years	Did Not Raise More Capital Within Two Years		
Characteristic	Description	Issued (1)	Still Trading (2)	Delisted (3)	Merged (4)
Duration or Spell Length	Time from IPO to next financing	0.88 (0.79) {1,922}	2.00 [c] (2.00) [c] {1,807}	1.47 [c] (1.53) [c] {112}	1.31 [c] (1.34) [c] {213}
Firm and IPO characteristics:					
Intangible asset ratio	Intangible assets as a fraction of total assets in year preceding IPO	0.09 (0.00) {1,612}	0.06 [c] (0.00) [c] {1,544}	0.07 (0.00) {99}	0.08 (0.00) [c] {188}
R&D/sales	Research and development expenditures as a fraction of sales in year preceding IPO	2.33 (0.11) {1,052}	1.20 [c] (0.12) {1,110}	3.03 (0.15) {60}	0.81 [c] (0.19) [c] {130}
Cash burn rate	Annual dollar burn rate as a fraction of total capital raised in IPO and following three months	0.17 (0.10) {1,840}	0.07 [c] (0.03) [c] {1,725}	0.21 (0.16) [c] {103}	0.13 [a] (0.07) {207}
CapEx	Capital expenditures as a fraction of book assets in year preceding IPO	0.25 (0.10) {680}	0.23 (0.09) {594}	0.24 (0.19) [c] {38}	0.26 (0.10) {88}
IPO funds	Total capital raised in IPO and following three months	71.00 (38.00) {1,922}	52.15 [c] (31.20) [c] {1,807}	32.66 [c] (13.20) [c] {112}	69.01 (48.00) [c] {213}
Firm age at IPO	Years between Founding and IPO	13.70 (7.00) {1,886}	13.67 (8.00) [c] {1,765}	6.34 [c] (4.00) [c] {105}	11.54 (6.00) [a] {205}
Dollar burn rate	Difference between funds used for investment and funds from operations in the year prior to the IPO	11.09 (2.66) {1,840}	4.86 [c] (0.72) [c] {1,725}	9.31 (2.19) {103}	9.31 (2.67) {207}
Market characteristics:					
Underpricing	IPO underpricing (first day return)	0.24 (0.10) {1,922}	0.23 (0.10) {1,807}	0.20 (0.06) {112}	0.30 [a] (0.10) {213}
Post-IPO return	Return on shares over the first 20 days following the IPO, excluding the first day	0.07 (0.02) {1,922}	0.02 [c] (0.00) [c] {1,807}	-0.06 [c] -(0.06) [c] {112}	0.01 [c] -(0.03) [c] {213}
Trading volume	Total trading volume over the first 20 days following the IPO as a fraction of total shares outstanding	1.17 (0.84) {1,922}	1.12 (0.87) [a] {1,807}	1.46 [c] (1.10) [c] {112}	1.51 [c] (1.04) [c] {213}

Table 4: Predicting amount of capital raised at the IPO

Coefficient estimates from Ordinary Least Squares models predicting the cash burn rate for firms that completed an IPO between 1990 and 2005. The dependent variable, the *cash burn rate*, equals the ratio of the difference between funds used for investment and the funds from operations in the year prior to the IPO divided by the total funds raised in the IPO. The inverse of this variable is the number of years of funding raised in the IPO assuming that the firm continues to burn capital at the same rate it did in the year before its IPO. *Percentage secondary* is the percentage of total IPO proceeds attributable to secondary sales. *Venture backed* is an indicator variable that equals 1 if the firm received venture capital financing prior to the IPO and zero otherwise. *Low IPO Activity* is an indicator variable that equals 1 if the IPO is completed during a period that is among the periods in the lowest quartile of IPO activity and zero otherwise. *High IPO Activity* equals 1 for IPOs completed during a period that is among the periods in the top quartile of IPO activity and zero otherwise. The level of IPO activity is measured over the period from day 15 to day +15 relative to the date of the sample firm's IPO. All other variables are defined in Table 3. Data are for a sample of 4,054 firms that completed an IPO between 1990 and 2005. p-values are reported in parentheses. The coefficient estimates of industry and year dummy variables, which are also included in the models, are not tabulated.

