Law, Finance, and Venture Capital:

The Cost of Capital for High-Tech Firms

1. Introduction

Private equity funding for high-technology firms in the form of professional venture capital partnerships began in the United States. Over the last two decades, however, this form of financing has expanded into a variety of legal and institutional settings, including Europe and Israel. This growth provides an interesting natural laboratory for examining institutional variation among countries: how does financing for innovative start-ups occur in different settings? In this paper, we consider the relationship between institutional environment (tax rates, bankruptcy laws, etc.), contracting with investors, and cost of capital for privately-backed, high-technology (biotechnology and pharmaceutical, semiconductors and electronics, services, software, and telecommunications) firms in the U.S., Europe, and Israel.

A number of researchers have recently examined how contracts differ for private equity investments across countries and legal settings, but the actual relationships underlying the contracting environment, investor relations, and valuation remains under-studied. Kaplan, Martel, and Strömberg (2003) examined contractual arrangements in various legal environments, but did not focus on valuation; Lerner and Schoar (2004) analyzed the valuations of relatively

mature firms in various emerging market legal environments in Latin America, Asia, and Eastern Europe. Neither of these recent treatments focus on *de facto* relations between private equity investors and portfolio firms, such as the provision of non-pecuniary advice (Gorman and Sahlman, 1989) and valuable introductions and the certifying effect associated with sophisticated VC investors (Hsu, 2004), which might vary in different institutional settings. Jeng and Wells (2001) and Armour and Cumming (2003) examined differences in legal and regulatory environments, but did not examine firm-level effects of such variation on performance, valuation, or the amount of money raised in individual venture capital financing rounds.

In this paper, rather than emphasizing *de jure* legal provisions that reflect aspects of investor-entrepreneur contractual negotiations, we examine the underlying, *de facto* relationship from the point of view of the manager of the portfolio firm. We also examine variation in performance as well as non-pecuniary assistance in various legal and regulatory jurisdictions. Our findings thus relate to those of Hellman and Puri (2000, 2003) and Kaplan and Strömberg (2004), but in a comparative setting.

Fundamentally, this paper seeks to analyze the nature of relationships between investors and portfolio firms in various environments and how these relationships relate to cost of capital and performance. To study this, we use a hedonic data set comprising 351 companies located in seven leading national VC markets in relatively advanced capitalist countries (France, Germany, Israel, the

Netherlands, Sweden, the United Kingdom, and the United States). Unlike data used in previous valuation studies that are based on information from VC partnerships, our "unfiltered" data originate from interviews with managers of the portfolio firms themselves. This reduces potential bias associated with the possibility that VC firms have an incentive to provide information only on their successful investments. The nature of the data also allows us to examine in some detail a large number of factors that may relate to the valuation and performance of early-stage, high-technology companies that were generally not present in previous empirical studies. These factors include variables relating to management team characteristics, exit strategies, patents and their usefulness, investor relations, and non-pecuniary assistance.

Denis (2003), in his review of the entrepreneurial finance literature, noted that capital for early-stage, high-technology firms is usually equity-based[1] and comes from professional venture capital firms (VCs), angel investors, the venture capital divisions of existing corporations (CVC), as well as other sources (e.g., corporate funding not from CVC, government, managers/founders, employees).

[1] Berger and Udell (1998) discuss why debt is inappropriate for early-stage innovative, high-technology firms. In general, typical bonds and bank loans are rarely a possibility for early-stage, high-technology firms because they generally do not own tangible assets to pledge and are not yet profitable, so they would be unable to make regular interest payments. Regarding the importance of leverage in equity valuation, most of the firms in the data set used in this paper possess relatively little debt, and leverage is a fairly minor factor in the valuation of such firms. Denis (2003) discusses the importance of equity (vs. debt) in funding early-stage companies, particularly in an international context. Note that we do not analyze the contractual terms of the investment (e.g., preferred convertible stock vs. pure common equity); for information on such *de jure* contractual details, see Kaplan, Martel, and Stromberg (2003) and Gompers and Schoar (2004). Rather, our study contains details on the type of investor (i.e., VC, angel, corporate VC, other), the amount invested by each type, and the *de facto* relationships between investors and portfolio firms. Jones and Rhodes-Kropf (2003) discuss the implications of systematic vs. unsystematic risk in venture capital investing.

VCs employ managing (or general) partners who collect and invest money primarily provided by the limited partners (the ultimate investors who fund the VC partnership). Previous studies have examined the special nature of VC funding, using a dummy variable to indicate whether any funding from VCs was received by a portfolio firm. Given that VCs may very well have different incentives if they are minority, lead, or majority investors, we improve upon these measures by examining the *portion* of the financing round that comes from various types of investors. In addition, we consider the relative sophistication of the VC investors (i.e., depth of industry experience and number of other portfolio firms in the same industry), and incorporate that into our analysis. We also include other variables that appear in other existing valuation studies.

We arrive at several major findings. First, we document a number of significant differences between firms located in the U.S. and those outside of the U.S., and between firms located in common law as opposed to civil law legal environments. These mainly relate to valuation, ownership ratio, investor relations, management team strength, and exit strategy. Second, we examine the relationship between venture capitalist sophistication or learning and valuation, and confirm a positive relationship between investor sophistication and the provision of advice, aid, and non-pecuniary services. Third, although holding patents does not robustly and positively relate to valuation of a portfolio firm, usefulness of those patents does. Finally, we find that institutional environment matters: firms located in the U.S. and in common law legal tradition countries

have a lower cost of capital than their counterparts; within Europe, firms face a lower cost of capital if they have more conducive regulatory environments for venture capital. Our findings inform the growing literature on international differences in private equity contracting by contributing detailed information on the *de facto* relationships between investors and their portfolio firms and by examining actual valuations and performance of companies in various national *de jure* legal and regulatory environments.

The paper proceeds as follows. Section 2 describes the data and introduces the new variables we construct based on the survey responses. Section 3 examines cost of capital (valuation) of high-technology firms in our data set. Section 4 explores contracting of high-tech firms in different legal and institutional environments, using a new dependent variable (the ownership ratio) measuring the portion of equity ownership purchased by the investor in a given round of financing. Section 5 concludes.

2. Data, Variables, and Models

Data

The main purpose of this paper is to document the firm-level effect of variation among private equity markets in different regulatory and legal environments. To do this, we employ a data set based on a professionally-conducted survey of executive officers for firms that received their seed or A-round of private equity financing in the period from January 1, 1998, through

June 30, 2001.[2] The firms were initially randomly selected from VentureOne's VentureSource database, which is commercially available. Gompers and Lerner (2000) based their study on that data set as well, although their analysis included only firms that received funding prior to 1996, and was restricted to U.S. companies.

Due to the detailed nature of our survey, and the expense of contacting anc interviewing managers in various countries speaking different languages, we focus on only a sub-set of the possible universe of high-tech firms. The Appendix contains detailed information on the number of surveyed companies that agreed to provide information relating to valuation and amount raised for at least one financing round.[3] Our data set reflects stratified survey sampling, motivated by a desire to have a statistically valid number of firms representing each of the high-technology industry categories of interest: biotechnology and pharmaceuticals, semiconductors and electronics, services, software, and telecommunications. For

[2] Using the original VentureOne data that provided the universe of firms that we sampled, we selected only firms that had received their first round of funding from January 1, 1999 through to June 30, 2001. We only chose firms in the industries of biotech and pharmaceuticals, semiconductors and electronics, services, software, and telecommunications. Once we contacted these firms, we discovered some errors in the VentureOne data base, such that a number of these firms actually received funding before January 1, 1999. Thus, the present study includes firms that reported to us that their initial round of funding was received any time between January 1, 1998 and June 30, 2001. We consider all initial funding rounds of less than $1,000,000 as "seed" funding rounds (any initial funding round of greater than this amount is considered a "first" round of funding).

[3] The companies analyzed in this paper were selected from VentureOne's VentureSource database, which contains data on privately held firms. For each industry group in the study, we randomly selected a portion of firms to be contacted, with the provision that they had to have received their first round of financing in 1998, 1999, or 2000. Firms that agreed to an interview were then asked questions concerning the number of financing rounds and the company characteristics at the time of the funding event. The appendix indicates the total population of firms, the number contacted, those that agreed to an interview, and the numbers that revealed information concerning the amount of money raised in and the pre-money valuation for the funding event.

example, of the total universe of firms indicated in the data base as receiving financing in the period we consider, we interviewed a total of 8%, of which three-quarters (6% of the entire data base) provided valuation information from at least one round of financing. The portion of firms interviewed within industries ranged from a high of 25% of biotechnology and pharmaceutical firms to a low of 5% in services companies since many more services companies existed in the VentureSource data base.

