CEPRES
Center of Private Equity Research

June 2006
www.cepres.de

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

The Pressure Chain of Private Equity and Venture Capital Financing

Examining the Impact of Capital Inflows into Funds on Staging Behavior and Investment Returns

This Draft: June 2006

[PRELIMINARY & INCOMPLETE: Please do not quote or circulate]

Victor Calanog
Department of Business & Public Policy
The Wharton School of the University of Pennsylvania
Philadelphia, PA 19104 USA
E-mail: vcalanog@wharton.upenn.edu

Rainer Lauterbach
Department of Finance
J.W. Goethe University
Frankfurt, Germany
E-mail: rlauterbach@alumni.upenn.edu

Mark Wahrenburg
Department of Finance
J.W. Goethe University
Frankfurt, Germany
E-mail: wahrenburg@finance.uni-frankfurt.de

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

The Pressure Chain of Private Equity and Venture Capital Financing

Examining the Impact of Capital Inflows into Funds on Staging Behavior and Investment Returns

[PRELIMINARY & INCOMPLETE: Please do not quote or circulate]

ABSTRACT

This study examines the effect of capital inflows into Private Equity (PE) and Venture Capital (VC) fund on their speed of capital allocation and staging behaviour. Gompers and Lerner (2000) interpret these inflows as demand pressure for VC and PE securities driving prices up during high inflow periods. This study extends their work and examines the effect of higher investment pressure on fund performance. Based on a merged dataset from the databases Venture Economics and CEPRES, we analyze 712 matched PE and VC investments with 1,549 financing rounds and 2,329 precisely dated cash injections from 1979 to 2003. Our results show that more capital inflows into PE and VC funds leads to an increase in the fund's speed of allocation as well as more intense staging behaviour, resulting in a *decrease* in the return on investment (ROI). We interpret lower ROI figures to be the joint product of fund managers making suboptimal capital allocation decisions, and portfolio companies receiving larger amounts of capital injections in a shorter period of time unable to harness surplus funds productively. Our findings help explain the volatile nature of PE and VC market returns in boom and bust periods.

JEL classification: G24; E51

Keywords: Private Equity; Venture Capital; Staging; Empirical Behavioral Finance, Decision making

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

I. Introduction

In 2005, Private Equity (PE) and Venture Capital (VC) firms invested US$174 billion in U.S.-based portfolio companies, more than a fourfold increase from 2004 (US$42 billion) and a sevenfold increase from 2003 (US$24 billion) (Thomson Financial, 2006). In the US, PE and VC funds source approximately 50% of their funding from pension funds, banks, insurance companies, endowments, foundations and other institutions that seek to profit from higher returns in this alternative investment asset class, relative to the single digit provided by comparable stock markets in recent years. Companies like Apple, Intel, Federal Express and Genentech are among the list of large companies that received VC funding early in their development (NVCA, 2006). There is speculation whether there is currently an asset price bubble in the PE and VC market, given historical records of booms and busts. This empirical study contributes to the understanding of the volatile nature of the PE and VC industry from a behavioral finance perspective (refer to Figures 4 and 5 in Appendix A for an illustration of the return characteristics of the VC and PE market in the US and Europe).

We examine factors that determine how PE and VC fund managers make investment decisions and the impact of such decisions on investment returns. This study focuses on an intriguing empirical finding: We find that the speed with which fund managers allocate capital to portfolio companies appears to be positively correlated with increases in inflows to PE and VC funds. This in itself would not be substantively interesting if we did not also find that a higher speed of allocation appears to result in *lower* returns on investment (ROI). Specifically, we define the *pressure chain* of PE and VC financing as the sequence of events, triggered by an increase in inflows to PE and VC funds, that influence investment managers to make faster capital allocation decisions associated with poor investment performance as measured by ROI. We assert that fund managers experience a higher amount of *investment pressure* during 'hot times' characterized by large inflows of capital from investors: Higher amounts of investment pressure influence fund managers to allocate capital to portfolio companies at a faster rate than what would be optimal to ensure good investment performance. The lower ROI from higher investment pressure may be the joint product of investment managers making suboptimal capital allocation decisions and portfolio companies unable to harness surplus funds in productive ways.

PE and VC fund managers act as agents for fund investors (limited partners or LPs) and make decisions about three basic investment choices: Which firms to support, how much financial support to offer, and how to time capital injections to maximize investment returns. However, prior to making any such decisions a PE or VC firm must consider how to attract LPs. Assuming that the character of a fund is fixed (some funds focus on supporting firms in certain industries like biotechnology, or those that operate in a particular geographical sector like the Silicon Valley, or European markets), one measure of the demand for securities by LPs is the amount of fund inflows that PE and VC funds receive, usually expressed by the capital committed by LPs to new funds. In a world without “investment pressure,” fund managers make capital allocation decisions based on one fundamental criterion: What is the optimal amount of capital that maximizes investment returns for a specific portfolio company, given its particular financial needs or development stage (e.g. seed capital to build a prototype, first round to build the customer base, second round to consolidate market growth, or capital to finance a turnaround or leveraged buyout transaction, etc.). Given the risks associated with potential agency problems and the probability of business failure, fund managers typically disburse capital in tranches, agreeing to support the next round of financing only if the portfolio company meets a predefined set of performance targets.

However, when larger than average amounts of capital from LPs pour into VC funds, fund managers are put under pressure to show how well they can earn returns for their investors, given the expectation that such “hot times” will not continue indefinitely. High-performing funds will attract the lion’s share of capital inflows: Even if one holds returns constant, a higher capital base translates to higher fees and earnings for fund managers. With this incentive structure in place, we speculate whether fund managers will make suboptimal decisions.

We test these speculations using information about PE and VC investment decisions derived from combining data from *Venture Economics* (http://www.venturexpert.com) and *CEPRES* (http://www.cepres.com). This allows us to observe detailed information on 1,549 financing rounds and 2,329 precisely dated cash injections (tranches) for 712 matched PE and VC investments from 1979 to 2003. We find that an increase in capital inflows into PE and VC funds are indeed associated with higher investment pressure, with fund managers increasing the speed and magnitude of capital allocation decisions. We find that a 100% increase in capital inflows into PE and VC funds is associated with a 62.2% increase in speed of capital allocation (Appendix B, Model 3) and a 91.0% increase in the staging intensity of financing rounds (Appendix C Model 2) as well as a 47.7% increase in the magnitude of the amount invested at each financing round into the portfolio company (Appendix D, Model 3). We find that decisions made under higher investment pressure are negatively associated with fund performance: A 100% increase in the relative speed of capital allocation results in a -35.8% fall in ROI (Appendix E, Model 4); and a 100% increase in the number of cash injections from the fund to the portfolio company results in a 5.1% decrease in ROI (Appendix E, Model 4).

This paper is organized as follows. In section 2 we review related literature on PE and VC funds and how fund managers make decisions. In section 3 we describe our empirical approach and predictions. We describe the data in Section 4. Section 5 reports our results, and section 6 offers concluding remarks.

II. Literature Review

PE and VC fund managers act as financial intermediaries for their investors (LPs), with the aim of maximizing returns and minimizing risks in investments. Fund managers' positive role in the allocation of VC in a market with imperfect information is explained in Chan (1983). In a more critical paper, Allen (2001) discusses the role of financial intermediaries and points out that their participation on the upside with rather limited participation on the downside of an investment creates incentives to support the growth of bubbles instead of actively refraining from more intense capital allocation during overheated market periods. Some prominent investors have likewise been vocal: In the latest annual report released by Berkshire Hathaway (2005), Buffett says "… for investors as a whole, returns decrease as motion increases," crucifying fund managers for encouraging a higher amount of market activity to profit from commissions. This study takes a detailed look at the capital allocation behavior of PE and VC fund managers, given the context of changing market and demand factors, and the impact of any changes in behavior on investment returns.

PE and VC fund managers must go through the first step of fund raising before they decide on capital allocation. Several papers study the fund raising phase in the PE and VC industry, but little research has been done on what determines how funds that have been raised is allocated. The underlying factors that drive fund raising are examined in Gompers and Lerner (1999) and Cumming, Fleming and Suchard (2005). Cumming, Fleming and Suchard (2005) provide evidence that fundraising is driven by value-added activities by the fund managers. The cyclical nature in terms of fund raising and returns of the PE and VC industry is described in Fenn, Liang and Prowse (1995), Gompers and Lerner (1999), and Lerner (2002).

