Private Equity Investments:
Drivers and Performance Implications of Investment Cycles

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Claudia Sommer

from

Germany

Approved on the application of

Prof. Dr. Andreas Grüner

and

Prof. Dr. Klaus Spremann

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The University of St. Gallen, School of Management, Economics, Law, Social Sciences and International Affairs hereby consents to the printing of the present dissertation, without hereby expressing any opinion on the views herein expressed.

St. Gallen, May 11, 2012

The President:

Prof. Dr. Thomas Bieger

To my mother Sigrid
And in loving memory of
My father Wolfgang

Acknowledgements

This piece of work results from a research idea inspired by my professional experiences during the private equity turbulences between 2005 and 2008. In 2005 and 2006, a time that can be considered to be the top of a private equity boom, I had been part of several due diligence teams and got involved in a few giant private equity deals that exceeded each other in terms of deal size and complexity. A few months later, working as a restructuring professional, I encountered companies struggling with their heavy debt burdens and being unable to find alternative financing in an almost dried up financial market. This observation made me wonder why private equity markets exhibit such massive cycles and sparked the research idea for this dissertation.

I am indebted to my referees Professor Andreas Grüner and Professor Klaus Spremann from the Swiss Institute of Banking and Finance at the University of St. Gallen. They have been genius supervisors and supported my research process in many ways. They greatly enhanced my research process and outcome by challenging my arguments, providing invaluable input and directions but at the same time giving me the freedom to develop my own ideas. I also thank participants of colloquiums, courses, and "Bastelstunden" (informal research round tables at the Swiss Institute for Banking and Finance), who have patiently listened to my sometimes premature thoughts and research results. They gave useful advice and were great mates making my visits in St. Gallen a lot of fun. In particular, I would like to thank Dr. Lydia Ebersbach for being the greatest motivator and closest friend who has accompanied my research endeavor.

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My deepest gratitude is owed to my family, who has provided fruitful ground, inspiration and support for all my achievements. Sadly, my father did not live long enough to see this dissertation completed. I dedicate this work to him.

Hamburg, September 2012 Claudia Sommer

Content Overview

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List of Abbreviations

AR	Autoregressive
ARCH	Autoregressive conditional heteroskedasticity
ARD	American Research and Development Corporation
ARMA	Autoregressive-moving average
CEPRES	Center for Private Equity Research
CLO	Collateralized loan obligations
ECB	European Central Bank
et al.	et alia
EURIBOR	Euro Interbank Offered Rate
EVCA	European Venture Capital Association
FGLS	Feasible generalized least squares
GDP	Gross domestic product
GP	General partner
i.i.d.	Independent and identically distributed
IORPS	Institutions for occupational retirement provision
IPO	Initial public offering
IRR	Internal rate of return
I(p)	Integrated of order p
LBO	Leveraged buyout
LM	Lagrange multiplier
LP	Limited partner
MEI	Main Economic Indicators
MLE	Maximum likelihood estimation

M&A	Mergers and acquisitions
NPV	Net present value
OLS	Ordinary least squares
OPEC	Organization of Petroleum Exporting Countries
PE	Private equity
PME	Public market equivalent
SMB	Small minus big
HML	High minus low
US	United States of America
VC	Venture capital
WLS	Weighted least squares

Abstract (English)

Conventional wisdom among scholars and practitioners has it that private equity investment occurs in waves. The most recent cycle, which peaked in 2006 and was followed by the collapse of private equity markets during the financial crisis in 2008, gives a vivid illustration of this wave pattern. However, academia has so far failed to identify either a comprehensive set of drivers of private equity firms' investment activity or the corresponding return implications. This dissertation steps into this research gap by analyzing the factors that influence European private equity transactions and investigating the activity-return relationship.

Using a data set of more than 40,000 deals conducted between 1990 and 2009 and employing several econometric approaches to the time series of transactions, the study investigates competing theories and drivers as well as return implications of the changing levels of deal activity for buyouts and venture capital investments in Europe. The results suggest that, in line with the neoclassical view, private equity cycles are mainly triggered by economic fundamentals and business cycle dynamics on aggregate and industry level. In addition, market timing theory, changing levels of information asymmetries and agency conflicts between GPs and LPs have supplementary explanatory power in explaining the fluctuations in deal activity.

This work establishes a negative relationship between deal activity and subsequent performance suggesting that private equity firms overpay in periods of brisk deal activity. This performance pattern is consistent with private equity firms paying premiums in bidding contests for a limited number of potential target companies in times of ample fund liquidity and cheap credit to finance transactions. The study argues that investment cycles are likely to persist in the future as fluctuations arise from inherent imbalances between deal flow and liquidity. This causes private equity markets to move back and forth between competition for deals and competition for capital.