Unlike previous firm-level valuation studies that examine either only the United States or emerging market settings, we include companies located in Western Europe and Israel, allowing us to consider countries with a diverse range of legal traditions. The common law countries in our data are the United States, United Kingdom, and Israel; the civil law countries are France, Germany, the Netherlands, and Sweden (see Table 4, Panel D for a break-down of observations by country).[4] Given the size of the U.S. and UK venture capital markets, we have more observations for common law firms than for civil law firms, but more observations for non-U.S. firms than for U.S. companies.[5]

[4] La Porta, et al (1997) and Lerner and Schoar (2004) differentiate common law legal origin from French, German, and Scandinavian legal family. In this paper, given the fact that we had only one country from each of the German and Scandinavian legal families (Germany and Sweden, respectively), we do not differentiate among the French, German, and Scandinavian legal traditions, grouping them all into an umbrella "civil law" category to distinguish them from common law traditions.

[5] When computing valuation, the amount raised, and quarterly sales figures, non-U.S. currencies were converted to U.S. dollars at the average exchange rate for the quarter in which the financing round took place (other currencies included UK pounds, French francs, German marks, Dutch guilders, Swedish kroner, and Israeli shekels) Given the large number of disparate currencies, and the relative stability of exchange rates in the period under study, our results are fairly clearly not being driven by foreign exchange prices. In terms of portfolio diversification, note that from the U.S. perspective, non- investments in non-U.S. countries might contain advantages which should

The survey was conducted in late 2001 by personnel who had achieved certification under the Interviewer Quality Control Scheme (IQCS) in accordance with the Market Research Society Code of Conduct, guaranteeing the interviewees total anonymity and confidentiality. Various portions of the survey, including the valuation data, were double-checked and triple-checked by the professional survey personnel, and respondents were re-contacted for verification in the event of discrepancies between the commercially available data base and the interview information.[6] Nevertheless, due perhaps to privacy concerns or unwillingness to answer all questions, some data are incomplete for some financing rounds, leading to differences in the number of observations for the various statistical tests we perform. However, we were able to obtain data on valuation from a much higher portion of firms than in the commercially available data base that formed the universe from which we chose sample firms, and due to the exhaustive checking procedures we employ, have confidence that the resulting valuation and other data are of high quality.

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lead to higher valuations than otherwise expected. Our finding that non-U.S. valuations are in fact lower, *ceteris paribus*, may actually be understated because of this portfolio diversification issue.

[6] In addition, two separate stages of spot checks were performed by high-technology industry experts regarding financing round information using web site information for the companies included in the survey. We found that, based on the numerous discussions with managers of start-ups, a number of early seed and startup financing rounds were omitted from the original VentureOne database, perhaps especially in Europe. Information on these rounds is important—uncorrected regression results (available upon request from the author) show that the raw database numbers indicate significantly *lower* valuations in countries with common law legal origin. Even selecting only the firms included in the survey (and there were many firms for which analogous financing rounds could not be found between the two data sets—meaning the disagreement as to the timing of the round closing date was off by more than one quarter [three months]), our findings were reversed compared to the higher quality data set that had been verified through the professionally conducted survey of portfolio firm managers.

New Variables

In addition to a vector of control variables introduced in previous valuation studies (Gompers and Lerner, 2000; Lerner and Schoar, 2004), we use the survey responses to develop a number of new variables which are either previously unexamined or are finer operationalizations of variables used in previous studies. The following new or refined variables include: investor sophistication, ownership ratio (amount raised divided by pre-money valuation in the funding round), portion of the invested funds coming from VC partnerships (as opposed to angel investors, corporate venture capital, and other sources), whether the portfolio firm had patents and if they were considered useful by the managers, management team strength, types of non-pecuniary services (aid and advice) offered or accepted by the portfolio firms, foreseen exit (trade sale or IPO), and replacement of management.

1. Investor Sophistication

In the negotiations surrounding private equity contracts, potential new investors generally try to obtain low valuations (so that the amount raised will purchase a larger amount of the firm's post-money equity), whereas founders and existing investors will try to obtain higher valuations, in order to maintain ownership of a higher portion in the firm's total equity. Thus, more sophisticated investors may find it easier to negotiate lower valuations, because their reputation and abilities will be associated with improved non-pecuniary assistance (Gorman

and Sahlman, 1989), or because of the reputation-based certification they offer to the portfolio firm (Hsu, 2004). Kaplan, Martel, and Strömberg (2003) examine the importance of learning by investors. In their paper, controlling for the level of sophistication of investors, legal setting (common law, etc.) does not have a significant relationship with contractual provisions. To measure investor sophistication, we construct a (dummy) variable, SOPHIST, equal to 1 if either the investor had significant management experience in the industry, or if the investor had numerous other portfolio companies in the same industry.[7]

2. Ownership Ratio

VC investments outside of the U.S. are generally associated with weaker liquidation and exit rights; contracts written in common law countries contain more rights and provisions than their civil law counterparts. Whether or not *more sophisticated* VCs introduce additional covenants in contracts for early-stage firms located in non-common law based countries remains an open question. Kaplan, Martel, and Strömberg (2003), who examined VC contracting in 23 countries, concluded that when the sophistication, experience, and age of the VC are considered, differences in legal systems across countries become insignificant in explaining differences in contractual terms. Conversely, Lerner and Schoar

[7] The questions on the survey were worded: "How many other companies in your industry were in your lead investor's portfolio at the financing event?" and, "How would you describe your lead investor's level of experience in your industry during the financing event: (1) no management experience at all, (2) little management experience, (3) some management experience, or (4) a lot of management experience." The sophisticated investor dummy variable was set equal to one if the survey respondent indicated that the investor had more than 10 other companies in the same industry, or had "a lot" of management experience in the industry.

(2004) found that contracts differ significantly across legal regimes, even controlling for the sophistication (legal origin) of the venture capitalist firm.

In the current paper we construct a variable, OWNRATIO or ownership ratio, which is the amount of money raised during the financing round divided by the pre-money valuation at that point in time. Several of the other variables in our paper may be associated with the ownership ratio. For example, if more sophisticated investors rely on complex contractual provisions as opposed to demanding a greater share of equity, sophisticated investors should be associated with a *lower* ownership ratio. Conversely, investors in common law legal environments where contractual provisions are more complex and easier to enforce might more willingly obtain a lesser share of the equity of portfolio firms. This would indicate that a larger ownership ratio should prevail in civil law countries where investors rely on significant portions of equity ownership, eschewing complex contractual provisions such as liquidation and exit rights. Finally, if certification and non-pecuniary services associated with sophisticated investors are important, sophisticated investors should be able to negotiate a larger ownership ratio, purchasing more of the firm's equity with a given investment amount. We will test each of these hypotheses.

3. Portion of VC Funding

VCs, more than other types of investors, seem to perform an important monitoring and mentoring role for their portfolio firms. VCs arrange staged

financing requiring that firms make specific progress, often documented through the use of execution reports, before receiving additional funding (Gompers 1995). Kaplan and Strömberg (2004) examined the investments of eleven VC partnerships in 67 different portfolio companies. While they mainly studied contractual issues, they included some basic analysis of valuation of U.S. companies. They found that firms receive significantly lower valuations given greater degrees of "external" risk (a measure related to market risk, competition risk, customer adoption risk, and financial market/exit risk). Hellman and Puri (2000, 2003) found that VCs, relative to other types of private equity investor, tend to facilitate more innovative product lines, improve the professionalization of management, and increase the sophistication of human resource practices. For example, VCs help early-stage firms to hire sales and marketing personnel, administrative and managerial personnel, and senior managers; assist them in the efficient adoption of stock option plans; and, when required, expeditiously replace a founding CEO with a professional CEO.

Hellman and Puri (2003) operationalize VC involvement using a dummy variable capturing whether a firm received any funding from a professional venture capital firm. This method does not take into account the fact that VCs in a minority shareholder position may face different incentives than VCs that act as the lead, majority, or sole investor. We refine the measure through use of a variable, VCPORTION, reflecting the *actual portion* of the financing round raised from professional VCs vis-à-vis other types of investors. We use include this

variable in analysis of whether management replacement was recommended or required by investors.