Fund raising and capital allocation decisions occur within the larger backdrop of changing market demand conditions. Several papers have explored both the macroeconomic context that influence investment returns as well as the microeconomic foundations of fund performance. In theoretical studies, Inderst and Mueller (2003) model the effect of capital market characteristics on the value of start-up firms and shed light into these effects during boom and bust periods. Berger and Udell (1998) discuss the impact of the macroeconomic environment on small firm finance. The influence of boom and bust cycles on investment returns is analyzed in Kaplan and Schoar (2003). They argue that aggregate industry returns are lower following a boom, but most of this effect is driven by the poor performance of new entrants: They find that the returns of established funds are much less affected by industry cycles. This argument is in line with the grandstanding idea discussed by Gompers (1996), where he highlighted the fact that younger investment firms adjust their investment behavior more than experienced firms, in line with gaining the reputation believed to be necessary in successfully raising follow-on funds. On a contrarian note, Baron, Shepherd and Zacharakis (2003) analyzed decision-making processes employed by VCs and provide evidence suggesting more experience may not always result in better decisions. They argue that relatively new VCs benefit from performance improvement associated with an increase in experience; however, beyond a specific point further gains in experience are associated with performance *reductions*.

Comprehensive studies on the risk and return characteristics of PE and VC funds are provided by Cochrane (2004) as well as Cumming and Walz (2004). Other papers examine more precise mechanisms that associate changes in market demand conditions to specific measures of fund performance. Empirically, Gompers and Lerner (2000) speculate about the phenomenon of "money chasing deals" and explain that increasing capital contributions to funds lead to higher valuations of new investments. They argue that exogenous shifts in the demand for securities affect their valuations and assert that the relation between increased fund raising and prices does not appear to be due to greater perceived investment prospects. In the paper, Gompers and Lerner conclude that the regulatory- and tax-driven nature of VC fundraising and the significant difference in success rates of investments in 'hot' and 'cold' fundraising periods suggest that "demand pressure" is driven up during high inflow periods. We extend their results in this paper by examining the impact of this demand pressure on *investment pressure*: Fund managers' specific investment decisions, and these decisions' effect on fund ROI. In line with Gompers and Lerner, we argue that higher demand pressure resulting from an increase in fund inflows is associated with fund managers accepting higher deal prices. However, this paper's contribution lies in examining one precise mechanism that appears to result in lower ROI: The change in fund managers' capital allocation decisions that is associated with higher demand pressure. Fund managers faced with increased fund inflows adjust their investment behavior to deploy a larger amount of capital into portfolio companies within a shorter period of time. In other words, the fund's pace of capital allocation is not only determined by exogenous investment opportunities and the portfolio firm's financing needs for further development, but also by the demand pressure faced by the fund manager.

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

The interaction between the limited lifespan of funds and PE and VC compensation and incentive structures affects how investment decisions are made. PE and VC investment management firms generate their income from (1) annual management fees, usually structured as a percentage of the fund's investment volume (on average around 2% per annum) and (2) participation in the fund's investment returns (on average around 20% of investment returns). Usually, a certain level of the fund's total capital (on average around 70%) has to be invested into portfolio companies, before the same investment management team is able and allowed to raise a follow-on fund. Due to their compensation scheme, PE and VC funds have an incentive to allocate capital quickly to obtain access to the consecutive generation of follow-on fund raising. Investors (LPs) of the fund have usually no control over the fund's speed of investing and have to provide capital when it is called by the fund.

A theoretical framework for budget constraint explanations for the VC cycle is provided by Gebhardt (2002). He argues that a fund manager cannot provide a hard budget constraint on portfolio companies due to agency problems, but LPs and less well informed outsiders could. Therefore, the fund manager delegates the continuation decision to the outsider by ex ante restricting the magnitude of capital he has under management at each fund. While this constraint is recognized for the *magnitude* of capital, its effect on the *speed* of capital allocation has yet to be explored. Robbie, Wright and Chiplin (1997) analyze the monitoring of venture capital firms by their fund providers, highlighting the nature and extent of these monitoring arrangements. Meyer (2003) proposes a modelling framework based on an internal age concept of the fund. These studies provide some rationale explaining how a fund's age and budget constraints may influence investment managers' behavior. We use these theoretical frameworks as a guide to our empirical tests as we explore what determines the speed of capital allocation.

Capital allocation decisions made by PE and VC fund managers are disbursed in stages, where fund managers decide on the optimal amount of capital a portfolio company needs at its specific stage in development, and then disburse additional funds only if predetermined performance targets are met.[1] Sahlman (1990) shows how portfolio companies receive capital in stages, based on their specific development needs and the fund manager's requirements to mitigate information asymmetries and agency problems. Theoretical models on staging provide ambiguous predictions. Hsu (2002), Neher (1999) and Wang and Zhou (2004) show how staging can positively impact the performance of portfolio companies and investment returns for the PE and VC fund. Staging essentially gives investors a "wait and see" option and can help mitigate commitment problems for entrepreneurs.

Theoretical papers by Cornelli and Yosha (2003), Bergemann and Hege (1998) and Wang and Zhou (2004) show how staging can have a negative effect as well. Cornelli and Yosha (2003) argue that staged financing creates a conflict of interest between the investor and the entrepreneur, inducing the entrepreneur to focus on meeting the immediate hurdle rate to qualify for the next round of financing, at the expense of overall or long-term performance. Bergemann and Hege (1998) argue that the least successful firms receive the most financing as investors take the time to learn more about the development of the company. This idea is consistent with Kahl (2002), who argues that investors – despite the option to abandon a nonperforming project – often lack information and use financial transactions through staging to learn more about the company. By the time a liquidation decision needs to be made, it is often too late as the fund will have suffered negative returns. In this view of the world, the often long-term nature of financial distress is a result of inefficient intertemporal decisions made because of the search and learning costs associated with the lack of perfect information.

The empirical evidence on whether positive or negative effects of staging outweigh the other is equally mixed. Gompers (1995) shows that a greater number of rounds and a higher magnitude of financing per round is positively correlated with companies exiting via IPO typically leading to higher

[1] The staging process is closely related to investment decisions by PE and VC funds being made with the objective of 'timing the market,' investing when the potential for growth is highest and exiting when returns have been maximized and may soon drop off. Ljungquist and Richardson (2003a, 2003b) explore the timing aspect of investment behaviour. They show that it takes several years for a fund to be invested and study which factors influence this investment schedule, including existing investment opportunities and competition amongst PE funds. They link the timing of funds' investment and exit decisions, and the subsequent returns they earn on their portfolio companies, to changes in the demand for PE in a setting where the supply of capital is 'sticky' in the short run. They show that existing funds accelerate their investment flows and earn higher returns when investment opportunities improve and the demand for capital increases. Knigge, Nowak and Schmidt (2004) investigate the market timing abilities of private equity fund managers. They find that investment timing has an impact on the performance of venture capital funds, but that (surprisingly) divestment timing has no such impact on returns.

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

returns. Hege, Palomino and Schwienbacher (2003) find evidence to the contrary, with an increase in the number of financing rounds related to a fall in IRR. Calanog, Krohmer and Lauterbach (2006) attempt to reconcile these conflicting findings by examining the timing aspect of financing rounds. We show that a higher amount of staging at earlier phases of an investment is associated with positive performance, while more staging before divestment decisions are made is negatively correlated with investment returns. We argue that in critical situations fund managers face a termination dilemma in abandoning non-performing projects. Furthermore, they may generate sunk costs due to postponed abortion of losers, and an attempt at “window dressing” by delaying when they report or write off losing propositions.

In a related paper, Gompers (1995) shows how relative risk and uncertainty affects staging: High-tech firms in their early stages of development receive more financing rounds. Interestingly, his paper also establishes a relationship between changes in the magnitude of committed capital to changes in two aspects of financing rounds: If the committed capital to new venture funds increases, the duration of financing rounds *decreases* during the following year. Furthermore, the *magnitude* of financing per round *increases* in the following year. Our speculations about investment pressure and our empirical results are consistent with these findings.

III. Empirical Strategy and Predictions

Every fund has limited resources of capital, time and effort to allocate to its portfolio companies. We argue that the pattern of resource allocation over a specific period of time is relevant for investment performance. Suppose for example that investment opportunities with an equal expected ROI arise in a uniform fashion over the course of a given investment time period. If a fund spreads the resources in a uniform fashion over the total investment period, the fund manager can assign for each invested dollar a uniform level of concentration and support for the portfolio company. However, if for some reason independent of investment opportunities (like our concept of investment pressure, for example), the fund allocates disproportionate high amounts of its capital (with

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

corresponding commitments of time and effort) during a certain fraction of the fund's investment period, there will be subproportional resources available for the portfolio companies during this investment period (again, under the assumption of an expected ROI value equal to other opportunities during the fund's lifetime), which may result in poorer quality of decision-making, monitoring and eventually, poor overall ROI of the investments made during this "pressured" investment period. We measure ROI by the internal rate of return (IRR) per annum for each investment based on the actual cash flows from the fund to a specific portfolio company (PC_i for the case of portfolio company *i*).

With this framework in mind, we measure the speed of capital allocation decisions using a ratio derived from a given fund's total capital invested over a specific time period.

III.A. Variable Specification for Speed of Capital Allocation.