In addition to its explanatory contribution this study introduces a framework for the development of investment strategies that enable general partners to exploit the wave pattern of private equity investment activity.

Abstract (German)

Unter Forschern und Praktikern ist es allgemein bekannt, dass Private-Equity-Investitionen in Wellen auftreten. Der jüngste Zyklus, der im Jahr 2006 seinen Gipfel erreichte und 2008 von einem Zusammenbruch des Private Equity Marktes gefolgt wurde, illustriert dieses Wellenphänomen auf eindrucksvolle Weise. Dennoch hat die Forschung bisher weder ein umfassendes Treibergerüst für die Investitionsaktivität von Private-Equity-Firmen identifiziert noch für die entsprechenden Renditeimplikationen. Diese Dissertation greift die Forschungslücke auf und liefert eine Analyse von Faktoren, die Europäische Private-Equity-Transaktionen beeinflussen, sowie eine Untersuchung der Beziehung von Investitionsaktivität und Rendite.

Mithilfe eines Datensatzes von über 40.000 Transaktionen zwischen 1990 und 2009 und unter Anwendung verschiedener ökonometrischer Ansätze auf die Transaktionenzeitreihen untersucht die Arbeit rivalisierende Theorien und Treiber sowie die Renditeauswirkungen der schwankenden Aktivität von Buyouts und Venture-Capital-Transaktionen in Europa. In Übereinstimmung mit einer neoklassischen Sicht legen die Ergebnisse nahe, dass Private-Equity-Zyklen vorrangig durch ökonomische Fundamentaldaten und Konjunkturzyklusdynamiken auf aggregierter Ebene und Industrieebene getrieben werden. Zusätzlich haben Market-Timing-Theorien, das Schwanken der Informationsasymmetrien im Zeitablauf sowie Agency-Konflikte zwischen GPs und LPs erklärende Bedeutung für die Fluktuationen in der Transaktionsaktivität.

Diese Arbeit zeigt einen negativen Zusammenhang zwischen Transaktionsaktivität und nachfolgender Rendite auf und deutet somit darauf hin, dass Private-Equity-Firmen zu Zeiten hoher Investitionsaktivität überhöhte Prämien zahlen. Dieses Renditemuster ist konsistent mit einer Vorstellung von Private-Equity-Firmen, die in Bieterschlachten Prämien für eine limitierte Anzahl potenzieller Target-Firmen zahlen, sofern ausreichend Fondsliquidität und günstige Refinanzierungsmittel zur Verfügung stehen.

Die Arbeit postuliert, dass Investitionszyklen auch zukünftig auftreten werden, da die Schwankungen aus inhärenten Ungleichgewichten zwischen Deal-Flow und Liquidität resultieren. Dies führt dazu, dass Private-Equity-Märkte fortwährend zwischen einem

Wettbewerb um Transaktionsobjekte und einem Wettbewerb um das entsprechende Kapital schwanken.

Zusätzlich zu ihrem erklärenden Beitrag enthält die Arbeit ein Gerüst zur Entwicklung von Investmentstrategien, die es Private-Equity-Firmen erlauben, sich die Wellen der Private Equity Investitionsaktivität zunutze zu machen.

1 Introduction

1.1 Motivation of Research

Private equity experienced a period of impressive global growth at the beginning of the 21st century, gaining tremendously in importance in Europe. According to the European Venture Capital Association (EVCA), private equity activity peaked in 2006 with EUR 74.3 billion funds raised and EUR 68.3 billion channeled into equity investments. Given that both figures had been single-digit-billion amounts just ten years earlier, private equity had clearly established itself as a permanent and influential asset class in Europe (Chew and Kaplan 2009, p. 12) providing financing for about 25,000 European companies (Frick 2010). As a result, private equity firms gained more and more influence both as financial intermediaries and as strategic directive forces on corporate boards (Metrick and Yasuda 2010, p. 2304). However, this growth period was followed by the collapse of the financial markets in 2007 (Reuters 2008). Transactions dried up and many companies owned by private equity firms filed for bankruptcy (Arnold and Sender 2009). After years of raising record funds and completing gigantic transactions, the industry thus reverted to a period of discretion and modesty and returned to record investments towards the end of 2010 (Bloomberg, October 22; 2010).

The boom of the mid-2000s had been helped by the high liquidity of debt markets and huge capital inflows into the private equity industry (Acharya, Franks and Servaes 2007, pp. 45–46; Chew and Kaplan 2007, p. 11). The emergence of private equity firms in Europe sparked a public debate about the merits and negative aspects of private equity for the acquired companies themselves and for the economy. Critics argued that private equity firms engaged in "asset stripping in Europe" (Garten 2007), cutting jobs and R&D expenses and leaving companies with heavy debt burdens in order to realize short term gains (Amess and Wright 2007). These critics may indeed have felt vindicated by the financial crisis. Private equity firms were accused of having contributed to the credit crunch by using leverage recklessly and paying unrealistically high prices at the peak of the LBO boom (Mannepalli and Victor 2009).