4. Patents and their Usefulness

Previous studies have examined the importance of patents in high-technology firms, and whether VCs are effective at spurring innovation (Kortum and Lerner, 2000). We postulate that possession of patents may be related to valuation. We construct the dummy PATENTS that takes the value of 1 if the firm had patents at the time of the funding round. To differentiate the effect on valuation of mere possession of patents from the effect of holding important patents we construct a second dummy variable USEFUL that takes the value of 1 if the patents were considered "useful" for generating such barriers by the interviewed manager of the portfolio company.[8]

5. Management Team Strength

Kaplan and Strömberg (2004) evaluated how VCs utilize the management team's strength during the screening process when making an investment decision. They found a significant and positive relationship between the VC's initial appraisal of the management team and the entry-stage firm's subsequent performance. They also analyzed management team strength using a dummy variable capturing whether the CEO is a repeat entrepreneur, but they found no

[8] The question on the survey was worded, "Do you think these patents are significant to your strategy and to establishing barriers, by giving you a competitive advantage?"

significant relationship between this variable and valuation. Our data contain considerably more detail about the strength of the major management team positions, and we incorporate it into our analysis. Hellman and Puri (2003) examined professionalization of management team staff, but they did not empirically measure the relationship between management team strength and valuation.[9]

We construct a measure, MGTINDEX, which is a ranking of the scores of the management team survey responses relating to positions filled and experience level of the named positions (CEO, VP Sales, CTO, and VP Engineering). This measure is based on an established method for measuring the overall effect on high-technology firm valuation of several types of geographical proximity (the GeoIndex measure of Boasson, Boasson, McPherson, and Shin, forthcoming). Both indices are transparent and straightforward techniques for measuring how valuation is related to intangible but nevertheless important issues. The score is calculated as follows:

$$MGTINDEX_{j,k} = \sum_{i=1}^{N} rank_{i,j,k} \ ,$$

where i represents each of five (N) management team survey questions, and j represents each funding round for each firm k. We ranked the responses, with

[9] Note that causality between valuation and management team strength may be difficult to determine. Firms with more experienced management teams may well receive higher valuations, reflecting a greater ability to achieve successful outcomes when confronted with adverse conditions or unforeseen problems. At the same time, firms with good prospects that should achieve a high valuation may be better able to attract more experienced management. We thus examine the relationship between management team strength and valuation without drawing causal inferences.

higher ranks for funding rounds with more management team positions filled or with higher experience levels of the named positions.[10] The MGTINDEX score represents the sum of these rankings; the higher the score, the better the management team.

6. Non-Pecuniary Services

Hsu (2004) demonstrates that VC firms with better reputations obtain equity in portfolio firms at a 15% discount relative to less sophisticated investors. Although a certification role probably explains a large portion of this discount, another reason may be related to the value-added services that more sophisticated and experienced investors provide for their firms, which can take many forms. Our survey included questions related to customer introductions, strategic alliance introductions, portfolio company alliances, recruitment and hiring, marketing and public relations, financial management, engineering and product development assistance, real estate assistance, strategy development, and technology assistance.

This non-pecuniary assistance provided by investors may affect valuation, such that VCs could negotiate a lower valuation if accompanied by a promise to provide key introductions and assistance. We construct a variable, NUMSVCS, which is the sum of all types of non-pecuniary assistance provided by the investor. We imagine that this is an important aspect of the contracting

[10] The management team questions related to the number of top managers and of the experience levels for the CEO, Vice President of Sales, Chief Technology Officer, and Vice President of Engineering. Exact wording of the questions and data for the MGTINDEX by country, stage of development, and industry is available from the authors on request.

negotiation, since VCs or other investors that provide more assistance may be able to negotiate a lower valuation, purchasing more of the firm's equity with a given fixed investment amount.

7. Exit Strategy

Venture capital investments generally have a finite horizon. Partners will invest money, work with the portfolio company managers, and then eventually liquidate the VC's ownership stake either due to bankruptcy, trade sale (acquisition), or initial public offering. If the national institutional environment discourages public equity markets, this may affect the exit strategy of the portfolio firm (Black and Gilson, 1998; Cumming and MacIntosh, 2003). To examine this, we construct a variable, SALEEXIT, equal to "1" if the manager reported that the firm was considering an acquisition as the exit option for the firm.

8. Management Replacement

It is generally believed that entrepreneurs who are skilled at envisioning new products and creating start-up firms are often not the best managers of the routine affairs typical in an established, more mature company. Hellman and Puri (2003) examined the replacement of founding entrepreneurs by professional CEOs, finding that VC investment is important for the replacement of managers. To examine this finding in light of potentially different incentives based on

various levels of VC participation in a funding round, we construct a variable, MGTREPLACE, equal to "1" if the investors recommended or required replacement during the funding round.

Descriptive Statistics

Table 1 displays descriptive statistics for the variables relating to the type and number of financing rounds, and for the mean pre-money log valuation calculations.[11] As indicated in Panel A, we had valuation information on 290 financing rounds for early-stage companies (portfolio firms in the start-up, product development, or beta testing stage). We also had valuation information from 193 financing rounds which were expansion stage investments (portfolio firms in the shipping, multiple release, or profitable stage of development). Summaries of valuation observations broken down by stage of development, industry, and country are presented in Panels B, C, and D.

Panel E of Table 1 illustrates variation in investor contribution by type of financing round. This table indicates that U.S. firms more frequently received funding from angel investors and that European firms more frequently received funding from corporate venture capital and "other" sources. Examining firms in both areas, we see that angel funding occurs most prevalently during the early "seed" stage of financing (here defined as any financing round less than 1,000,000

[11] To ensure that outliers were not driving our results, we removed from the valuation observations all funding rounds with natural log valuations either above or below four standard deviations from the mean.

U.S. dollars or their equivalent calculated using the average exchange rate for the relevant quarter). CVC funding remains fairly low, such that for firms in the seed round, an average of 5.60% of funds came from this source. Professional venture capital partnerships account for between 42.77% and 65.56% of funding, on average. Finally, other sources provided from 9.17% to 34.83% of the investment for the funding rounds broken down by type.

Angel investing in the U.S. appears very important, as it accounts for almost half of all funding, on average, during the seed round. Angels, in fact, maintain a high level of involvement in firms even as late as the second and third rounds, accounting for 17.04% and 11.61% of all invested funds, respectively. We see the opposite situation outside the U.S., with angel investors providing only 23.84% of funds in the average seed round, declining to below 15% for the other rounds. At every stage of development, non-U.S. firms receive much more money from "other" funding sources; even in the seed round, over a quarter of funds raised were from this source. The high figure for the last "over third" category (including all fourth, fifth, etc. funding rounds) reflects the fact that in four of the eight such funding rounds in Europe, 100% of the financing came from other sources.[12]

Methodology

[12] We also examine the statistical significance of these differences, the results of which are presented in Table 4.

We make use of a number of different econometric techniques in our analysis. For models with dependent dummy variables (Table 3, column G and H; Table 5, column A), we perform logit regression analysis, using robust estimation (i.e., correcting error terms for heteroskedasticity). For models (Table 3, columns A, B, and C) with the dependent variable NUMSVCS that measures the number of types of non-pecuniary services received or offered by the investors to the portfolio firm during the funding round, we considered Poisson regression (after Gompers and Lerner, 1996), which is ideal for the non-negative, ordinal nature of the dependent variable. Since the mean and variance of NUMSVCS were quite different, however, we employ negative binomial regression. We used a fixed-effects generalized least squares (GLS; within) model to estimate the time-varying, firm-specific relationship between management team strength (MgtIndex) and portion of VC funding.

For all of the other models we estimate (specifying as dependent variables the log of pre-money valuation, the log of amount raised, and the ownership ratio), we use robust ordinary least squares ("robust" again referring to heteroskedasticity-corrected error terms). Following Gompers and Lerner (2000), we performed (unreported) generalized least squares robustness checks to account for possible correlation of residuals that can occur even using robust estimation; we found identical signs and generally very similar levels of significance on the

coefficients.[13] In general, perhaps due to the detailed nature of the survey questions and resulting high level of information about the firms in our study, the coefficient of determination (R^2) in our valuation specifications is higher than in previous valuation analyses.

The control variables are listed in each specification, but for ease of presentation we do not report coefficients for the battery of dummies relating to stage of development, industry, and type of funding round. Due to occasionally missing data for some observations, we were forced to choose our variables with a goal to maximizing the number of observations while at the same time including as many controls as possible. Where appropriate, we replicate the control variable set of Gompers and Lerner (2000), although not all of the variables available to them were available to us.[14] For example, we generally control for the natural log of number of employees, log of quarterly sales, the type of round (seed, first, etc.), the industry (biotech, etc.), and market timing variables (including industry index and inflows into VC partnerships to account for the money chasing deals effect, an important factor in the time period under examination). We also control for

[13] We did not obtain GLS results for the logit estimations in Table 6 columns A and B, for which the number of observations was too low to generate meaningful results (we restricted these tests to European observations only), and for the poisson regression reported in Table 7 column B. For the other GLS tests, the few exceptions to levels of significance compared to the robust OLS tests are as follows (signs on coefficients were identical for all statistically significant results reported in Tables 5, 6, and 7): the coefficient for patents in Table 6 column E and on Table 8 column B was not statistically significant; the coefficient on VC financing in Table 7, column A was not statistically significant; and the coefficient for industry index on Table 8 column B was not statistically significant. None of these changes the major findings of the paper, and full reports for the GLS results are available from the author.

[14] Notably, our measure for firm age was unfortunately badly worded and vague and provides little explanatory power in multivariate models, although it allows us to make simple conclusions about average age (recall Panel A of Table 2).

firm stage of development, except in the estimation where we split the sample into early-stage (startup, development, and beta) and expansion (shipping, multiple, profitable) financing rounds (Table 5 columns G and H). See Table 1 for descriptive statistics of the variables used. A summary of the hypotheses we examine, each motivated in the "new variables" section above, is listed in Table 2.