To illustrate, suppose we have two funds *A* and *B*, both of which have US$100 million to invest. Fund A provides the first capital investment to portfolio company i (*PCi*) in April 2000 and gets the final distribution after the exit of *PCi* two years later in April 2002. During this holding period of two years, Fund A invests a sum of US$60 million into all portfolio companies. Fund B invests US$50 Mio. into all portfolio companies during 2 years holding period of the portfolio company from April 1992 till April 1994. We then use the following measures to estimate the speed of allocation variable:

1. $FCO_{PC_i}^{Fund}$: A measure that captures the amount of a particular fund's capital that was invested ("fund cash outflow") in all of the fund's portfolio companies during the holding period of PC_i (HP_{PCi}). From the example above, suppose that funds *A* and *B* invested US$60 million and US$50 million respectively into all of their portfolio companies over the holding period of their respective PC_i, which in this example is an equal amount of time (two years). Given variable definitions and the illustrative example, we have $FCO_{PC_i}^{A}$ = $30 million per annum and $FCO_{PC_i}^{B}$ = $25 million per annum.

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

2. $TFCO_{allPC}^{Fund}$: Is the total accumulated capital outflow of the fund to all portfolio companies during the fund's lifetime. Taking this figure as denominator standardizes $FCO_{PC_i}^{Fund}$ across different fund sizes.

3. $SCA_{PC_i}^{Fund}$: We get the general measure of the fund's speed of capital allocation (SCA) during the fund's investment period for PC_i, which is simply the ratio of $FCO_{PC_i}^{Fund}$ and $TFCO_{allPC}^{Fund}$:

$$SCA_{PC_i}^{Fund} = \frac{FCO_{PC_i}^{Fund}}{TFCO_{allPC}^{Fund}}$$

The Speed of Capital Allocation (SCA_{PCi}) of Fund A during the investment period of *PCi* is 30% per annum and SCA for Fund B in this example is 25% per annum. To take the lifetime of the fund into consideration, we perform the analyses also for the Relative Speed of Capital Allocation. To illustrate we build on the given example: Fund *A*, however, has a lifespan of 10 years and fund *B* has a lifespan of 5 years. If each fund allocated its US$100 million of capital in a uniform fashion over its lifespan, fund *A* would have $10 million to invest in any given year over its 10 year life, and fund B would have $20 million to invest. We then use the following measures to estimate the Relative Speed of Capital Allocation variable:

4. $FIR_{PC_i}^{Fund}$: Stands for "fund investment ratio," or the total amount of investment capital that a particular fund has at its disposal over its lifetime divided by its lifespan in years. For the illustrative example, $FIR_{PC_i}^{A}$ = $10 million per annum and $FIR_{PC_i}^{B}$ = $20 million.

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

5. $RSCA_{PC_i}^{Fund}$: Here we arrive at the measure of the relative fund's speed of capital allocation (RSCA) during the observation period for PC_i, which is simply the ratio of $FCO_{PC_i}^{Fund}$ and $FIR_{PC_i}^{Fund}$:

$$RSCA_{PC_i}^{Fund} = \frac{FCO_{PC_i}^{Fund}}{FIR_{PC_i}^{Fund}}$$

Using the given hypothetical values in the illustrative example, we therefore have $RSCA_{PC_i}^{A}$ = 3 ($30 million *FCO* divided by $10 million *FIR*) and $RSCA_{PC_i}^{B}$ = 1.25 ($25 million *FCO* divided by $20 million *FIR*).

A greater SCA therefore implies a faster speed of capital allocation for a given fund during the holding period of a specific portfolio company, and a greater RSCA measures a faster speed of capital within the fund lifetime compared to the funds average speed of capital allocation. This in itself does not merit any value judgment: Fund managers have many reasons why they deploy capital at faster or slower rates at any given period of time. A higher or lower SCA or RSCA value simply reflects the speed with which a given fund allocates its capital during the holding period of a particular portfolio company, relative to the fund's lifespan and total capital available for investment. What is interesting (and what we show in this paper) is that higher demand pressure from LPs appears to be related to higher SCA and RSCA values, and that higher SCA and RSCA values appear to result in lower ROI.

PE and VC funds are structured as investment products with limited a lifetime (often a maximum of 8 to 12 years) and constrained by a limited budget. PE and VC firms generally cannot create or raise another fund until a certain threshold of the current fund has been invested (often a minimum of around 70% of the capital committed to the fund). Raising capital for these funds is marked by 'hot' and 'cold' periods as described by Gompers and Lerner (2000). It seems plausible that periods characterized by low levels of capital inflow from LPs will drive fund managers to invest current funds cautiously, to avoid running out of capital before the follow-on fund is raised. This implies lower investment pressure, signifying the need to maintain larger reserves for investments in portfolio companies given the slow trickle of funds from LPs. At the other end of the spectrum, when high levels of capital are committed to new funds, PE and VC firms have an incentive to increase the speed of capital allocation to generate good results and take full advantage of the 'hot' period, allowing it to gain the reputation believed to be necessary to raise follow-on funds. This leads us to our first prediction:

Prediction 1: A higher level of committed capital to PE and VC funds will increase the funds' speed of capital allocation

III.B. Speed of Capital Allocation and Its Potential Impact on Staging Behavior

How does a PE or VC fund increase the speed of investment and resolve the higher pressure to invest? To put more capital to work, the fund may invest at a higher frequency in *new* and *existing* portfolio companies and inject a higher amount of capital for each round of financing. Several papers have explored investment decision changes for *new* investments. Gompers and Lerner (2000) show that in 'hot' periods with increased fund inflows, valuations of new investments rise. They correctly surmise that more attractive investment opportunities that appropriately generate higher valuations cannot possibly emerge in direct proportion with increased capital inflows, except by pure coincidence. These higher valuations imply that funds would need to pay a higher price or invest more capital to acquire the same level of a portfolio company's equity, relative to 'cold' periods.

Funds could also choose to invest in a larger number of new companies, which may affect long-term results if this larger quantity of investment decisions imply less due diligence on a per-company basis.. Funds could also inject more capital into companies that already belong to the fund's portfolio. These companies have passed a certain fund-specific threshold and have been selected as promising candidates; fund managers have also gotten to know more details about these portfolio companies over time. With greater information about existing portfolio companies, fund managers are in a better position to identify the best recipients of more capital during periods of increased investment pressure.

Since PE and VC firms stagger capital injections in tranches to mitigate information asymmetry and risk, it is plausible that higher investment pressure will affect staging behavior. This extends current research on staging, which usually attempt to identify fund-specific or company-specific determinants. This paper argues that one important fund-specific determinant of staging behavior is the relative amount of investment pressure as measured by the SCA and RSCA variables: We hypothesize that an increase in a given fund's speed of capital allocation is associated with a higher frequency of financing rounds and a higher magnitude of investment per round.

Prediction 2: An increase in the fund's speed of capital allocation leads to a higher staging intensity as measured by an increase in the number of financing rounds and tranches.

Prediction 3: An increase in the fund's speed of capital allocation leads to a higher average investment amount per financing round and tranche.

III.C. Speed of Capital Allocation and Its Potential Influence on Returns on Investment

If fund managers face greater investment pressure, there is an incentive to put more capital to work with new and existing companies within a shorter period of time. For *new* deals, fund managers may accept higher acquisition costs due to increased valuations, a factor relevant for speed of capital allocation but not for staging behaviour. For *existing* portfolio companies, fund managers might increase the staging behaviour and tolerate a higher burn rate of capital in specific portfolio companies by increasing marketing or hiring costs in line with achieving greater performance. In some cases, these efforts may be successful and lead to higher ROI. For other cases, the rush in spending additional capital may imply lower value added per unit of capital. As capital requirements of portfolio companies are driven foremost by underlying factors highly specific to their particular stage of development (Sahlman (1990)), high levels of speed of capital allocation may imply surplus capital that cannot be put to effective use by the recipient firm, resulting in lower ROI:

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

Prediction 4: An increase in speed of capital allocation is associated with lower investment returns.

Prediction 5: An increase in the staging behaviour driven by higher speed of capital allocation is associated with lower investment returns.

We now turn to a detailed description of our dataset.

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

IV. Data

To generate the data we need to test our predictions, we combine data on VC and PE deals from *Venture Economics* (www.thomsonfinancial.com) with the content from the *CEPRES* database (www.CEPRES.de). Information from both databases provide critical information: *Venture Economics* gathers PE and VC data voluntarily provided by investment firms.[2] *CEPRES* gathers similar data, but bases most of the information on due diligence reports, including audited filings of investment firms.[3]

Both datasets provide different kinds of information about specific investment deals. *Venture Economics* provides information on the magnitude of investment and valuations for each financing round, but does not provide precise cash flow information with exact dates for each tranche of given financing rounds, preventing calculations of investment returns on a per-tranche or per-financing round basis. *CEPRES* provides information about cash flows for each financing tranche, filling in what is missing from *Venture Economics* and allowing the calculation of measures of investment performance like the IRR. Merging both databases by matching on investment deals that are in both *Venture Economics* and *CEPRES* generates a dataset with more than 150 different variables for each investment deal, allowing us to perform our empirical analysis (see Appendix B for a description of the variables we use in our estimations). We merged the datasets in November 2003, and as of this date *Venture Economics* contained information on over 220,000 separate financings. These are matched with information provided by CEPRES on 5,308 investments in 4,476 portfolio companies financed by 229 different funds belonging to 74 investment firms.