Academics started to employ the term "boom and bust cycles" (Acharya et al. 2007, pp. 45–46; Chew and Kaplan 2007, p. 11; Chew and Kaplan 2009, p. 8) to refer to the recurring phenomenon whereby private equity transactions surge to temporary peaks before subsequently dropping to almost zero activity. The private equity waves of 1986-1988, 1995-2000 and 2003-2006 vividly illustrate this pattern.

While each boom had its peculiarities, there were also significant parallels. Specifically, excessive leverage and premiums paid for target companies were criticized in the 1980s as the main reasons why the private equity bubble burst (Curran 1990; Jensen and Chew 2000, p. 14–15). The same pattern was also criticized after the two more recent booms (Cao, Mason and Song 2009). It seems that history does repeat itself; and it remains puzzling why market players do not seem to have learned their lessons from previous cycles – and why boom and bust sequences persist.

1.2 Problem Statement and Research Gap

A growing body of academic literature is today addressing the phenomenon that corporate financing transactions occur in waves.[1] Waves of mergers have been studied by Mitchell and Mulherin (1996), Rhodes-Kropf and Viswnathan (2004), Harford (2005) and Bartholdy, Blunck and Poulsen (2009), among others; IPO waves are examined by Ritter (1984), Lowry (2003) and Pástor and Veronesi (2005); and Dittmar and Dittmar (2008) explore the clustering of stock repurchases.

Along similar lines, a related wave pattern can be found in private equity transactions too. Figure 1 shows that the number of private equity investments is volatile not only when seen over multi-year periods, but also on a quarterly basis.

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1 For a thorough review of literature on various wave patterns in corporate events, see Rau and Stouraitis (2010)

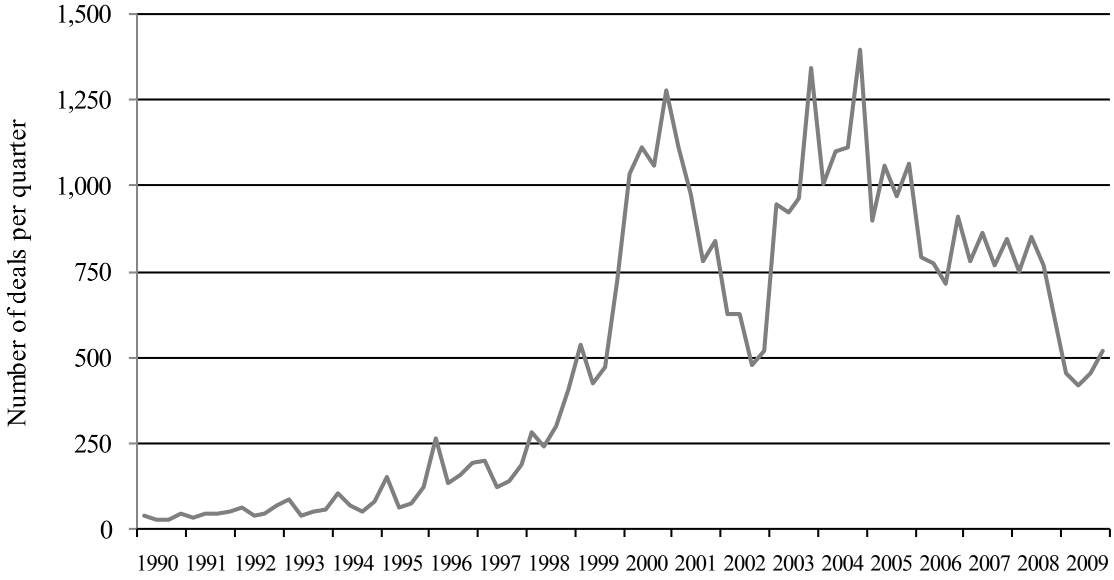

Figure 1: Time Series of Private Equity Investment Activity in Europe

Figure 1 exhibits the number of investments per quarter made by private equity firms in companies that are incorporated in Europe, according to the Thomson One Banker Database.