3. Analysis of the New Variables

We begin our econometric analysis with a series of estimations to examine the new variables we introduce in this paper, the results of which are reported in Table 3. Columns A, B, and C presents results on the relationship between number of services and investor sophistication. We estimate negative binomial regression models designed to consider variation in NUMSVCS. Column A presents univariate results indicating that sophisticated investors provide more types of assistance. Column B confirms these results, holding for round, industry, and stage dummy variables. As indicated in Column C, our measure of management team strength is not associated in a statistically significant way with the number of services received or offered. We did find, however, that, controlling for the firm's stage of development, round type, and industry, sophisticated investors provided more non-pecuniary services on average. This finding is consistent with the literature on VC assistance (Gorman and Sahlman, 1989; Hsu, 2004). More sophisticated investors may be more likely to become aware of problems and provide assistance to solve them.

The relationship between management team strength, measured by our MGTINDEX variable, valuation, and amount raised is included in Columns D and E. Controlling for round, stage, and industry dummies, we find that the variable does indeed enter with a positive and significant coefficient, providing initial evidence that good managers are either able to find firms with high valuations, or that management team strength helps determine a higher valuation. In addition, consistent with Hellman and Puri (2000, 2003), we found that investor type matters for the size and professionalization of the management team. As indicated in Column F, in a fixed-effects (within) generalized least squares regression to examine changes over time in the same portfolio firm, companies receiving greater portions of VC funding (vis-à-vis funding from other sources) had stronger management teams, controlling for type of funding round (seed, first, etc.) and stage of firm development (start-up, product development, etc.).

The relationship between venture capital and development of *useful* patents has been documented for the United States (Kortum and Lerner, 2000), a finding we now extend in an international context. Column G of Table 3 presents the results of a regression considering only countries outside the U.S., and includes a variable measuring the extent of VC funding relative to other sources (angel, CVC, other). The results indicate that increased VC funding is significantly and positively related to the probability that non-U.S. high-technology firms will possess useful patents.

In Column H of Table 3, the dependent variable equals 1 if management replacement is either recommended or required by the investor(s) and 0 otherwise. Assuming that more experienced management teams less likely need replacement, we include the management team index variable in this estimation. Consistent with the arguments of Hellman and Puri (2000, 2003), we find that the portion of professional venture capital partnership involvement in the financing round is significantly and positively related to the probability of management replacement. This suggests that a higher likelihood of management replacement occurs in financing rounds dominated by VCs (as opposed to angels, corporate venture capital, or other sources). At the same time, firms with better management teams (operationalized here by a higher management team index score) are less likely to face requirements or recommendations for replacement, indicated by the negative and significant coefficient for that variable. Finally, firms that are provided a larger number of services are more likely to face the requirement or recommendation of management change.

4. Institutional Variation and Cost of Capital

The Cost of Capital for High-Technology, Privately-Held Firms

Many factors affect the equity cost of capital for high-technology firms, and its precise measurement poses some interesting problems. Bond traders often quote fixed income instruments not by their price but in terms of their yield

(which of course moves in opposite direction as the price); conversely, we can measure the equity cost of capital for private investments in terms of valuation. Assume that a fixed investment of $1,000,000 is being invested in a portfolio firm. The higher the "pre-money" valuation, the lesser the portion of the existing firm's equity is purchased by that fixed investment.[15] We therefore can indirectly measure a firm's equity cost of capital by examining its valuation because a firm with a higher valuation, *ceteris paribus*, has a lower cost of capital. To see this, consider two nearly identical firms (with identical future cash flows) that have different valuations. To arrive at a different valuation, the identical future cash flows must have been discounted at a higher rate for the firm with the lower valuation, corresponding to a higher cost of capital. Thus, valuation data can be used to study the equity cost of capital for unlisted, high-technology firms.[16] In this paper, we compare valuations in a number of different legal environments in order to draw conclusions about resulting variation in the cost of capital facing firms in those various settings.

Although growing, the number of venture capital partnerships focused on financing early-stage firms based in Western Europe is low compared to the U.S. (Armour and Cumming, 2003; Jeng and Wells, 2001). In addition, most European

[15] A "pre-money" valuation of $2,000,000 means the $1,000,000 investment purchases one-third of the firm's equity (because it constitutes one-third of the "post-money" valuation of $3,000,000); a "pre-money" valuation of $3,000,000 means the investment only purchases one-quarter of the firm.

[16] The expected timing and quantity of cash flows, of course, could also vary among the firms in our data set, so the valuation is clearly not driven only by the discount rate. To control for this, we include a number of explanatory variables also used in previous research (i.e., Gompers and Lerner, 2000).

private equity outlays are devoted to later-stage, buy-out funds that are very different from the early-stage, high-technology companies studied in this paper (PricewaterhouseCoopers, 2001). Since European firms operate in locations farther away from the major global sources of early-stage venture capital, we might expect firms located there to have lower valuations compared to firms located in the United States. Recent research focusing on international finance also suggests a connection between location and valuation. For example, Mayer, Schoors, and Yafeh (2003), studying evidence on investment sources in Germany, Israel, Japan, and the U.K., find that the identity of VC limited partners and the geographic spread of investment varies significantly in different countries.

The nature of a country's legal system may also impact valuation, providing a way in which location and valuation may be linked. La Porta, et al. (1997) showed that national financial market development depends critically upon the degree of investor protection afforded by law. In another paper, they found that publicly-traded companies operating in countries with common law as opposed to civil law legal systems had higher valuations, other things equal (La Porta, et al., 2002). Firms in common law environments may have lower equity cost of capital due to greater certainty associated with investor legal recourse. Indeed, Demirguc-Kunt and Maksimovic (1998) found that firms located in countries with common law legal systems were more likely to obtain long-term external debt and publicly-traded equity financing compared to firms located in less investor-friendly legal environments. These findings suggest that early-stage

firms located in European countries with legal systems based on French, Germanic, and Scandinavian traditions (together, civil law systems) would have lower valuations than comparable firms located in the U.S., U.K. and Israel (with common law legal systems). Capital market characteristics affect pre-money valuation in the theoretical model of Inderst and Müller (2003). Lerner and Schoar (2004) present some evidence of this for firms in emerging market countries in Latin America, Asia, and Central and Eastern Europe. Common law countries also tend to have better relative development of equity markets that serve as a vehicle for IPO exits (Black and Gilson, 1998; Jeng and Wells, 2000), an issue we study at the firm level.

Univariate Analysis of Variation in Institutional Environment

In order to examine *de facto* variation in firm-level effects of differences in institutional environments, Table 4 presents results from a number of univariate statistical comparisons between U.S. and non-U.S. firms (summarized in Panel A) and between firms located in countries with common law and civil law traditions (summarized in Panel B). For continuous variables (e.g., amount raised during the funding round, pre-money valuation, number of services provided), we report the p-values of T-tests for differences in means and nonparametric tests for differences in medians. Means of categorical questions ("yes" or "no" survey responses) represent percentages of the variables with "yes" responses equal to one (thus, if 20.5% of common law firms answered "yes" to a question, the mean

common law score on the table would be reported as 0.205). Note that for many questions, managers could provide more than one answer, as well as answer "other" or "refuse", and so the totals will not necessarily add up to 100%. We examined responses to a large number of survey questions, and report in Table 4 only summary data.[17]

U.S. firms in our sample were older than non-U.S. firms and common law firms were older than civil law firms. At the same time, U.S. and common law firms had gone through relatively more financing rounds, raised more money on average in each financing round, had higher valuations, and approached more potential investors compared to their counterparts. Firms in civil law countries received more term sheets on average, which may be inconsistent with the notion that contracts in such legal systems are dominated by simpler arrangements based on pure equity. In fact, we see no significant difference in the ownership ratio between firms located in common and civil law jurisdictions. Indeed, the average ownership ratio of U.S. firms—presumably located in the one of the most sophisticated contracting environments—significantly exceeds that of firms located outside the U.S. (true for both means and medians). We return to this finding when conducting multivariate results. U.S. firms had significantly better management teams, measured as either the mean or median of the management index score; common law firms had a significantly higher mean management index score, but the difference in medians was not significantly different.

[17] More complete tables, including analysis of many survey responses not listed here, are available from the author.

Table 4 provides additional information on firms' relationships with investors. The most striking finding reveals that firms in the U.S. and in common law countries reported receiving more kinds of non-pecuniary assistance relative to their comparison groups. U.S. firms, relative to their counterparts, more frequently held patents, and more frequently claimed that these patents acted as effective barriers to entry (later, we characterize this subset of patents as "useful"). Common law firms also showed more prevalent and more advantageous patent activity than their civil law counterparts. In addition, and perhaps indicating more effort devoted by investors, we found that the total number of execution reports required was significantly higher for U.S. firms.