	Model		
	(1)	(2)	(3)
Constant	0.521	0.022	-0.386
	(0.000)	(0.885)	(0.096)
Firm and IPO characteristics:			
Intangible asset ratio	0.298		0.454
	(0.000)		(0.004)
R&D/sales		0.002	0.002
		(0.000)	(0.007)
CapEx			0.093
			(0.003)
IPO funds	0.000	0.000	0.000
	(0.470)	(0.122)	(0.290)
Firm age at IPO	-0.001	-0.001	0.001
	(0.083)	(0.322)	(0.494)
Percentage secondary	-0.305	-0.346	-0.599
	(0.000)	(0.000)	(0.000)
Venture backed	0.072	0.073	0.108
	(0.000)	(0.000)	(0.000)
Market characteristics:			
Underpricing	-0.012	-0.036	-0.029
	(0.273)	(0.012)	(0.091)
High IPO actvity	0.020	0.017	-0.004
	(0.229)	(0.350)	(0.900)
Low IPO activity	0.023	0.047	0.044
	(0.324)	(0.048)	(0.143)
Number of observations	3294	2302	784
Adjusted R^2	0.082	0.091	0.152

Table 5: Predicting the time from IPO to first post-IPO financing

Coefficient estimates from a hazard model of the the time to the first post-IPO financing. The model is semi-parametric with a non-parametric baseline hazard and an exponential hazard distribution. The model is in accelerated failure time—a negative coefficient estimate indicates the event (first post-IPO financing) happens more quickly. The coefficient estimates of the baseline hazard, as well as those associated with industry and year dummy variables, are not tabulated. All variables are defined in Tables 3 and 4. Data are from a sample of 4,054 firms that completed an IPO between 1990 and 2005. p values are reported in parentheses.

	Model			
	(1)	(2)	(3)	(4)
Constant	2.177	2.031	2.070	2.031
	(0.000)	(0.000)	(0.000)	(0.000)
Firm and IPO characteristics:				
Intangible asset ratio	-0.597		-0.640	-0.441
	(0.003)		(0.175)	(0.332)
R&D/sales		-0.010	-0.010	-0.016
		(0.017)	(0.007)	(0.000)
CapEx				-0.178
				(0.053)
Cash burn rate	-0.270	-0.425	-0.345	-0.369
	(0.000)	(0.249)	(0.154)	(0.037)
IPO funds	-0.001	-0.001	-0.001	-0.001
	(0.000)	(0.096)	(0.098)	(0.244)
Firm age at IPO	0.002	-0.002	0.002	-0.004
	(0.289)	(0.528)	(0.506)	(0.322)
Percentage secondary	0.251	0.248	0.188	0.124
	(0.107)	(0.268)	(0.445)	(0.627)
Venture backed	-0.072	-0.087	-0.138	0.047
	(0.440)	(0.212)	(0.087)	(0.765)
Market characteristics:				
Underpricing	-0.270	-0.281	-0.309	-0.320
	(0.000)	(0.044)	(0.014)	(0.001)
Post-IPO return	-0.986	-0.815	-0.951	-1.160
	(0.000)	(0.034)	(0.002)	(0.000)
Trading volume	0.021	-0.004	-0.008	0.064
	(0.631)	(0.909)	(0.847)	(0.208)
High IPO actvity	0.064	-0.056	-0.070	-0.396
	(0.292)	(0.594)	(0.594)	(0.011)
Low IPO activity	-0.131	-0.146	-0.129	-0.334
	(0.084)	(0.080)	(0.143)	(0.032)
Number of subjects	3280	2297	1995	781
Number of failures	1543	1029	879	365
Log likelihood	-3538.1	-2407.1	-2060.4	-803.1

Table 6: Predicting whether a firm obtains post-IPO financing

Coefficient estimates from Probit models predicting whether a firm that completes an IPO subsequently completes another financing within two years. The models compare firms that raised additional capital within two years of their IPO to firms that were still trading two years after their IPO and that did not obtain post-IPO financing. The dependent variable equals 1 if the firm completes a subsequent financing and 0 otherwise. All variables are defined in earlier tables. Data are for the 3,729 firms, from a sample of 4,054 firms that completed an IPO between 1990 and 2005, that were still publicly traded two years after their IPO. Firms that merge or delist within two years of their IPO are excluded. p-values are reported in parentheses. The coefficient estimates of industry and year dummy variables, which are also included in the models, are not tabulated.