The volatility seems to exceed variations in economic fundamentals by far. This raises the question why the volume and number of private equity investments fluctuates so considerably over time. At the current stage of research, it is well documented that private equity transactions occur in waves (Acharya et al. 2007, pp. 45–46; Chew and Kaplan 2007, p. 11). Important factors contributing to the recent boom have been high liquidity in the credit market, tremendous growth in fund liquidity, and the increasing importance of hedge funds (Acharya et al. 2007, pp. 46–47). The increase in the capital available to finance deals can be attributed to the development of the syndicated loan market. However, the question of why this market has provided so much capital remains unanswered by academia (Axelson, Jenkinson, Strömberg and Weisbach 2007, p. 24).

A number of industry observers argue that fluctuations in private equity investments manifest themselves in boom and bust cycles (Acharya et al. 2007, pp. 45–46) that result from fund managers' overreactions to investment opportunities (Gupta 2000), or from misaligned incentives between dealmakers and investors (Jensen 1991). Kaplan and Strömberg (2009) provide an explanation of boom and bust cycles in the US that is based on two main considerations. First, sporadic windows of opportunity with favorable financing conditions allow private equity firms to exploit temporary mispricing in capital markets, leading to an increase in deal activity. This reasoning is backed by descriptive statistics and charts that lend visual support to the argument. No statistical hypotheses are tested, however. Second, Kaplan and Strömberg (2009) identify a relationship between fund liquidity and returns. Consistent with Kaplan and Schoar (2005) and Lerner, Schoar and Wongsunwai (2007, p. 748) they find that, following periods of high private equity returns, investors channel more liquidity into private equity funds and thus apparently follow high returns. Conversely, they hold funds back after periods of lower returns. While this explains the pronounced fluctuations in the volume of funds raised, it does not explain the investment behavior of private equity firms, as private equity firms seem not to invest in proportion to the inflow of capital into funds. In contrast, the last boom flushed billions of uninvested capital into private equity funds (Axelson et al. 2007; Kelly 2009). In lack of attractive investment targets and given the poor conditions to leverage deals, part of this volume found its way back to investors during the financial crisis (Rossa, June 05; 2008). This dissertation steps into precisely this research gap by analyzing factors that are postulated to stimulate or slow down private equity firms' investments in target companies.

The ultimate intention of this study is to investigate the drivers of private equity investment activity on an aggregate level and industry level and examine its performance implications. More specifically, the study seeks to shed light on two major aspects of private equity investments: First, by using different econometric approaches to analyze time-series transaction data, it aims to explore the forces behind deal activity at industry and at aggregate levels. Aided by the use of proxies, this analysis focuses on four sets of drivers or theoretical approaches: neoclassical drivers (e.g. economic fundamentals), information asymmetries, agency conflicts and market timing aspects. Second, the study investigates whether the performance of private equity investments made during periods of substantial activity is lower or higher than that of investments made during times of sluggish activity. This question is approached by analyzing fund performance in relation to deal activity.

1.3 Purpose of Study

The research questions are motivated by the failure of current academic literature to explain the significant fluctuations in private equity firms' investments in target companies. The study aims to fill this research gap and to deliver research results that are of interest to a broad audience. It therefore addresses academia, private equity practitioners, potential investors, companies seeking private equity to finance their operations, and shareholders who wish to dispose of their company stakes. The study therefore makes five major contributions to existing research in the field of private equity, as shown in Figure 2.