The merged dataset provides information on 1,747 specific investments, matched according to the name of the investment management firm, the fund name, the name of specific portfolio companies

[2] The following papers used *Venture Economics* data and provide more details: Gompers (1995) and Hege, Palomino & Schwienbacher (2003).
[3] Cumming & Walz (2004), Cumming, Schmidt & Walz (2004) and Schmidt (2004) use *CEPRES* data and provide more details about the dataset.

that received capital injections, and the specific dates when portfolio companies received capital and when the investment was liquidated.

The dataset is further reduced along the following lines: All unrealized investments are excluded to mitigate reporting bias and to base IRR figures only on fully or partially realized investments. To reduce valuation bias and estimation errors of partially realized investments, partially realized investments are excluded when their *q*-value is above 20%. The *q*-value selection rule is in line with Diller and Kaserer (2004), where the threshold is defined using the equation:

$$q \geq \frac{RNAV_T}{\sum_{t=0}^{T} |CF_t|}$$

The residual net asset value ($RNAV_T$) of partially realized investments as of November 2003 is divided by absolute sum of cash flows from the fund into the portfolio company, and out of the portfolio company as the fund is liquidated. This calculation results in the threshold q-value. The limit of the *q*-value can be set flexibly. For partially exited portfolio companies, $RNAV_T$ is taken as an estimate for the final distribution from the company to the fund. As the $RNAV_T$ reported by funds may include reporting bias leading to overestimation of future returns, the chosen *q*-value of 20% helps to limit estimation errors in consideration of the company's historical cash flows.

As a final step, we exclude all cross-fund investments to eliminate double-counting. Cross-fund investments imply that two or more follow-on funds of the same investment management firms invested in the same portfolio company. After all of these reductions, we observe 712 different investments made by 122 PE and VC funds belonging to 51 different investment firms. These investments include 1,549 financing rounds with 2,329 cash injections (tranches) spanning a period of 24 years from 1979 until 2003.

The dataset appears to be representative of the general pool of PE and VC deals, as it corresponds with the distribution of key aspects of the market of PE and VC financings (refer to

Figures 1 to 3 in Appendix A for frequency distributions). The frequency distribution of the dates for the beginning and exit of investments appears to be similar to industry developments from 1979 to 2003. The frequency distribution with respect to countries of origin is comparable with the size of regional PE and VC markets. A majority of investments (447, or 63%) were done in the United States, with the remainder distributed over 21 countries in Europe, Asia and Latin America. Within Europe, 56 investments are in the United Kingdom, 30 in France and 26 in Germany.

In terms of industries or sectors in which funds were invested, the distribution is as follows: Information Technology (25.3%), Health Care and Life Science (16.4%), Internet and Media (11.2%), Industrial / Manufacturing (9.6%), Telecommunications (9.1%) and 7,3% Consumer and Retail (7.3%).

A majority (55.4%) of investments were funnelled to portfolio companies that were relatively young (31.5% up to one year, 23.9% two to five years). Companies aged 6-20 years received 12.8% of total investment, and only 5.1% of the total invested capital was channelled to companies older than 20 years.

We identify portfolio companies that are at different stages of development. 31.7% of investments were made for early stage financing (seed, start-up, early), 15.9% for expansion (expansion and acquisition financing), 18.5% in later stage (later, MBO/MBI, LBO, public to private, mezzanine), and 2% in turnaround (turnaround and recapitalization). The remaining 31.9% of investment deals did not provide information about development stage. 84.8% of the 712 observed deals were fully realized and 15.2% were partially realized. 52% of investments were terminated through a trade sale or merger, 11.5% through an IPO, 21.5% were written off, and 15% did not provide information about the type of exit decision.

The level of detail and accuracy of this paper extends that of previous empirical studies that explored how staging influences investment performance. Gompers (1995) based his study on data from *Venture Economics* and used a proxy for measuring performance by classifying the exit type and considering an IPO exit as a success. This measurement approach is imprecise since a highly valued trade sale may provide higher investment returns than a poorly priced IPO. Hege, Palomino and

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

Schwienbacher (2003) based their performance measurement on a hand-collected questionnaire dataset, supplemented by valuation data from *Venture Economics*. For the hand-collected questionnaire dataset, they applied the same grid used by Gompers (1995), which generate measures that are difficult to interpret. The IRR figures in Hege, et. al. are subject to measurement error because of two critical weaknesses inherent in their approach:

1. IRR measurements based on *Venture Economics* data alone may lead to *milestone bias*, which can materially affect researchers' estimates of returns and valuation patterns over time. IRR calculations as a measure of investment performance are meaningful if the data provide information on the exact beginning and end dates of the investment, but *Venture Economics* only provides dates of financing rounds, not the exact date of cash injections: The exact date of cash injections often differ from the date of the financing round because rounds are often broken up into several cash injections, referred to as milestone rounds. This weakness has been identified in Kaplan, Sensoy and Strömberg (2002), which stresses the impossibility of accurately measuring milestone round information using *Venture Economics* data: "Milestone rounds, therefore, are problematic because the amount invested at closing and the total amount actually invested at those terms can differ." This same weakness affects exit dates provided by *Venture Economics*, which is not always equivalent to the precise date of when the investor has exited and receives the cash flow back from the portfolio company.
2. Hege, Palomino and Schwienbacher (2003) use valuation data instead of cash flows for their performance measurement. Their IRR measurement is partially based on estimates for the first stage valuation for those cases with missing information in the dataset.

Unlike these previous studies, our merged dataset provides information for each financing round as well as for each cash injection or milestone rounds within specific financing rounds. We believe that our data allows the most detailed and accurate analyses of staging and investment returns currently possible.

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

V. Results

Appendix C summarizes the results of descriptive analysis and correlation tests for specific independent variables. Appendix D to F summarize the results from exploratory OLS regressions, which appear to confirm our predictions.

Confirmation of Prediction 1. A higher level of committed capital to PE and VC funds appears to be associated with an increase in funds' speed of capital allocation. Refer to the table in Appendix B, where we measure an increase in demand for PE/VC investments using the *committed capital* variable, defined as the magnitude of committed capital in the overall market at the time that a particular investment in a specific portfolio company was made. Higher values of committed capital therefore imply that more funds are available from LPs relative to an average year. We find that periods marked by a 100% increase in capital inflows are associated with a 62.2% increase in SCA values at the means (Appendix B, Model 3).

We control for various factors that may affect the way we interpret our results. We control for the internal age of the fund since its inception, expressed either in time since closing or as the fraction of portfolio companies in which the fund chose to invest since closing, compared to the total number of its deals during its lifetime. The more deals to which the fund is committed, or the older the fund gets, the less capital it has left over for further investments, leading to a reduction of SCA. The results for SCA are also robust with respect to changes in GDP. A growing economy may imply a healthy business environment, which may impact SCA positively. We also include the risk-free rate as a control variable, since an increase in the risk free interest rate may influence the SCA negatively through a reduction in the demand for equities (which include PE and VC funds) relative to debt.

Regression models for SCA and RSCA are straightforward to interpret (Table B). During periods of increased committed capital in the overall market, the speed of capital allocation of PE and VC funds increases. RSCA moves in the same direction as SCA but do not exhibit as strong a result in terms of statistical significance or coefficient magnitude, but this is to be expected since the RSCA measure already partially captures the increase in speed of capital allocation *within* funds.

Confirmation of Predictions 2 and 3. An increase in the fund's speed of capital allocation is associated with an increase in the amount of staging behaviour: We observe an increase in staging intensity as well as a higher magnitude of capital investment per financing round and tranche (cash injection). We find that a 100% increase in SCA is associated with a 155.1% increase in the staging intensity of financing rounds (Appendix C, Model 1) and a 58.6% increase in the average amount of investment per financing round (Appendix D, Model 1). When we examine the impact of the RSCA measure, we find that a 100% increase in RSCA is associated with a 112.7% increase in the staging intensity of tranches (Appendix C, Model 6) and a 39.9% increase in the average amount per tranche (Appendix D, Model 6).

These results appear to support our argument that fund-specific characteristics like higher investment pressure on the part of fund managers influences the staging behavior, controlling for firm-specific characteristics associated with particular portfolio companies and their developmental stage. Our results for the SCA and RSCA variables remain robust even as we control for factors like the age or developmental stage of portfolio companies, their business associated to the high tech sector, etc. all of which can signal agency problems and have been established as important determinants of staging behavior. The results for predictions 2 and 3 are robust even as we control for exogenous demand changes in the PE/VC market and other market characteristics.