Multivariate Analysis: Effect of Institutional Variation

We now empirically examine some potentially important legal and institutional variation, examining the coefficients for variables measuring venture capital environment, legal origin, and bankruptcy severity. In countries with better environments for venture investing (e.g., low capital gains taxes and robust capital markets), we expect that managers will be more likely to plan on an eventual IPO for their company, as opposed to the trade sale or acquisition option that would be relatively more prevalent in a country with a less amenable IPO institutional environment.

In Column A, we present results from robust logit analysis of managers reporting that they considered an acquisition or trade sale as the likely exit for

their firm.[18] Following Armour and Cumming (2003), we operationalize the institutional environment for venture capital and private equity using a measure constructed by the European Venture Capital Association (EVCA, 2004).[19] The measure is based on subjective scores for a number of national policies, such as those relating to fund structures, merger regulation, research and development subsidies, corporate tax rates, and other relevant issues (EVCA, 2004). On the whole, higher values indicate a perception of a more difficult environment for venture capital. Our results indicate that managers located in European countries with higher EVCA scores were significantly more likely to foresee trade sale as the expected exit strategy.[20] Column B of Table 5 indicates that, including the battery of control variables from Gompers and Lerner (2000), the EVCA score is related to valuation as well, such that firms in "better" institutional environments (lower EVCA scores) have higher valuations. Note that these two estimations include only firms in Europe, since EVCA scores are not available for the U.S. or Israel.

The model specifications reported in columns C through H of Table 6 address how patent activity relates to valuation and the amount raised in the funding round, including various controls. Previous valuation studies generally did not incorporate data on patents, despite the potential importance of barriers to

[18] The question was posed for each financing event and was worded: "What was your expected exit strategy?"—see Panel B of Tables 1 and 2 for break-downs of answers by jurisdiction.
[19] See Panel G of Table 4 for country scores used in our paper. No score for the U.S. or Israel was available, so regressions including the EVCA score include only European firms.
[20] In unreported regressions, we found that U.S. firms were more likely than European firms to consider the IPO as the expected exit strategy, but given that U.S. companies often reported more than one expected exit strategy, we reported the regression that focuses only on European firms.

entry in the business model of many high-technology firms. We find that the *presence* of patents does not significantly enhance valuation: controlling for their usefulness, the coefficient on patent possession is actually negative, and occasionally significant, in various specifications. But the *usefulness* of patents is robustly and positively related to valuation and to the amount raised. One interpretation of this result is that firms with patents but without useful patents potentially wasted resources on technologies that did not help the firm's prospects, resulting in lower valuations and in less money raised.

Columns C and D include a control variable for bankruptcy severity, using a measure applied by Armour (2003) to national-level venture capital activity. We find that greater severity of personal bankruptcy law has an effect similar to the finding of Armour (2003) and Armour and Cumming (2003), such that firms located in countries with more severe personal bankruptcy laws have lower valuations. This is consistent with their finding that such laws serve to dampen the demand for entrepreneurial finance, leading to lower valuations.

Columns F and G of Table 5 present results relating to geography and legal jurisdiction. Following Lerner and Schoar (2004), who study established companies in emerging markets, we find that firms in common law jurisdictions have higher valuations for high-technology firms in the U.S., Western Europe, and Israel. Given the importance of the U.S. firms in our sample, we include an additional dummy control variable in column F that equals 1 for U.S. companies. The fact that the common law dummy retains its positive, significant coefficient

suggests that the common law result is not being driven by the U.S. portion of the sample. Given the timing of our analysis and the importance of the Internet boom in the late 1990s and early 2000s, one might have hypothesized that valuations in this era would have been higher for U.S. firms than their counterparts. Our results do not support that hypothesis.

The final two columns of Table 5 examine differences between early-stage and expansion stage venture capital investing (Jeng and Wells, 2000; Armour and Cumming, 2003). The results are intriguing, and indicate differences between what affects valuation in these types of investment. In Column G, including only funding rounds for firms in the startup, product development, or beta testing stage of development, the dummy variable indicating management expectation for a trade sale exit is not significant, whereas the variable measuring the severity of personal bankruptcy rules is. The latter finding is in line with the argument of Armour and Cumming (2003), who postulate that such rules will be of greater concern to managers of early-stage firms. The estimation reported in Column H employs the same variables, but includes only firms in the expansion stage of development (i.e., shipping, multiple, and profitable). The findings are opposite those of Column G, in that the coefficient for an expected acquisition exit is significant and negatively associated with pre-money valuation, whereas the personal bankruptcy variable is no longer significant. This indicates that later-stage firms that foresee an acquisition exit are seemingly perceived as less valuable to their investors, and receive lower valuations; the uncertainty relating

to the eventual exit event for firms in very early stages of development, however, may be too high to significantly impact valuations. Finally, the lack of importance of personal bankruptcy rules in more established, later-stage firms may indicate that managers of these companies are less concerned about the personal implications of failure.

5. International Variation in Contracting: The Ownership Ratio

Recall that a firm's ownership ratio (OWNRATIO) simply reflects the amount of money raised divided by the valuation. The ratio will be larger for those funding rounds in which a higher portion of the firm's equity is purchased by the given amount of the financing commitment. Investors in common law countries may be willing to receive a *lower* portion of the portfolio firm's equity ownership, due to their ability to obtain control rights and liquidation provisions through enforced, complex contracting. At the same time, more sophisticated investors with better reputations may be able to obtain *larger* portions of ownership due to their promise of providing more assistance to the portfolio firm through introductions, expert advice, reputational certification, etc. Finally, more skilled managers may be able to negotiate lower ownership ratios with their investors. We test each of these hypotheses.

Table 6 displays the results of multivariate regressions relating to the ownership ratio. In all specifications where it is included, the strength of the management team is associated with a lower ownership ratio, perhaps indicating

the ability of skilled managers to negotiate lower portions of ownership yielded to investors, or the willingness of investors to compensate existing manager-owners with larger shares of equity if they are highly skilled. Column A includes variables relating to investor sophistication and provision of non-pecuniary advice and services. The results indicate that investor sophistication and more extensive provision of non-pecuniary services are both associated with significantly *higher* portions of ownership, which is consistent with the argument relating to the importance and value of non-pecuniary services. This contradicts the argument that more sophisticated investors should be willing to receive a *lower* portion of the portfolio firm's equity, since they can include complex contractual provisions to protect their interests, especially in common law and U.S. environments.

Columns B through F examine the importance of location and legal setting, again based on the finding that contracts in the U.S. and in common law countries are more sophisticated, and that the portion of ownership demanded by investors should therefore be lower in common law countries. The results indicate, however, that the ownership ratio in the United States (columns B, D, E and F) is in fact *higher* (with a positive, statistically significant coefficient) than in other countries. Column D presents results for a specification that includes variables measuring both common law origin and U.S. location. The common law variable does not have a significant coefficient, and the U.S. variable remains positive and statistically significant despite the introduction of the legal origin

variable. These findings contradict the argument that predicts a lower ownership ratio in such environments.

We include all four variables relating to investor sophistication, number of services provided, common law origin, and U.S. location in Column E. Again, the variables for investor sophistication and number of services are positive and significant, whereas the U.S. dummy variable is also positive and significant. These findings are further supported by Column F, which omits the management variable to ensure that findings are not being driven by the level of management team strength, which is significantly higher in the U.S. and in common law countries as indicated in Table 3.

6. Conclusion

This paper uses a detailed database resulting from a survey of managers at privately-held, high-technology companies in seven relatively advanced capitalist economies. We test a variety of hypotheses relating to firm-level cost of capital and institutional variation, and emphasize actual relationships and performance of firms in different jurisdictions and at different stages of development rather than provisions in legal contracts. Consistent with Lerner and Schoar (2004), who examine relatively mature and established firms in emerging market settings, the analysis here indicates that the valuation (and, hence, cost of capital) of high technology companies in countries with advanced capital markets varies

significantly in different jurisdictions, with higher valuations for firms in common law legal origin environments.

Regarding the firm-level effects of institutional variation, our paper documents numerous univariate findings. For companies in the survey sample, U.S. and common law firms raised more, had higher pre-money valuations, and received a higher portion of financing from angel investors; non-U.S. and civil law firms on the other hand received more funding from corporate venture capital and other sources (including government, non-CVC corporate financing, etc.) Firms in the U.S. and in common law jurisdictions received relatively more non-pecuniary assistance such as advice and guidance from their investors. In addition, management teams were deeper and broader (in terms of number of positions filled and experience levels of those managers) for firms in such countries. These univariate findings were robust to t-tests for significant difference in mean as well as nonparametric analysis of differences in median.

The multivariate analysis revealed that the institutional environment is related in a statistically significant way to a manager's exit strategy (acquisition compared to IPO), such that European companies located in countries with "worse" regulatory environments were significantly more likely to expect a trade sale exit. Firms in such environments also had lower valuations. In addition, a portfolio firm's simple possession of patents did not result in higher valuations *per se*, but possession of *useful* patents was associated with higher valuation and greater amount raised. Valuations of early-stage firms were negatively related to

more severe personal bankruptcy regimes, whereas valuations of firms in the expansion stage were negatively associated with expectation of trade sale exit.