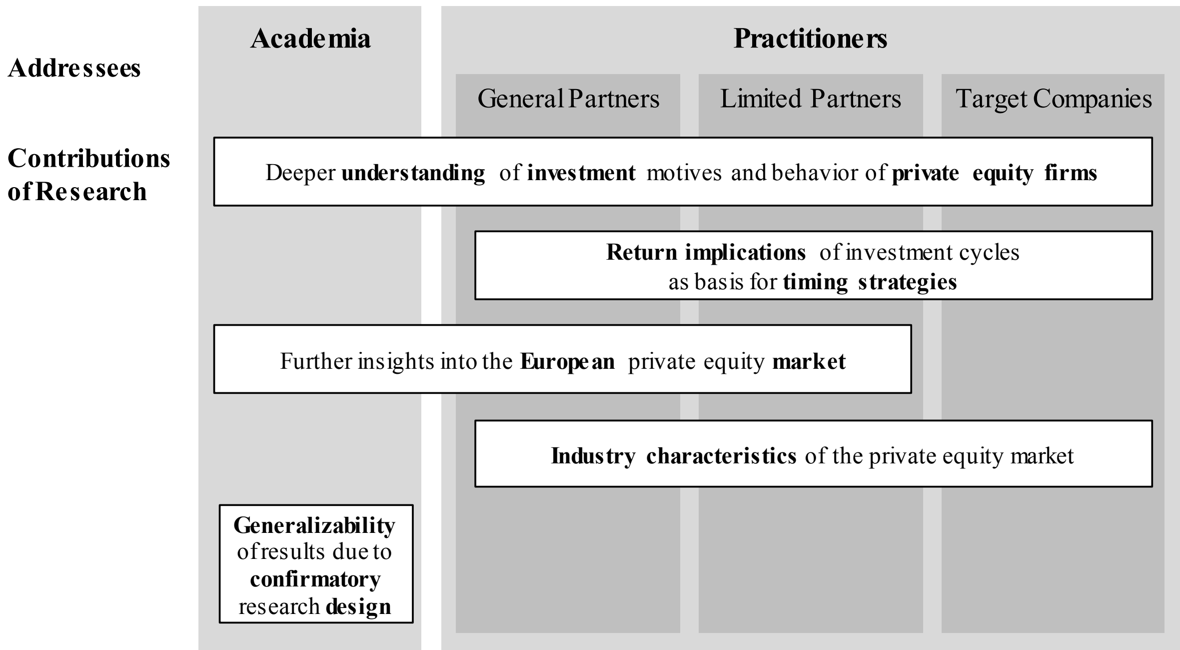

Figure 2: Contributions to Research by Addressees

First, the study seeks to develop a deeper understanding of the investment motives and behavior of private equity firms. In particular, the dissertation investigates the extent to which fluctuations in deal activity are driven by economic fundamentals[1] and how much influence should be ascribed to the agency and market timing aspects that

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1 "Economic fundamentals" refers to conditions that vary over time and that have the potential to affect real investment opportunities and, hence, companies' demand for capital demand. Of further interest are the economic conditions in the financial environment that determine the timing of and companies' ability to execute transactions. Examples include the liquidity of debt markets and interest rates.

determine private equity investment activity. In particular, the study aims to reveal to what extent private equity deals are driven by fund managers pursuing other interests than performance maximization for their investors, ignoring signs of temporary overvaluations and engaging in bidding contests in which premiums are paid for a limited number of suitable targets.[1]

Second, in establishing a relationship between deal activity and subsequent returns, the study provides valuable information about the optimal timing for private equity transactions from a practitioner's point of view. Strategies for the timing of transactions can then be derived from such insights. If private equity investments made during periods of a booming private equity market were found to underperform, for example, prospective investors could be alerted not to invest during peak times. From the perspective of companies seeking finance or shareholders wishing to dispose of their shares, this would mean that periods of brisk deal activity provide windows of opportunity to acquire cheap capital. This scenario would imply that the private equity market is a "seller's market" during boom times in which suitable targets are rare commodities. This would also explain the premiums paid by investors. The opposite strategies would be advisable if an inverse activity-return relationship were to be identified.

Third, in focusing on Europe, the study aspires to contribute to a better understanding of this formerly immature private equity market. Existing academic literature has so far largely focused on the US, mainly due to the longer history of private equity in this country and to the better availability of time-series data (Strömberg 2009). It seems reasonable to assume that not all results found for private equity in the US will also hold true for the European market (Wright, Renneboog, Simons and Scholes 2006, pp. 8–9). Therefore, the study intends to add further insights to complement present research on the European private equity market.

Fourth, in analyzing the research questions on both aggregate and industry levels, the study reveals to what extent the phenomenon covers the whole economy and whether certain sectors or industries are especially prone to shifts in activity. The industry level

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[1] The basic idea of this "money-chasing-deals effect" is that, since private equity investments do not have close substitutes among public firms, increasing fund inflows will result in competition among private equity firms for target companies and will therefore drive up acquisition prices Gompers and Lerner 2000, p. 287.

perspective also shows that some industries are particularly suitable as investment focus since they provide the opportunity to derive investment timing strategies from the results of this study.

Fifth, the study follows a quantitative confirmatory research design that includes the development of a driver model which are tested in econometric models. Although the topic of private equity cycles is already addressed in academic literature, existing publications typically exhibit an explorative research design that derives hypotheses from observation of the private equity market and analysis of patterns in transaction data, see Acharya et al. (2007), Chew and Kaplan (2007) and Chew and Kaplan (2009), for example. The confirmatory research design of this study thus allows findings to be generalized (Punch 2005) in contrast to existing explorative research results.

1.4 Research Methodology

The study uses a quantitative research approach and employs a confirmatory research design. In particular, a theoretical framework is developed, then research hypotheses are formulated which are subsequently tested with the help of a large sample of investment and performance data. Since most of the drivers are not directly observable, the study uses proxies to operationalize the hypothesized relationships.

1.5 Research Process

Figure 3 illustrates a roadmap of the completed research steps. In an adaptation of the Hypothetico-Deductive Method of research proposed by Sekaran and Bougie (2010, p. 29), the research process is outlined in seven steps, most of which have been conducted one after the other. However, loops between the different steps have been built in to adjust and improve the research process, design and outcomes.