	Model			
	(1)	(2)	(3)	(4)
Constant	-0.778	-0.705	-0.746	-0.801
	(0.000)	(0.000)	(0.000)	(0.000)
Firm characteristics:				
Intangible asset ratio	0.553		0.714	0.529
	(0.012)		(0.025)	(0.330)
R&D/sales		0.010	0.012	0.016
		(0.052)	(0.057)	(0.038)
CapEx				0.029
				(0.754)
Cash burn rate	0.299	0.415	0.327	0.423
	(0.003)	(0.003)	(0.020)	(0.028)
IPO funds	0.001	0.001	0.001	0.001
	(0.001)	(0.012)	(0.060)	(0.285)
Firm age at IPO	-0.002	0.001	-0.002	0.001
	(0.141)	(0.445)	(0.344)	(0.864)
Percentage secondary	-0.234	-0.214	-0.205	-0.086
	(0.080)	(0.275)	(0.316)	(0.707)
Venture backed	0.067	0.069	0.106	-0.017
	(0.453)	(0.347)	(0.208)	(0.902)
Market characteristics:				
Underpricing	0.133	0.133	0.167	0.215
	(0.054)	(0.074)	(0.035)	(0.019)
Post-IPO return	0.728	0.527	0.677	0.868
	(0.000)	(0.000)	(0.000)	(0.000)
Trading volume	-0.020	-0.012	-0.009	-0.080
	(0.488)	(0.682)	(0.767)	(0.091)
High IPO actvity	-0.012	0.080	0.111	0.337
	(0.838)	(0.212)	(0.228)	(0.016)
Low IPO activity	0.140	0.143	0.141	0.343
	(0.072)	(0.034)	(0.049)	(0.004)
N	3016	2115	1832	708
Log-likelihood	-1962.5	-1382.4	-1180.4	-437.7
Pseudo R^2	0.061	0.0565	0.069	0.107

Table 7: Predicting whether a firm obtains post-IPO financing

Coefficient estimates from a multinomial logit model predicting whether a firm that completes an IPO subsequently completes another financing within two years. The default for the dependent variable is that the firm is still trading and has not issued at the end of two years. The other outcomes are that the firm raised more capital wthin two years, the firm delisted before raising capital, or the firm merged with another firm before raising capital. All variables are defined in earlier tables. The coefficient estimates indicate how the independent variable affects the likelihood of being in the group. For example, *intangible assets* has an estimated coeffcient of 1.074 for the issued group. This indicates that a firm with more intangible assets is more likley to raise capital rather than to be still trading without having raised capital. Data are from a sample of 4,054 firms that completed an IPO between 1990 and 2005. p-values are reported in parentheses. The coefficient estimates of industry and year dummy variables, which are also included in the models, are not tabulated.

	Raised More Capital	Delisted	Merged
Constant	-1.261	-1.605	-3.634
	(0.000)	(0.047)	(0.012)
Firm charcateristics:			
Intangible asset ratio	1.150	1.951	1.404
	(0.027)	(0.098)	(0.041)
R&D/sales	0.020	0.037	-0.024
	(0.067)	(0.000)	(0.063)
Cash burn rate	0.602	1.038	-0.004
	(0.027)	(0.001)	(0.991)
IPO funds	0.002	-0.022	0.002
	(0.051)	(0.185)	(0.120)
Firm age at IPO	-0.004	-0.041	-0.002
	(0.332)	(0.049)	(0.805)
Percentage secondary	-0.312	-4.392	-0.276
	(0.343)	(0.053)	(0.715)
Venture backed	0.167	-0.277	0.563
	(0.211)	(0.085)	(0.074)
Market characteristics:			
Underpricing	0.267	-1.404	-0.331
	(0.024)	(0.000)	(0.074)
Post-IPO return	1.058	-1.501	-0.366
	(0.000)	(0.005)	(0.085)
Trading volume	-0.006	0.184	0.052
	(0.891)	(0.029)	(0.173)
High IPO actvity	0.164	0.651	0.122
	(0.272)	(0.083)	(0.463)
Low IPO activity	0.239	-0.050	0.248
	(0.039)	(0.912)	(0.534)
Number of observations		1995	
Log-likelihood		-1,741.3	
Pseudo R^2		0.100	