Confirmation of Predictions 4 and 5. An increase of speed of capital allocation as well as in staging behaviour driven by higher speed of capital allocation is associated with lower investment returns. We specify an *absolute* IRR measure based on precise data on the timing and magnitude of

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

cash flows into and out of portfolio companies.[4] We calculate absolute IRR for specific investments based on initial cash injection through the final distribution back from portfolio companies into the fund. We take the natural logarithm of absolute IRR figures to ensure that our dependent variable conforms to Gaussian assumptions necessary for classical linear regression. Specifying the dependent variable as *log*(IRR + 1,1) covers all cases with positive and negative IRR results as well as write-offs (IRR= -100 %).

Consistent with hypotheses about divided time, allocation of resources, attention and focus on the part of the fund manager, and the failure of portfolio companies to maximize the use of surplus capital, we find that an increase of the speed of capital allocation as well as of staging behavior impact IRR negatively. Specifically, we find that a 100% increase in SCA is associated with a -22.4% fall of IRR (Table E, Model 1). The results show further that a 100% increase in RSCA leads to a -35.8% fall of IRR (Table E, Model 4).

When we examine staging behavior, we find that a 100% increase in the number of tranches results in a 5.1% decrease in IRR (Appendix E, Model 4). Our results are robust even controlling for committed capital (our measure for demand pressure) and for other determinants such as the companies' business association to the high tech sector, syndication, VC fund type, the investment manager's years in business, and different market characteristics.

While we use simple OLS models we find that the data support classical linear regression assumptions, with tests for collinearity and heteroskedasticity within acceptable tolerance limits. Future research will test whether our results hold for different estimation techniques, including specifying various dependent variables as categorical and using maximum likelihood methods.

[4] Further analyses were performed on *relative* IRR measures compared to the performance of a simultaneous investment in a public index (NASDAQ or MSCI world). Results were similar to specifications that used absolute IRR. Appendices show results using absolute IRR figures.

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

VI. Conclusions

Our results confirm that higher inflows of LP capital into PE and VC funds are associated with an increase in the speed of capital allocation to portfolio companies. This appears to lead to more intense staging behavior as funds employ more financing rounds and invest a higher magnitude of capital per financing round in an attempt to generate good results. We find that a higher speed of capital allocation is associated with lower investment returns.

We believe that examining the mechanism that drives what we term as the pressure chain of PE/VC financing helps explain the differences in investment performance during "hot" and "cold" fundraising periods. One of this paper's main contributions is measuring the speed of capital allocation for specific funds into particular portfolio companies: Previous papers were hampered from measuring this variable because of insufficient data. We show how the relative speed of capital allocation influences staging behavior and investment performance. During "hot" times, managers of PE and VC funds participate on the upside of asset price bubbles by speeding up capital allocation, intensifying staging behavior and capitalizing on large amounts of capital available for investment. However, during "cold" times or downturns they suffer minimal exposure as they slow down capital allocation and put relatively less capital at risk. This can be interpreted as fund managers simply carrying out their fiduciary duty to maximize returns and minimize risks for their investors. However, our results imply that a higher speed of capital allocation may in fact not be optimal for investors, given its negative impact on investment returns.

These findings contribute to the ongoing debate about financial market rationality and investor behavior in the Private Equity and Venture Capital markets. Investigating the impact of fund managers' behavior on investment returns, through the mechanisms of the speed of capital allocation and staging intensity, brings up important questions as to how to create appropriate incentive structures that will align fund managers's behavior with their supposed primary role as financial intermediary. Given existing incentive structures, fund managers may continue to contribute or exacerbate the volatile nature of PE and VC market returns during boom and bust periods.

References

Allen, Franklin, 2001, Do Financial Institutions Matter?, *The Journal of Finance* LVI.

Baron, Robert A., Dean A. Shepherd, and Andrew L. Zacharakis, 2003, VCs' decision processes: Evidence suggesting more experience may not always be better, *Journal of Business Venturing* 18, 381-403.

Bergemann, Dirk, and Ulrich Hege, 1998, Venture Capital financing, moral hazard, and learning, *Journal of Banking & Finance* 22, 703-735.

Berger, Allen N., and Gregory F. Udell, 1998, The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle, *Journal of Banking & Finance* 22, 613-673.

Buffet, Warren, 2005, How to Minimize Investment Returns, *RV Business Magazine*, December 2005 edition, 18-19

Chan, Yuk-Shee, 1983, On the positive role of financial intermediation in allocation of venture capital in a market with imperfect information, *Journal of Finance* 38, 1543-1569.

Cochrane, John H., 2004, The Risk and Return of Venture Capital, (University of Chicago).

Cornelli, Francesca, and Oved Yosha, 2003, Stage Financing and the Role of Convertible Securities, *Review of Economic Studies* 70, 1-32.

Cumming, Douglas, Grant Fleming, and Jo-Ann Suchard, 2005, Venture capitalist value-added activities, fundraising and drawdowns, *Journal of Banking & Finance* 29, 295-331.

Cumming, Douglas, Daniel Schmidt, and Uwe Walz, 2004, Legality and Venture Governance around the the World, (University of Alberta, Canada, University of Frankfurt, Germany).

Cumming, Douglas, and Uwe Walz, 2004, Private Equity Returns and Disclosure Around The World, RICAFE - Risk Capital and the Financing of European Innovate Firms (University of Frankfurt, Germany).

Diller, Christian, and Christoph Kaserer, 2004, European Private Equity Funds - A Cash Flow Based Performance Analysis, Working paper series - Center for Entrepreneurial and Financial Studies (Munich).

Fenn, George W., Nelli Liang, and Stephen Prowse, 1995, The Economics of the Private Equity Market, *Federal Reserve Bulletin.* January 1996.

Gebhardt, Georg, 2002, A Soft Budget Contraint Explanation for the Venture Capital Cycle, (University of Munich).

Gompers, Paul A., 1995, Optimal Investment, Monitoring, and the Staging of Venture Capital, *Journal of Finance* 50, 1461-1491.

Gompers, Paul A., 1996, Grandstanding in the venture capital industry, *Journal of Financial Economics* 42, 132-157.

Gompers, Paul A., and Josh Lerner, 1999. *The Venture Capital Cycle* (MIT Press, Cambridge Mass).

Gompers, Paul A., and Josh Lerner, 1999, What Drives Venture Capital Fundraising?, Working Papers -- Harvard Business School Division of Research.

Gompers, Paul A., and Josh Lerner, 2000, Money Chasing Deals? The Impact of Fund Inflows on Private Equity Valuations, *Journal of Financial Economics* 55, 281-324.

Hege, Ulrich, Frédéric Palomino, and Armin Schwienbacher, 2003, Determinants of Venture Capital Performance: Europe and the United States, Working Paper (University of Amsterdam).

Hsu, Yao-Wen, 2002, Staging of Venture Capital Investment: A Real Option Analysis, (University of Cambridge).

Inderst, Roman, and Holger M. Mueller, 2003, The Effect of Capital Market Characteristics on the Value of Start-Up Firms, *Journal of Financial Economics*.

Kahl, Matthias, 2002, Economic Distress, Financial Distress, and Dynamic Liquidation, *The Journal of Finance* LVII.

Kaplan, Steve, and Antoinette Schoar, 2003, Private Equity Performance: Returns, Persistence and Capital Flows, (University of Chicago).

Kaplan, Steven N., Berk A. Sensoy, and Per Strömberg, 2002, How well do venture capital databases reflect actual investments?, (University of Chicago Graduate School of Business.).

Knigge, Alexander, Eric Nowak, and Daniel Schmidt, 2004, On the Performance of Private Equity Investments: Does Market Timing matter?, (University of Frankfurt, Germany; University of Lugano, Switzerland).

Krohmer, Philipp, Rainer Lauterbach, and Victor Franco M. Calanog, 2006, Private Equity Post-Investment Phases - The Bright and Dark Side of Staging, Working Paper (J.W. Goethe University, Frankfurt, Germany and The Wharton School, Philadelphia).

Lerner, Josh, 2002, Boom and bust in the venture capital Industry and the impact on innovation, *Economic Review (Federal Reserve Bank of Atlanta)* 87, 25-40.

Ljungquist, Alexander, and Matthew Richardson, 2003, The Cash Flow, Return and Risk Characteristics of Private Equity, (Stern School of Business, New York).

Ljungquist, Alexander, and Matthew Richardson, 2003, The Investment Behaviour of Private Equity Fund Managers, (Stern School of Business, New York).

Meyer, Thomas, 2003, Modelling Venture Capital Funds, *Risk Magazine* October 2003.

Neher, Darwin V., 1999, Staged Financing: An Agency Perspective, *The Review of Economic Studies* 66, 255-274.