Process steps	Research question	Pre-tests	Theoretical framework	Data collection	Operation-alization	Analysis	Interpre-tation
	Documentation						
Activities	• Screening of literature • Development of research question • Outline of research design	• Construction of a simplified research model • Development of initial hypotheses • Statistical tests with a data set from Thomson One Banker	• Extensive literature review • Development of a theoretical framework	• Definition of required transaction and fund level data • Proxy selection • Retrieval of proxy and transaction data	• Establishment of a research model • Specification of appropriate statistical methods • Operationaliz-ation of drivers	• Econometric analyses using STATA: – Rank models – Logit models – Cointegration models – Time-series regressions: OLS, FGLS, WLS	• Interpretation of results • Evaluation of research contribution and limitations of research
Outcome	• Research proposal	• Initial empirical results • Adjustment of research design of the dissertation	• Theoretical framework • Research hypothesis	• Data set for private equity transaction and fund performance data	• Finalized research methods • Operationalized statistical hypotheses	• Emperical results	• Conclusion • Answer to reserach question • Contribution

Figure 3: Research Process

1.5.1 Development of the Research Question

The development of the research question has been a result of a review of the existing private equity literature and discussion with practitioners as well as with academics. The problem statement, the relevance of the research question and the general research design are described above.

1.5.2 Empirical Pre-Tests

A series of pre-tests with transaction data to experiment with some basic hypotheses has been completed in order to refine the research approach and empirical test setting. The most important finding of these pre-test is related to the time series characteristics of private equity transactions and their implications for the the research design and appropriate statistical methods: Private equity investment activity, measured in terms of the number of deals per quarter, is a non-stationary time series as tests for unit roots reveal. Consequently, ordinary least squared (OLS) methods could cause problems in proper statistical inference, as F and t statistics are likely to be overestimated (Cochrane and Orcutt 1994b; Hjalmarsson 2008). Consequently, any investigated causality of potential drivers could be overstated. This requires the use of the alternative econometric approaches which will be discussed in more detail in the empirical parts of the study.

1.5.3 Development of the Theoretical Framework

The theoretical framework for the study is based on an extensive literature review. Insights and experience gained in the pre-tests have been incorporated. For example, descriptive statistics revealed that a lot of variance in deal activity can be attributed to a small number of industries. This observation has been taken into account by extending the analysis from the aggregate level to the industry level. Additional input to the theoretical part was obtained through informal interviews with private equity practitioners, in which the theoretical framework was discussed, challenged and adjusted.

1.5.4 Data Collection

The necessary investment and performance data can be obtained from several potential data sources, which are discussed in greater detail in section 4. For a number of reasons, the author has opted for two data sets provided by Thomson Reuters: Transaction data were retrieved from the private equity module of Thomson One Banker; and performance data based on fund cash flows were collected from the Thomson Reuters' Private Equity Performance database.

The transaction data sample covers 40,682 private equity transactions conducted in Europe between January 1990 and December 2009. Of this total, 24,641 deals are classified as venture capital investments. The remaining 16,041 deals represent buyouts. For each transaction, the data set includes detailed information about the transaction itself, the acquiring firm and the target company. Information about the transaction volume is ambiguous, however, and is only available for a limited number of investments. To accommodate this deficiency, the study bases deal activity mainly on the number of deals per quarter, while volume characteristics are used only to check the robustness of the data. Nevertheless, detailed industry-specific classifications enable the transactions to be analyzed industry by industry.

The performance data sample includes 682 venture capital funds and 415 private equity funds closed between 1990 and 2008. Sub-samples consisting of first-time funds only are constructed for both types of fund. Vintage IRRs based on fund cash flows serve as the measure of performance.

In addition to the private equity data, a variety of proxies are contructed and the data retrieved from several databases. These data include macroeconomic indicators, stock market data, financial figures of listed companies, data on debt markets and fund raising statistics of private equity funds. These proxy data were collected from the OECD statistical warehouse, the ECB, Datastream and Thomson One Banker.

1.5.5 Operationalization

The theoretical framework is translated into a driver model and falsifiable hypotheses are formulated that hypothesize cause-effect relationships between the suggested drivers and the level of deal activity. For each driver alternative proxies are constructed which are supposed to be close measures of the assumed drivers. The hypothesized relationships are then tested at the aggregate level and industry level with the help of alternative econometric models – for both, buyouts and venture capital investment activity. In these tests deal activity, measured as number of deals or used as binary variable, constitutes the dependent variable while the proxies serve as the independent variables.

For each of the theoretical viewpoints, a specific performance implication is formulated, which is subsequently tested. In particular, each of the competing drivers implies either a positive or negative activity-return relationship. The analysis of the activity-return relationship thus provides further supporting evidence for some of the competing theoretical perspectives.