Management team strength is negatively associated with the ownership ratio (amount raised divided by valuation), such that more sophisticated managers seemingly are able to raise funds while offering lower portions of their firm's equity to their investors. Perhaps surprisingly, the ownership ratio in the average funding round was *higher* in the U.S. than elsewhere, controlling for investor sophistication and amount of non-pecuniary services provided to the portfolio firm by its investor. This evidence does not support arguments that indicate more sophisticated investors rely less on equity ownership stakes and more on liquidation and exit rights that are prevalent in common law legal environments. On the other hand, the results support the argument that more sophisticated investors, and those providing more non-pecuniary services, are in fact able to contract for higher ownership ratios, perhaps as compensation for certification or other assistance in terms of non-pecuniary aid and advice (Gorman and Sahlman, 1989; Hsu, 2004).

Future work incorporating the presence of liquidity provisions and other control rights into the ownership ratio analysis would contribute to our results. In addition, it might be interesting to examine whether provision of non-pecuniary services offered or the intrinsic certification of VCs with better reputations is behind our findings. Finally, more work on the implications of relative

management team skill levels for the investor-manager relationship and resulting negotiations surrounding funding rounds could be illuminating.

Appendix: Firms Revealing Information

Number of Firms

Industry	Population	Contacted	Interviewed	$ Raised Data Obtained*	Valuation Data Obtained*
Biotech/Pharma	243	243	61	56	47
Telecoms	697	518	59	57	42
Electronics/Semi	299	299	37	34	21
Software	1010	823	84	81	72
Services	2201	1299	109	103	75
Total	4450	3182	350	331	257

Percentage of Total Population

Industry	Population	Contacted	Interviewed	$ Raised Data Obtained*	Valuation Data Obtained*
Biotech/Pharma	100%	100%	25%	23%	19%
Telecoms	100%	74%	8%	8%	6%
Electronics/Semi	100%	100%	12%	11%	7%
Software	100%	81%	8%	8%	7%
Services	100%	59%	5%	5%	3%
Total Sample	100%	72%	8%	7%	6%

Percentage of Firms Interviewed That Revealed Information

Industry	Interviewed	$ Raised Data Obtained*	Valuation Data Obtained*
Biotech/Pharma	100%	92%	77%
Telecoms	100%	97%	71%
Electronics/Semi	100%	92%	57%
Software	100%	96%	86%
Services	100%	94%	69%
Total Sample	100%	95%	73%

*Firms for which information on at least one funding round was revealed during the interview

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Table 1: Descriptive Statistics

Panel A: Number of Valuation Observations Per Quarter
Mean log valuation in parentheses (Note: includes multiple financings of same firm)

Quarter:	Early-Stage	Expansion
1Q98	4 (14.528)	0
2Q98	5 (15.530)	0
3Q98	6 (14.868)	0
4Q98	4 (14.864)	3 (15.619)
1Q99	8 (15.475)	3 (14.605)
2Q99	16 (16.178)	9 (15.751)
3Q99	18 (15.780)	8 (16.020)
4Q99	23 (15.575)	6 (16.646)
1Q00	31 (15.638)	11 (16.082)
2Q00	39 (16.152)	25 (16.596)
3Q00	35 (15.906)	22 (16.877)
4Q00	20 (16.251)	20 (16.546)
1Q01	29 (16.033)	22 (15.980)
2Q01	18 (16.102)	18 (15.899)
Total	**290 (15.823)**	**193 (16.356)**

Early-stage includes start-up, development, and beta; expansion includes shipping, multiple, and profitable

Panel B: Stage of Development and Financing Round Log Valuations

Stage	n	Mean Log Valuation	Min Log Valuation	Max Log Valuation
Startup	66	15.959	12.612	19.232
Development	161	16.614	11.513	18.198
Beta	63	16.212	13.816	19.519
Shipping	112	16.303	13.528	20.436
Multiple	39	16.704	13.760	18.421
Profitable	42	16.177	13.816	18.493

Panel C: Valuation Observations by Stage of Development and Industry
(Mean log valuation in parentheses)

Stage	Biotech and Pharmaceuticals	Semiconductors/ Electronics	Services	Software	Telecom-munications
Startup	23 (16.071)	4 (15.374)	15 (16.313)	7 (15.261)	17 (15.922)
Development	45 (15.372)	21 (15.907)	34 (15.368)	39 (15.711)	22 (16.040)
Beta	9 (15.846)	5 (16.874)	11 (16.618)	25 (15.881)	13 (16.507)
Shipping	5 (16.094)	3 (18.350)	48 (16.178)	36 (16.077)	20 (16.753)
Multiple	1 (16.188)	2 (16.209)	17 (16.683)	16 (16.086)	3 (16.789)
Profitable	1 (16.118)	2 (16.762)	19 (15.835)	14 (16.248)	6 (16.908)
Total	84 (15.675)	37 (16.240)	144 (16.049)	137 (15.998)	81 (16.385)

Table 1: Descriptive Statistics, Continued

Panel D: Valuation Observations by Stage of Development and Country (mean log valuation in parentheses)

Stage	US	UK	France	Sweden	Netherlnd.	Germany	Israel
Startup	39 (16.167)	12 (16.522)	4 (15.456)	4 (14.902)	1 (13.816)	4 (15.266)	2 (14.109)
Development	93 (15.726)	29 (15.509)	10 (14.928)	3 (15.410)	3 (14.903)	8 (15.330)	14 (15.891)
Beta	30 (16.416)	17 (15.914)	2 (15.125)	1 (16.811)	4 (15.535)	3 (16.563)	6 (16.578)
Shipping	51 (16.448)	31 (16.416)	5 (16.157)	10 (15.948)	7 (16.179)	6 (15.484)	2 (15.863)
Multiple	18 (16.806)	12 (17.305)	1 (16.188)	3 (15.608)	2 (16.049)	3 (15.398)	0
Profitable	18 (16.251)	12 (16.114)	0	7 (15.628)	3 (16.133)	0	0
Total	249 (16.142)	113 (16.181)	22 (15.378)	28 (15.656)	20 (15.721)	24 (15.520)	24 (15.912)

Panel E: Relative Contributions by Investor Type and Type of Funding Round: All firms, US firms, and Non-US firms

All Firms

	Seed (150 obs)	First (307 obs)	Second (155 obs)	Third (71 obs)	>Third (24 obs)
Angel	33.973	18.990	11.355	11.113	4.792
Corporate VC	5.600	6.280	10.065	10.958	2.500
VC	42.767	65.557	63.226	61.690	57.875
Other	17.660	9.173	15.355	16.239	34.833

US firms Only

	Seed (68 obs)	First (149 obs)	Second (82 obs)	Third (41 obs)	>Third (16 obs)
Angel	46.191	25.664	17.037	11.610	5.313
Corporate VC	5.368	3.134	5.000	7.317	3.750
VC	40.015	63.342	64.768	65.805	67.438
Other	8.426	7.859	13.195	15.268	23.500

Non-US Firms Only

	Seed (82 obs)	First (158 obs)	Second (73 obs)	Third (30 obs)	>Third (8 obs)
Angel	23.841	12.696	4.972	10.433	3.750
Corporate VC	5.793	9.247	15.735	15.933	0.000
VC	45.049	67.646	61.493	56.067	38.750
Other	25.317	10.411	17.781	17.567	57.500

Table 1: Descriptive Statistics, Continued

Panel F: EVCA and Bankruptcy Severity Scores

Country	EVCA Score (ascending)	Bankruptcy Severity Code	Number of Valuation Observations	Mean of Log Valuation Observations
UK	1.26	2	113	16.181
Netherlands	1.76	5	20	15.721
France	1.89	3	22	15.378
Sweden	2.05	5	28	15.656
Germany	2.37	3	24	15.520
Israel	--	3	24	15.912
U.S.	--	1	249	16.142

Note: EVCA did not compute scores for non-European countries, thus no scores for Israel or the U.S. are reported. For both EVCA score and bankruptcy severity, low numbers are "good," indicating favorable environments for private equity and laws that allow entrepreneurial recovery in the event of bankruptcy. Sources: EVCA, 2003 and Armour, 2003.