Robbie, Ken, Mike Wright, and Brian Chiplin, 1997, The monitoring of venture capital firms, *Entrepreneurship: Theory & Practice* 21, 9-29.

Sahlman, William A., 1990, The structure and governance of venture-capital organizations, *Journal of Financial Economics* 27, 473-522.

Schmidt, Daniel, 2004, Private equity-, stock- and mixed asset-portfolios: A bootstrap approach to determine performance characteristics, diversification benefits and optimal portfolio allocations, Center of Financial Studies (University of Frankfurt, Germany).

Wang, Susheng, and Hailan Zhou, 2004, Staged financing in venture capital: moral hazard and risks, *Journal of Corporate Finance* 10, 131-155.

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

Appendix A

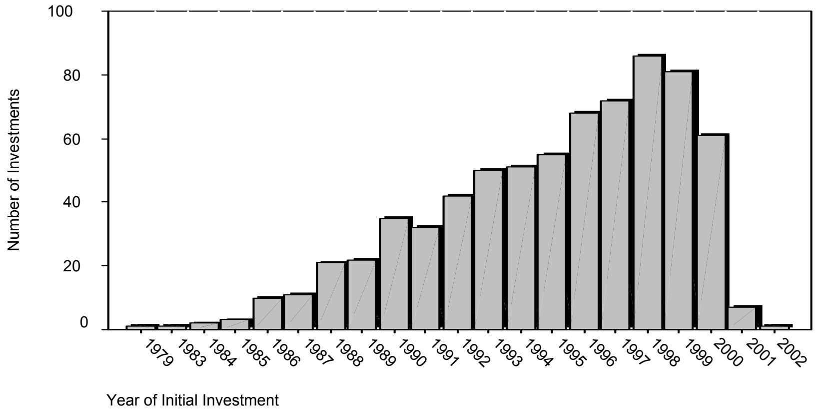


Figure 1: PE Investments per year (Sample 712 Investments)

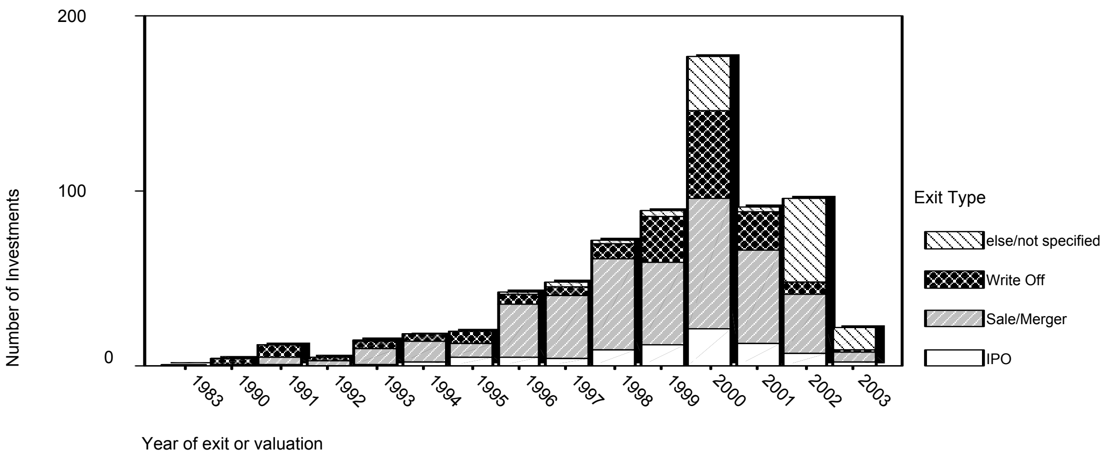


Figure 2: Number and type of exits per year (Sample: 712 Investments)

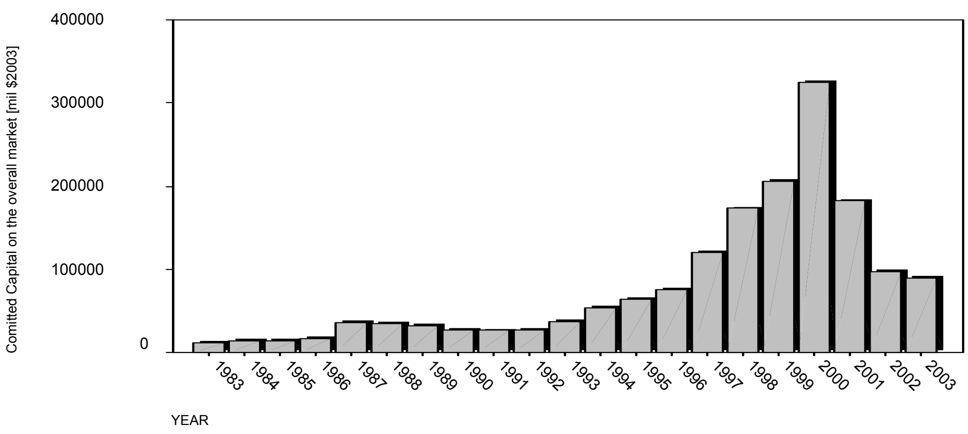
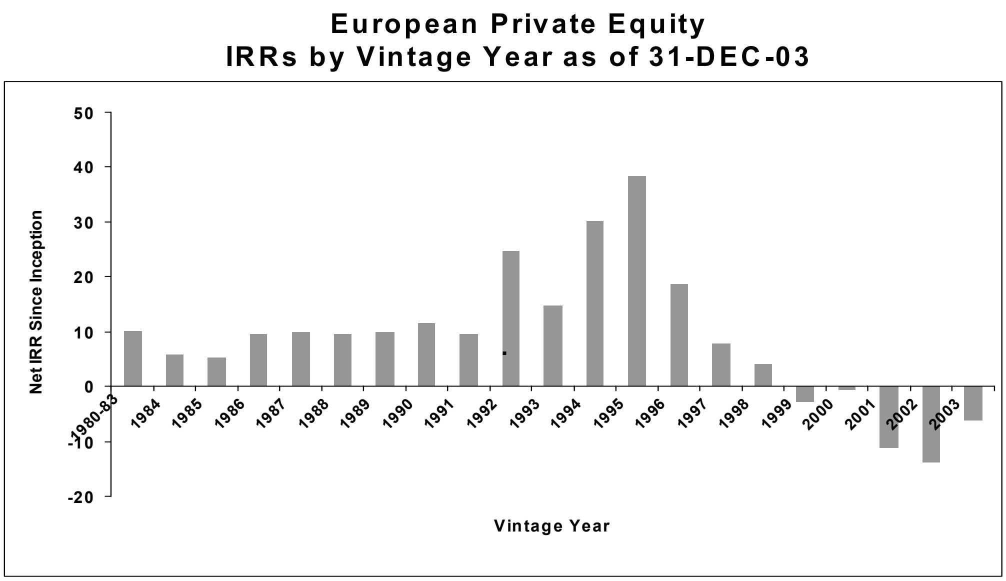


Figure 3: Committed Capital on the overall market [in mil 2003 US Dollars] by year. Source: Venture Economics April 2005

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg



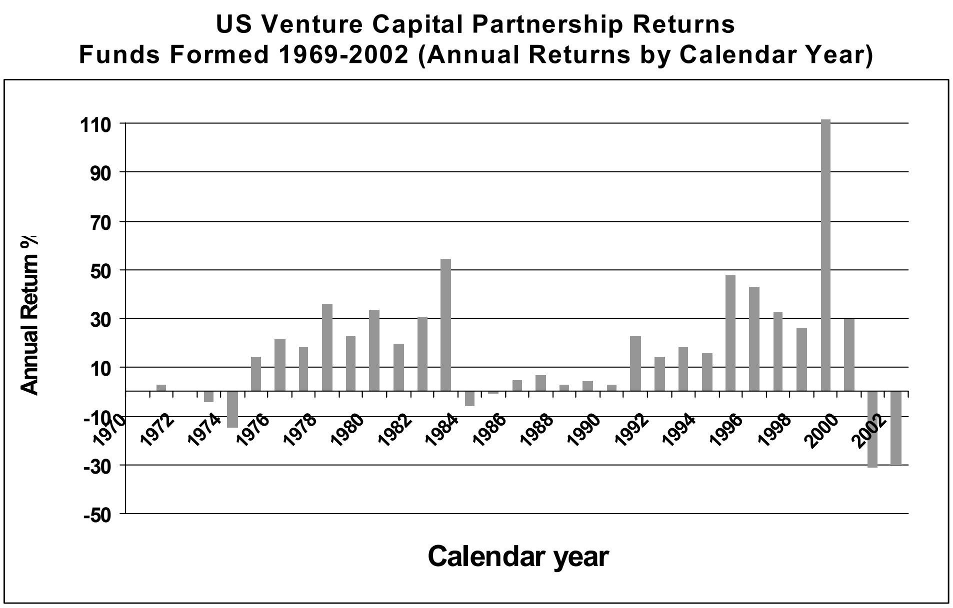
Database Source: VentureXpert database from Thomson Venture Economics