1.5.6 Analysis

The data analysis encompasses descriptive statistics on deal activity and deal characteristics as well as statistical tests of hypotheses at the aggregate and industry levels. Performance is evaluated at the aggregate level only, partly because fund level data are used, and partly because private equity funds rarely focus on only one particular industry.

A detailed analysis of the time series characteristics of dependent and independent variables determines the statistical tools that can be employed to obtain reliable results.

Different methodologies are used to investigate the drivers of deal activity by testing hypotheses about various cause-effect-relationships that are each derived from competing theoretical viewpoints. These methodologies include rank models, logit models and different kinds of time-series regressions. Finally, the activity-performance relationship is investigated using robust time-series regressions.

1.5.7 Interpretation

The results are finally interpreted with regard to hypotheses formulated beforehand and linked to related research. In addition, practical implications and timing strategies are derived from the obtained research results.

2 Background

2.1 Definition and Structure of Private Equity Investments

2.1.1 Private Equity as Asset Class

Private equity can be defined as any non-public equity investments in private or public firms (Fenn, Liang and Prowse 1998, p. 2). Following the definition submitted by Thomson Venture Economics, the term private equity comprises all types of venture investing, buyout and mezzanine investing (EVCA 2004: p. 27). Depending on the stage of investment, private equity is commonly split into venture capital and buyouts. As illustrated by Figure 4, venture capital denotes a subset of private equity that refers to equity investments made in companies at an early stage of their development, whereas buyouts refer to investments in more mature companies that may also consist of non-equity financial stakes, e.g. mezzanine or debt (Achleitner 2002, p. 9). Other important differences are that, in buyout transactions, the private equity firm acquires a majority stake in an existing or mature firm, whereas venture capital firms typically engage only with a minority equity investment (Kaplan and Strömberg 2009, p. 121).

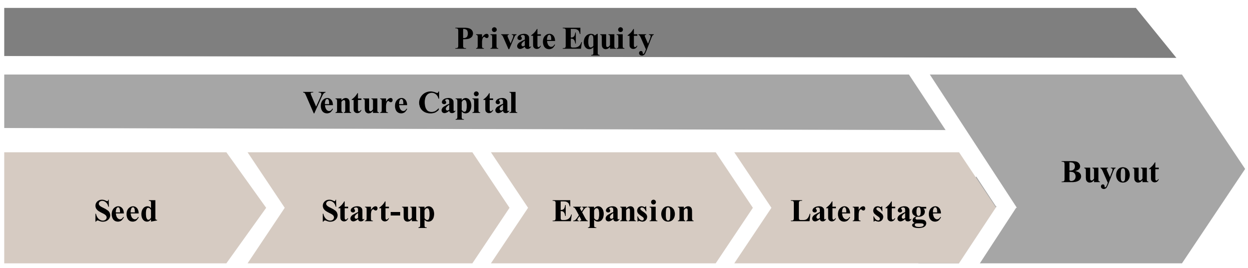

Figure 4: Private Equity Types According to Financing Stages

Source: Adopted form Munari, Cressy and Malipiero et al. (2006, p. 10) and (Sahlmann 1990)

Authors with a research focus on US capital markets typically treat venture capital and buyouts as distinct asset classes (see for example Gottschalg and Phalippou 2009 or Ljungqvist, Richardson and Wolfenzon 2008, pp. 3–4) and sometimes use the terms private equity and buyout interchangeably (Jones and Rhodes-Kropf 2003; Kaplan and Strömberg 2009, p. 121). However, in European publications venture capital and buyouts are often subsumed under the term private equity and sometimes treated as a single asset class. This may be due to the fact that the venture capital market is still immature in continental Europe (Marti and Balboa 2001, p. 3), delivers relatively low performance in comparison to the US market and has less well developed exit channels (EVCA 2007; Hege, Palomino and Schwienbacher 2008). Throughout this dissertation the term private equity is used to refer to the joint asset class of venture capital and buyouts.

2.1.2 Private Equity Investments

Private equity investments are typically made by funds, which are closed-end vehicles with a limited lifetime of ten to twelve years (Kaplan and Strömberg 2009, p. 123). Fund investors are usually institutions such as pension funds, endowments or banks and wealthy individuals (Fenn et al. 1998, p. 45) who commit a certain amount of capital to the fund. This capital is then invested by the fund managers during the first five years after fund closing and is returned in the subsequent five to eight years (Kaplan and Strömberg 2009, p. 123). Investments are made in individual companies for a typical holding period of three to five years (Kaplan and Strömberg 2009, p. 129). Funds provided by the transaction to the investee company can be used for a variety of entrepreneurial purposes: Private equity is used to finance growth for start-ups and also for established companies, as replacement capital when the ownership structure changes, to realize succession plans (Grabenwarter and Weidig 2005, p. 3) and as distressed investment for turnaround financing (Böttger 2007, p. 278).