Panel G: Non-Dummy Variables

Non-Dummy Variables	N	Mean	Standard Deviation	Minimum	Maximum
NUMSVCS	624	4.788	3.209	0	10
MGTINDEX	1755	383.835	351.202	1	1624
VCPORTION	707	59.562	44.612	0	100
OWNRATIO (=Amount Raised/Valuation)	406	0.337	0.229	0.005	0.984
Industry Index	662	2.155	0.797	0.876	4.663
Log of Employees	484	2.604	1.106	0	5.733
Log of Quarterly Revenues	618	5.320	6.384	0	17.387
Log of VC Inflows	660	10.225	0.232	9.622	10.463
EVCA Score	875	1.647	0.418	1.26	2.370
Log of Pre-Money Valuation	483	16.036	1.236	11.513	20.436
Log of Amount Raised	699	14.877	1.383	9.942	18.431
Bankruptcy Severity	1755	2.066	1.305	1	5

Panel H: Dummy Variables

	Dummy Variable	# Obs (total)	# of "1"s	# Obs with valuation data	# "1"s with valuation data
Location	Common Law Legal Origin	1755	1315	483	386
	US	1755	810	483	249
Round Dummies	Seed (omitted)	1755	155	483	18
	First	1755	352	483	252
	Second	1755	350	483	142
	Third	1755	351	483	52
	> Third	1755	547	483	19
Industry Dummies	Biotech (omitted)	1755	305	483	84
	Semiconductors/Electronics	1755	185	483	37
	Services	1755	545	483	144
	Software	1755	420	483	137
	Telecoms	1755	295	483	81
Stage Dummies	Start-Up (omitted)	1755	97	483	66
	Development	1755	273	483	161
	Beta	1755	93	483	63
	Shipping	1755	168	483	112
	Multiple	1755	62	483	39
	Profitable	1755	55	483	42
New Variables	PATENTS (Had any patents 1 = "yes")	726	309	469	202
	USEFUL (Patents Useful? 1 = "yes")	726	252	469	157
	SOPHIST (Sophisticated investor =1 if investor had "a lot" of management experience and/or if investor had more than 10 other firms in the same industry in their investment portfolio)	710	312	459	193
	SALEEXIT (Expectation of Acquisition Exit; 1 = "yes")	689	266	437	184
	MGTREPLACE (Management replacement either recommended or required by investors)	677	163	432	114

Table 2: List of Hypotheses Examined

Relationships Among New Variables		
H1	More sophisticated investors are associated with more types of aid	Table 3, Columns A and B
H2	Management Team strength matters for valuation and amount raised	Table 3, Columns C and D
H3	Portion of VC funding is associated with increased likelihood of generating *useful* patents	Table 3, Column E
H4	As portion of VC investment rises for a given firm, so does amount of aid provided	Table 3, Column F
H5	Portion of VC funding matters for management replacement	Table 3, Column G
Institutional Variation and Cost of Capital		
H6	Significant differences in US, non-US, Common, and Civil Law jurisdictions	Table 4
H7	Managers of companies in "worse" institutional environments are more likely to view acquisition (as opposed to IPO) as the expected exit strategy	Table 5, Column A
H8	Firms in "worse" institutional environments will have lower valuations	Table 5, Column B
H9	Legal origin, US location, and bankruptcy severity matter for valuation and amount raised	Table 5, Columns C-F
H10	Bankruptcy severity matters more for early-stage firms, whereas predicted exit path matters more for firms in the expansion stages of development	Table 5, Columns G & H
Contracting, Investor Sophistication, and Ownership Ratio		
H11	Share of VCs vs. other types of investor funding is related to likelihood that change in management team will be required or recommended by the investors	Table 6, Column A
H12	Relatively sophisticated investors provide more non-pecuniary services and advice	Table 6, Column B
H13	Ownership ratio is lower for more sophisticated investors (compensation hypothesis)	Table 6, Columns C, G, and H
H14	Ownership ratio is lower Common Law countries (contract complexity hypothesis)	Table 6, Columns D, F, G, and H
H15	Ownership ratio is lower in the United States (contract complexity hypothesis)	Table 6, Columns E, F, G, and H

Table 3: Analysis of New Variables

	A	B	C	D	E	F	G	H
Dependent Variable:	NumSvcs	NumSvcs	NumSvcs	Log of Pre-Money Valuation	Log of Amount Raised	MgtIndex	Useful Patents	Mgt. Rplcmnt.
Estimation:	Negative binomial reg.	Negative binomial reg.	Negative binomial reg.	Robust OLS	Robust OLS	GLS fixed effects (within)	Robust Logit	Robust Logit
Constant	1.512*** (0.000)	1.367*** (0.000)	0.970 (0.651)	13.08*** (0.000)	14.04*** (0.000)	406.74*** (0.000)	-2.427 (0.886)	-1.960 (0.822)
Sophisticated Investor (1= "yes")	0.141** (0.021)	0.146** (0.018)	0.165** (0.032)	--	--	--	--	--
MgtIndex	--	--	0.000 (0.371)	0.001*** (0.000)	0.001*** (0.000)	--	-0.001 (0.379)	-0.001* (0.082)
Portion of VC funding	--	--	--	--		0.659** (0.015)	0.014** (0.032)	0.006* (0.090)
Industry Index	--	--	0.002 (0.976)	--	--	--	-1.072 (0.163)	-0.054 (0.846)
Log of Quarterly Revenue	--	--	0.002 (0.783)	--	--	--	0.076 (0.249)	0.001 (0.982)
Log of VC Inflows	--	--	0.037 (0.870)	--	--	--	1.077 (0.559)	0.018 (0.984)
Log of Employees	--	--	--	--	--	--	0.026 (0.928)	-0.337** (0.029)
NumSvcs	--	--	--	--	--	--	--	0.121*** (0.008)
Round and Stage Dummies	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	No	Yes	Yes	Yes	Yes	No	Yes	Yes
#Obs	603	603	352	483	699	707	142	320
R^2 or pseudo R^2	0.004	0.020	0.008	0.404	0.200	0.422	0.244	0.100
F-Stat or Wald Chi^2 or $Chibar^2$	276*** (0.000)	245*** (0.000)	208*** (0.000)	39*** (0.000)	12*** (0.000)	26*** (0.000)	36*** (0.005)	31* (0.098)

Note: *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level. Column G only includes observations from European firms.

Table 4: Significant Variation in Different Legal Jurisdictions

Panel A: U.S. and Non-U.S. Funding Rounds

Numerical Survey Responses	Mean U.S.	Mean Non-U.S.	Mean T-Test p-Value	Median U.S.	Median Non-U.S.	Median Test p-Value
How long has your company been incorporated? (scale)†	4.354	4.207	0.002***	5	5	N/A
Total number of financing events	1.642	1.249	0.000***	1	1	0.000***
Amount Raised (in log USD)	15.098	14.647	0.000***	15.32	14.85	0.001***
(difference from Amt. Expected to raise) (in log USD)	0.037	0.062	0.684	0	0	0.659
Pre-Money Valuation (in log USD)	16.142	15.923	0.050**	16.12	15.94	0.186
Average time taken to close (months)	3.489	4.134	0.002***	3	3	0.013**
Average time taken to receive money (weeks)	1.382	0.774	0.024**	0	0	0.532
Difficulty raising cash (1=not; 5=extremely difficult)	2.441	2.403	0.680	2	2	0.920
How many potential investors did you approach?	22.329	11.574	0.000***	6	10	0.000***
How many term sheets did you receive?	2.555	2.974	0.412	1	1	0.853
What proportion of the financing round came from:						
Angels	25.065	13.296	0.000***	0	0	0.000***
VCs	59.683	59.439	0.942	80	90	0.625
CVC	4.500	10.154	0.002***	0	0	0.002***
Other	10.753	17.111	0.007***	0	0	0.055***
Ownership ratio (amount raised/pre-money valuation)	0.421	0.317	0.000***	0.359	0.250	0.003***
Of which, excluding "100%" rounds	0.376	0.296	0.004***	0.333	0.250	0.013**
Total number of execution reports required	2.841	2.554	0.033**	3	2	0.011**
How many other firms in your industry were in your lead investor's portfolio?	2.555	2.974	0.412	1	1	0.861
Total number of services received/offered (see below)	3.310	2.360	0.000***	6	4	0.000***
MgtIndex	408.78	362.46	0.006***	310	277	0.000***

Categorical Survey Responses ("yes" or "no")	Mean "Yes" answers US	Mean "Yes" answers Non-US	T-test p-value
Were any of the following services offered or provided by your lead investors or VC partners during the financing event? :			
Customer introductions	0.466	0.328	0.000***
Strategic alliance introductions	0.600	0.427	0.000***
Portfolio company alliances	0.565	0.364	0.000***
Recruitment and hiring	0.492	0.250	0.000***
Marketing and PR	0.218	0.141	0.014**
Financial management	0.316	0.260	0.126
Engineering, product development assistance	0.105	0.045	0.005***
Real Estate assistance	0.106	0.090	0.514
Strategy Development	0.630	0.450	0.000***
Technology	0.115	0.048	0.003***
Prior to the financing event, did your company file and/or receive any patents?	0.488	0.364	0.001***
If so, do you think these patents are significant to your strategy and to establishing barriers, by giving you a competitive advantage?	0.407	0.288	0.001***

†The scale is as follows: 1. less than six months; 2. 6-12 months; 3. 13-18 months; 4. 19-24 months; 5. more than two years

Note: *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level.