Investment Data Source: The MoneyTree Survey by PricewaterhouseCoopers/Thomson Venture Economics/NVCA

All other data Source: Thomson Venture Economics

Figure 4: US Venture Capital Partnership Returns by year. Source: Venture Economics

Figure 5: European Private Equity IRRs by Vintage Year. Source: Venture Economics



Database Source: VentureXpert database from Thomson Venture Economics

Investment Data Source: The MoneyTree Survey by PricewaterhouseCoopers/Thomson Venture Economics/NVCA

All other data Source: Thomson Venture Economics

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

Table 1: Description of Variables

	Variable Name	Variable Description
Performance Measure	IRR [Log(IRR+1,1)]	The exact IRR (Internal Rate of Return) based on the investment cashflows from the fund to the portfolio company and return flow from the company to the fund. For the regression analyses we take logs of (IRR+1,1) to conform to Gaussian assumptions necessary for classical linear regressions and to cover all positive and negative IRR results as well as write-offs
Speed of Capital Allocation Measures	Fund's Speed of Capital Allocation (SCA) [log]	The Fund's Speed of Capital Allocation during the investment period of portfolio company i [SCA] is calculated as the fund's capital outflows to all portfolio companies during the investment period of portfolio company i (in real 2003 U.S. Dollars)* [FCOall-pci] divided by the fund's accumulated capital outflows during the total fund's lifetime (in real 2003 U.S. Dollars)* [FCOlifetime] divided by the holding period of portfolio company i in years [HPpci]. [For the regression analysis we take logs.]
	Fund's Relative Speed of Capital Allocation (RSCA) [log]	The Fund's Relative Speed of Capital Allocation during the investment period of portfolio company i (RSCA) is calculated as the fund's capital outflows to all portfolio companies during the investment period of portfolio company i (in real 2003 U.S. Dollars)* [FCOall-pci] divided by the holding period of portfolio company i in years [HPpci] divided by the fund's accumulated capital outflows during the total fund's lifetime (in real 2003 U.S. Dollars)* [FCOlifetime[divided by the fund's lifetime in years [FLT]. [For the regression analysis we take logs.]
Demand Measure	Committed Capital [log]	Comitted Capital on the Overall Market at Date of Investment (in real 2003 U.S. Dollars, in millions)* [For the regression analysis we take logs.]
Staging-related Variables	Staging-Intensity (Tranches) [log]	The Staging-Intensity (Tranches) is the ratio: Number of Tranches the fund invested in portfolio company i divided by the holding period of portfolio company i in years. [For the regression analysis we take logs]. Tranches are cash outflows at CEPRES. Each Financing Round can include one or more tranches.
	Staging-Intensity (Rounds) [log]	The Staging-Intensity (Rounds) is the ratio: Number of Financing Rounds the fund invested in portfolio company i divided by the holding period of portfolio company i in years. [For the regression analysis we take logs]. Financing Rounds are reported at Venture Economics
	Number of Tranches	Number of Tranches the fund invested in portfolio company i during its holding period
	Average Tranche-Investment [log]	The average Tranche-Investment is the total investment amount (in real 2003 U.S. Dollars)* the fund invested into portfolio company i divided by the number of Tranches of the fund to portfolio company i. [for the regression analysis we take logs]. Tranches are cas ouitflows at CEPRES. Each Financing Round can include one or more tranches.
	Average Round-Investment [log]	The average Round-Investment is the total investment amount (in real 2003 U.S. Dollars)* the fund invested into portfolio company i divided by the number of financing rounds of the fund to the portfolio company i. [for the regression analysis we take logs]
Control Variables		
Portfolio Company	High Tech	A dummy variable equal to 1 for Companies of the High Tech - Sector [The Company is classified as High Tech, when belonging to one of the following CEPRES Sector categories: HealthCare/LifeScience, IT, High Tech, Semiconductor, Software, Internet, Telecommunications]
	Later Stage	A dummy variable equal to 1 for Later Stage Companies [The Company is classified as Later Stage (Early Stage = 0), when belonging to one of the following CEPRES Stage categories: later, MBO/MBI, LBO, public to private, Mezzanine, turnaround, recapitalisation. (Early stage categories: seed, startup, early, expansion)]
	Age of Company	Age of portfolio company i (in years since its founding date) at date of initial investment by the fund
	Syndication	Total number of Fund Investment Management Firms investing in portfolio company i during its lifetime
Fund	VC-Fund	A dummy variable equal to 1 for Funds specialized on Venture Capital
	Time since closing	Maturity of the Fund (in years since its closing date, which marks the end of its fund raising) at date of initial investment of portfolio company i
	Fraction of Companies since closing	The fraction of companies is the number of portfolio companies the Fund has invested in since its closing date to date of initial investment of portfolio company i, divided by the total number of portfolio companies the Fund invested in during the lifetime of the fund.
Fund Investment Management Firm	IM Years in Business	No. of years the Fund Investment Management Firm is in business at time of the initial investment of the Fund in portfolio company i
	US-IM	A dummy variable equal to 1 for the Fund Investment Management Firm with the main office in the United States
	No. of Professionals	Number of investment professionals employed by the Fund Investment Management Firm
Market	Exit/Valuation in Bubble	A dummy variable equal to 1, if portfolio company i was exited between September 1998 and March 2000, 0 otherwise (if the investments is not fully realised, we consider date of last valuation as exit date)
	No. Of IPOs	Number of (PE-backed) IPOs one year before date of exit/valuation of portfolio company i
	Risk Free Rate	The short term interest rate at date of the initial investment of the Fund into portfolio company i (for U.S. investments:The Federal Reserve Bank 1 month treasury bills; for EU investments: the BBA Libor rate)
	NASDAQ Development	NASDAQ Development is the variation of the NASDAQ Composite Index between the initial investment date of the Fund into portfolio company i versus three quarters before the initial investment
	GDP	The GDP is the average variation of Real US Gross Domestic Product p.a. over the holding period of the Fund's investment into portfolio company i
		* The inflation adjustment is based on Consumer Price Index (CPI) data for all urban households and all items. Data is derived from the records of the U.S. Department of labor (www.bls.gov)

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

Appendix B:

Regression Analysis on the Determinants of the Fund's Speed of Capital Allocation

The table presents the results of the OLS regression; the full dataset includes 712 Investments (one observation is per company, not per financing round). The cross heading specifies the dependent variable. The last four rows present the model diagnostics (Number of Observations, R square, Adjusted R square and the F- statistic). Observations with incomplete data for the transaction were skipped. The first column defines the categories of the independent variables, the second column presents the variables. The unstandardized coefficients of the OLS regression are illustrated in the following columns. *, **, *** Significant at the 10%, 5%, 1% levels, respectively. Variables are as defined in Table 1.

		Modell (1)	Modell (2)	Modell (3)	Modell (4)	Modell (5)	Modell (6)
		Dependent Variable =Log (Speed of Capital Allocation)	Dependent Variable =Log (Speed of Capital Allocation)	Dependent Variable =Log (Speed of Capital Allocation)	Dependent Variable =Log (Relative Speed of Capital Allocation)	Dependent Variable =Log (Relative Speed of Capital Allocation)	Dependent Variable =Log (Relative Speed of Capital Allocation)
	Constant	-3.241***	-3.789***	-3.897***	0.547**	0.639***	0.551**
	Comitted Capital [log]	0.522***	0.619***	0.622***	0.014	0.007	0.017
Portfolio Company	High Tech					0.001	
	Age of Company				-0.004***	-0.004***	-0.004***
	Later Stage					-0.068**	-0.069**
	Syndication	0.000	8.21E-05				
Fund	Time since closing	-0.095***					
	Fraction of Companies since closing		-0.469***	-0.470***	-0.238***	-0.236***	-0.233***
IM	IM Years in Business	0.002*		0.001	-0.002	-0.002*	-0.002
	US-IM	0.074**	0.175***	0.183***	-0.469***	-0.483***	-0.446***
	No. of Professionals		5.37-04*				
Market	NASDAQ Development	0.048	0.037	0.023	-0.024	-0.066	-0.030
	No. of IPOs	1.29E-04	1.09E-04	1.87E-04	0.000	-7.58E-05	0.000
	GDP	0.453***	0.453***	0.453***	0.424***	0.429***	0.430***
	Risk Free Rate	-0.016**	-0.12*				
Model Diagnostics	Number of Observations	687	682	691	513	492	513
	Rsquare	0.540	0.522	0.520	0.319	0.351	0.326
	Adjusted Rsquare	0.534	0.515	0.515	0.308	0.337	0.314
	F Statistic	88.170***	81.497***	105.569***	29.505***	25.975***	27.073***

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

Appendix C:

Regression Analysis on the Determinants of Staging of PE and VC - Investments

Staging is measured by Staging-Intensity

The table presents the results of the OLS regression; the full dataset includes 712 Investments (one observation is per company, not per financing round). The cross heading specifies the dependent variable. The last four rows present the model diagnostics (Number of Observations, R square, Adjusted R square and the F- statistic). Observations with incomplete data for the transaction were skipped. The first column defines the categories of the independent variables, the second column presents the variables. The unstandardized coefficients of the OLS regression are illustrated in the following columns. *, **, *** Significant at the 10%, 5%, 1% levels, respectively. Variables are as defined in Table 1.