Table 4: Significant Variation in Different Legal Jurisdictions, Continued

Panel B: Funding Rounds in Common Law vs. Civil Law Countries

Numerical Survey Responses	Mean Comn. Law	Mean Civil Law	Mean T-Test p-Value	Median Comn. Law	Median Civil Law	Median Test p-Value
How long has your company been incorporated? (scale)[†]	4.340	4.064	0.000***	5	4	N/A
Total number of financing events						
Amount Raised (in log USD)	15.014	14.352	0.000***	15.202	14.509	0.000***
(difference from Amt. Expected to raise) (in log USD)	0.068	-0.024	0.235	0	0	0.448
Pre-Money Valuation (in log USD)	16.139	15.624	0.000***	16.118	15.656	0.003***
Average time taken to close (months)	3.697	4.211	0.037**	3	4	0.008***
Average time taken to receive money (weeks)	1.090	1.040	0.879	0	0	0.207
Difficulty raising cash (1=not; 5=extremely difficult)	2.452	2.317	0.224	2	2	0.474
How many potential investors did you approach?	18.834	11.000	0.001***	10	6	0.001***
How many term sheets did you receive?	2.459	4.211	0.035**	1	2	0.040**
What proportion of the financing round came from:						
Angels	21.534	11.058	0.001***	0	0	0.000***
VCs	58.693	62.628	0.331	80	100	0.167
CVC	6.889	8.782	0.388	0	0	0.801
Other	12.884	17.532	0.100*	0	0	0.948
Ownership ratio (amount raised/pre-money valuation)	0.380	0.334	0.157	0.300	0.300	0.943
Of which, excluding "100%" rounds	0.342	0.319	0.417	0.285	0.293	0.902
Total number of execution reports required	2.729	2.583	0.356	3	3	0.292
How many other firms in your industry were in your lead investor's portfolio?	5.399	35.999[††]	0.020**	0	1	0.066*
Total number of services received/offered (see below)	5.099	3.807	0.000***	5	4	0.000***
MgtIndex	393.590	364.680	0.044**	277	270.5	0.179

Categorical Survey Responses ("yes" or "no")	Mean "Yes" answers Common Law	Mean "Yes" answers Civil Law	T-test p-Values for Difference in Means
Were any of the following services offered or provided by your lead investors or VC partners during the financing event?			
Customer introductions	0.429	0.299	0.004***
Strategic alliance introductions	0.547	0.396	0.001***
Portfolio company alliances	0.474	0.365	0.017**
Recruitment and hiring	0.400	0.263	0.002***
Marketing and PR	0.197	0.093	0.003***
Financial management	0.279	0.283	0.929
Engineering, product development assistance	0.091	0.060	0.233
Real Estate assistance	0.102	0.067	0.197
Strategy Development	0.572	0.433	0.003***
Technology	0.099	0.047	0.047**
Prior to the financing event, did your company file and/or receive any patents?	0.456	0.321	0.002***
If so, do you think these patents are significant to your strategy and to establishing barriers, by giving you a competitive advantage?	0.372	0.259	0.008***

Note: *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level.

[†]The scale is as follows: 1. less than six months; 2. 6-12 months; 3. 13-18 months; 4. 19-24 months; 5. more than two years

[††]Note that the very high civil law mean is based in part on a single survey response that 3,000 other firms were in the lead investor's portfolio. Omitting this response from the analysis, we found the same sign and significance level to the t-test and median test, although the civil law mean declines from 35.992 to 13.366 and the median remains 1.

Table 5: Effects of Institutional Variation

	A	B	C	D	E	F	G	H
Dependent Variable:	**Sale exit**	**Log of Pre-Money Valuation**		**Log of Amount Raised**	**Log of Pre-Money Valuation**		**Log of Pre-Money Valuation**	
Estimation:	Robust Logit	Robust OLS	Robust OLS	Robust OLS	Robust OLS	Robust OLS	Robust OLS	Robust OLS
Observations:	Europe only	Europe only	All	All	All	All	Early-Stage only	Expansion only
Constant	-23.405 (0.083)*	12.598 (0.030)**	7.637 (0.014)**	9.245 (0.008)***	7.611 (0.016)**	7.612 (0.016)**	9.778 (0.012)**	-8.672 (0.198)
Industry Index	-0.405 (0.460)	0.225 (0.230)	0.195 (0.027)**	0.177 (0.083)**	0.194 (0.029)**	0.195 (0.029)**	0.244 (0.010)***	-0.579 (0.050)**
Log of Employees	-0.171 (0.433)	0.523 (0.000)***	0.518 (0.000)***	0.624 (0.000)***	0.519 (0.000)***	0.519 (0.000)***	0.480 (0.000)***	0.509 (0.000)***
Log of Quarterly Revenue	-0.068 (0.091)*	-0.005 (0.793)	-0.008 (0.448)	-0.026 (0.035)**	-0.006 (0.554)	-0.006 (0.552)	-0.012 (0.400)	0.025 (0.185)
Log of VC Inflows	1.983 (0.169)	0.011 (0.985)	0.435 (0.166)	0.362 (0.304)	0.393 (0.216)	0.392 (0.217)	0.240 (0.535)	2.217 (0.002)***
EVCA Rating	1.163 (0.015)**	-0.515 (0.010)***	--	--	--	--	--	--
Bankruptcy Severity	--	--	-0.140 (0.001)***	-0.167 (0.000)***	--	--	-0.185 (0.008)***	-0.083 (0.200)
Common Law	--	--	--	--	0.335 (0.004)***	0.319 (0.036)**	--	--
U.S.	--	--	--	--	--	0.024 (0.851)	--	--
MGTINDEX	--	--	0.0003 (0.087)*	0.000 (0.489)	0.0003 (0.089)*	0.0003 (0.089)*	0.0002 (0.238)	0.0003 (0.143)
PATENTS (1 = "yes")	--	--	-0.267 (0.084)*	0.042 (0.834)	-0.298 (0.059)*	-0.299 (0.059)**	-0.015 (0.947)	-0.473 (0.029)**
USEFUL (1="yes")	--	--	0.583 (0.001)***	0.413 (0.044)**	0.614 (0.001)***	0.612 (0.001)***	0.122 (0.587)	1.127 (0.000)***
SALEEXIT (1 = "yes")	--	--	--	--	--	--	-0.159 (0.190)	-0.654 (0.000)***
Round and Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stage Dummies	Yes	Yes	Yes	Yes	Yes	Yes	No	No
#Obs	165	125	301	402	301	301	170	104
Pseudo R^2 or R^2	0.180	0.390	0.577	0.392	0.577	0.572	0.655	0.615
Wald Chi^2 or F-Stat	26.56 (0.065)*	5.40 (0.000)***	36.40 (0.000)***	12.12 (0.000)***	35.18 (0.000)***	36.73 (0.000)***	44.03 (0.000)***	91.36 (0.000)***

Note: *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level.

Table 6: Ownership Ratio

(Dependent variable: amount raised/valuation; robust OLS)

	A	B	C	D	E	F
Constant	2.632** (0.016)	1.595 (0.178)	1.595 (0.181)	1.728 (0.153)	2.615* (0.051)	2.654** (0.047)
Industry Index	0.032 (0.415)	0.027 (0.475)	0.021 (0.575)	0.028 (0.457)	0.034 (0.382)	0.031 (0.433)
Log of Employees	0.021 (0.168)	0.016 (0.291)	0.020 (0.242)	0.020 (0.214)	0.021 (0.186)	0.124 (0.430)
Log of Quarterly Revenue	0.001 (0.665)	0.001 (0.857)	0.001 (0.867)	0.000 (0.924)	0.001 (0.799)	0.001 (0.703)
Log of VC Inflows	-0.225* (0.096)	-0.120 (0.332)	-0.116 (0.350)	-0.131 (0.298)	-0.224 (0.103)	-0.229 (0.094)
MgtIndex	-0.0001** (0.033)	-0.0001** (0.036)	-0.0001** (0.036)	-0.0001** (0.026)	-0.0001** (0.042)	--
NumSvcs	0.015*** (0.001)	--	--	--	0.011** (0.013)	0.010** (0.021)
Sophisticated Investor	0.060 (0.080)*	--	--	--	0.060 * (0.066)	0.059* (0.074)
U.S.	--	0.087*** (0.004)	--	0.112*** (0.001)	0.086** (0.019)	0.087** (0.017)
Common Law legal origin	--	--	0.021 (0.566)	-0.055 (0.187)	-0.048 (0.280)	-0.037 (0.399)
Round, Industry, and Stage Dummies	Yes	Yes	Yes	Yes	Yes	Yes
#Obs	220	259	259	259	220	220
R^2	0.215	0.163	0.134	0.169	0.234	0.220
F-Statistic	3.03*** (0.000)	2.63*** (0.004)	2.14*** (0.005)	2.61*** (0.000)	2.92*** (0.000)	2.93*** (0.000)

Note: *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level