		Staging-Intensity of Financing Round			Staging-Intensity of Tranches		
		Modell (1)	Modell (2)	Modell (3)	Modell (4)	Modell (5)	Modell (6)
		Dependent Variable =Log (Staging-Intensity (Rounds))	Dependent Variable =Log (Staging-Intensity (Rounds))	Dependent Variable =Log (Staging-Intensity (Rounds))	Dependent Variable =Log (Staging-Intensity (Tranches))	Dependent Variable =Log (Staging-Intensity (Tranches))	Dependent Variable =Log (Staging-Intensity (Tranches))
	Constant	1.033	-5.948***	-5.639***	0.695	-5.756***	-5.519***
Speed of Allocation	SCA [log]	1.551***			1.451***		
	RSCA [log]		0.975***	1.259***		0.892***	1.127***
Portfolio Company	High Tech	0.017	-0.069	-0.62	0.062	0.025	-0.013
	Age of Company	8.47E-04		0.002	-0.001		0.000
	Later Stage	-0.33***	-0.366***	-0.321***	-0.298***	-0.313***	-0.295***
	Syndication	0.002	-0.004	-0.009	-0.001	-0.014	-0.011
Fund	VC-Fund	0.005	-0.039	0.155	0.242*	0.270**	0.340**
IM	IM Years in Business	0.0095**	0.013***	0.012***	0.013***	0.015***	0.016***
	US-IM	0.166	0.793***	1.021***	-0.061	0.567***	0.714***
Market	Comitted Capital [log]	-0.146	0.910***	0.787***	-0.035	0.941***	0.837***
	NASDAQ Development	0.384*	0.489***	0.495**	0.402*	0.457***	0.504**
	No. Of IPOs	4.3E-04	7.51E-04*	7.81E-04	6.5E-04	7.86E-04*	0.001**
	Exit/Valuation in Bubble	0.078	0.068	0.087	0.018	0.058	0.031
	GDP	0.911***	1.170***	1.068***	0.863***	1.097***	1.031***
Model Diagnostics	Number of Observations	497	682	497	499	683	499
	Rsquare	0.448	0.378	0.403	0.470	0.389	0.421
	Adjusted Rsquare	0.433	0.367	0.386	0.455	0.378	0.405
	F Statistic	30.098***	33.922***	25,034***	33.020***	35.514***	27.088***

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

Appendix D:

Regression Analysis on the Determinants of Staging of PE and VC - Investments

Staging is measured by the Average Investment Amount

The table presents the results of the OLS regression; the full dataset includes 712 Investments (one observation is per company, not per financing round). The cross heading specifies the dependent variable. The last four rows present the model diagnostics (Number of Observations, R square, Adjusted R square and the F- statistic). Observations with incomplete data for the transaction were skipped. The first column defines the categories of the independent variables, the second column presents the variables. The unstandardized coefficients of the OLS regression are illustrated in the following columns. *, **, *** Significant at the 10%, 5%, 1% levels, respectively. Variables are as defined in Table 1.

		Average Investment Amount per Financing Round			Average Investment Amount per Tranche		
		Modell (1)	Modell (2)	Modell (3)	Modell (4)	Modell (5)	Modell (6)
		Dependent Variable =Log (avg. Investment per Round)	Dependent Variable =Log (avg. Investment per Round)	Dependent Variable =Log (avg. Investment per Round)	Dependent Variable =Log (avg. Investment per Tranche)	Dependent Variable =Log (avg. Investment per Tranche)	Dependent Variable =Log (avg. Investment per Tranche)
	Constant	7.808***	6.968***	5.360***	8.148***	7.107	5.262***
Speed of Allocation	SCA [log]	0.586***	0.348**		0.684***	0.430***	
	RSCA [log]			0.269*			0.399***
Portfolio Company	High Tech	-0.157	-0.157	-0.196	-0.206*	-0.256**	-0.247**
	Age of Company	0.006*		0.006*	0.008**		0.008**
	Later Stage	0.887***	0.950***	0.875***	0.860***	0.889***	0.851***
	Syndication	-0.030***	-0.35***	-0.033***	-0.027**	-0.25**	-0.031***
Fund	VC-Fund	-0.782***	-0.648***	-0.741***	-0.971***	-0.872***	-0.924***
IM	IM Years in Business	0.040***	0.032***	0.040***	0.036***	0.030***	0.037***
	US-IM	0.245*	0.388***	0.472***	0.473***	0.580***	0.777***
Market	Comitted Capital [log]	0.121	0.257	0.477***	0.009	0.179	0.423***
	NASDAQ Development	0.143	-0.56	0.176	0.127	-0.038	0.169
	No. Of IPOs	-0.001	-0.001*	0.000	-0.001	-0.001*	-0.001
	Exit/Valuation in Bubble	-0.090	-0.062	-0.071	-0.031	-0.052	-0.015
	GDP	-0.28	-0.176	-0.135	-0.231	-0.103	-0.097
Model Diagnostics	Number of Observations	497	680	497	499	681	499
	Rsquare	0.483	0.452	0.471	0.515	0.470	0.502
	Adjusted Rsquare	0.469	0.442	0.457	0.502	0.460	0.489
	F Statistic	34.661***	45.895***	33.050***	39.558***	49.356***	37.673***

Autoren:
Victor Calanog
Rainer Lauterbach
Mark Wahrenburg

Appendix E:

Regression Analysis on the Determinants of Investment Performance

Performance measured by the Internal Rate of Return (IRR)

The table presents the results of the OLS regression; the full dataset includes 712 Investments (one observation is per company, not per financing round). The cross heading specifies the dependent variable. The last four rows present the model diagnostics (Number of Observations, R square, Adjusted R square and the F- statistic). Observations with incomplete data for the transaction were skipped. The first column defines the categories of the independent variables, the second column presents the variables. The unstandardized coefficients of the OLS regression are illustrated in the following columns. *, **, *** Significant at the 10%, 5%, 1% levels, respectively. Variables are as defined in Table 1.

		Modell (1)	Modell (2)	Modell (3)	Modell (4)	Modell (5)	Modell (6)
		Dependent Variable = Log (IRR+1,1)	Dependent Variable = Log (IRR+1,1)	Dependent Variable = Log (IRR+1,1)	Dependent Variable = Log (IRR+1,1)	Dependent Variable = Log (IRR+1,1)	Dependent Variable = Log (IRR+1,1)
	Constant	0.449	-0.085	0.450	1.316***	0.207**	1.248***
Speed of Allocation	SCA [log]	-0.224***	-0.213***	-0.164**			
	RSCA [log]				-0.358***	-0.303***	-0.329***
Staging	Staging-Intensity (Tranches) [log]		-0.005***	-0.004***		-0.004***	-0.003**
	Average Tranche-Investment [log]	1.98E-06*	1.87E-06*	1.91E-06*	1.72E-06	1.89E-06*	1.87E-06*
	Number of Tranches	-0.045***	-0.045***	-0.047***	-0.051***	-0.042***	-0.049***
Portfolio Company	High Tech	0.054	0.050	0.054	0.083	0.052	0.071
	Syndication	-0.002	-0.003	-0.003	0.000	-0.002	-0.001
Fund	VC-Fund	-0.056	-0.054	-0.077	-0.043	-0.025	-0.055
IM	IM Years in Business	-0.004*	-0.004*	-0.004*	-0.005**	-0.005**	-0.005**
	US-IM		0.134**	0.126**		-0.009	-0.026
Market	Comitted Capital [log]	-0.094		-0.109	-0.233***		-0.222***
	NASDAQ Development	-0.308***	-0.396***	-0.309***	-0.348***	-0.514***	-0.324***
	No. Of IPOs	2.34E-04	2.11E-04	3.46E-04	2.69E-04	3.04E-04	4.05E-04
	Exit/Valuation in Bubble	-0.116**	-0.119**		-0.100*	-0.099*	
	GDP	-0.146	0.151		-0.099	0.131	
Model Diagnostics	Number of Observations	667	667	667	668	668	668
	Rsquare	0.122	0.142	0.137	0.155	0.151	0.159
	Adjusted Rsquare	0.106	0.124	0.121	0.140	0.134	0.143
	F Statistic	7.602***	8.285***	8.629***	10.028***	8.946***	10.308***