The investment management process can be divided into four main stages as shown in Figure 5. Defining the investment occasion as the closing of the deal, the phases can be further classified as pre-investment stages (which consist of the selecting and structuring of investments) and the post-investment stages (which cover monitoring and exiting from deals).

Figure 5: Private Equity Investment Management Process

Source: Based on (Fenn et al. 1998, p. 2)

The selection process comprises all activities in which private equity firms engage to identify potential target companies. The time consuming screening and evaluation of investments often follows a structured and standardized approach (Kaplan and Strömberg 2001, p. 428) in order to ensure a constant flow of high quality investment deals. As deals are privately negotiated, and because of competition among private equity companies for a limited number of suitable targets (Gompers and Lerner 2000, p. 283), the crucial capability of "deal flow generation" depends to a large extent on a powerful business network. Most private equity firms have a deal generation strategy that focuses on companies in a certain industry, size bracket, geographic region, stage of development and/or other characteristics depending on the specializations of the team members (Wright and Robbie 1998, p. 536). Based on these key investment criteria, private equity firms screen the market for promising investment candidates and typically reject nine out of ten business plans that do not meet these criteria (Fenn et al. 1998, p. 30). Many acquisition processes are arranged in a structured auction process that requests an indicative offer by interested investors after initial information about the company has been made available in an information memorandum, proposal or business plan.

After the non-binding offer has been accepted by the selling party, the private equity firm enters the potentially time-consuming process of structuring the deal. This stage typically starts with an in-depth due diligence phase that scrutinizes financials, the management team, strategic prospects and legal issues. The information gathered in this process refines the "rough" valuation on which the indicative offer was based. If the private equity firm remains interested in the target company after the due diligence process, the partners start negotiating the investment agreement that includes the purchase price, the financial instruments to be used and governance aspects relating to the investment. Key aspects are the proportion of ownership that will be transferred to the private equity fund, management incentive schemes and the extent of control the private equity firm will exercise over the investee company (Fenn et al. 1998, p. 31).

After the investment has been closed, private equity firms actively monitor the companies in which they have invested and play an active role on their boards. They draw on their industry expertise, broad experience and superior contacts to implement value creation plans that aim to increase the operational and financial performance of their portfolio companies (Kaplan and Strömberg 2009, pp. 130–132). Finally, the exit strategy must be defined and executed in light of the timing and nature of divestment, e.g. initial public offering (IPO), full or partial private sale or secondary buyout (Wright and Robbie 1998, p. 549).

2.1.3 Private Equity Firms

In the market for entrepreneurial capital and corporate control, private equity firms act as intermediaries (Achleitner 2002) between investors seeking superior returns in an alternative asset class and non-public companies with a need for financial resources. In particular, private equity serves as an important source of funds for start-ups, private medium-size companies and public firms seeking buyout financing (Fenn et al. 1998, p. 1). The universe of firms in the market is sometimes further broken down into LBO firms[1] and venture capital firms, depending on the developmental stage of the companies in which they invest (Kaplan and Strömberg 2009, p. 121).

Most private equity firms are organized as partnerships or limited liability corporations. A few, such as the Blackstone Group and Fortress Investment Group, are listed. On average, private equity firms employ less than 13 investment professionals (Kaplan and Strömberg 2009, p. 123) who typically have an investment banking background. They handle fund raising, investment management as outlined in Figure 5 and the distribution of results. Occasionally they assign part of their responsibilities to other service providers, such as specialized fund raisers or investment advisors, or engage in "club deals" through syndication with other private equity firms to tackle larger deals (Fenn et al. 1998, p. 21).

[1] In some publications, the terms private equity firm and LBO firm are used interchangeably (Kaplan and Strömberg 2009, p. 121).

For their services, private equity firms are paid by investors, who are usually charged a management fee based on managed volume and a success fee based on the realized returns (Wright and Robbie 1998, p. 534). The interests of investors and the private equity firm acting as their agent are not perfectly aligned, as the private equity firm typically has only a financial stake of about 1% in the partnership via a vehicle that serves as general partner (Fenn et al. 1998, p. 28; Strömberg 2009, p. 5). For example, private equity firms have an incentive to leverage deals excessively, thereby increasing the risk associated with investments (Sahlmann 1990, p. 496) as the success fee is directly related to profits realized on investments but usually has no loss participation element.

2.1.4 Structure of Private Equity Transactions

The dominant form of private equity fund is the limited partnership as shown in Figure 6.

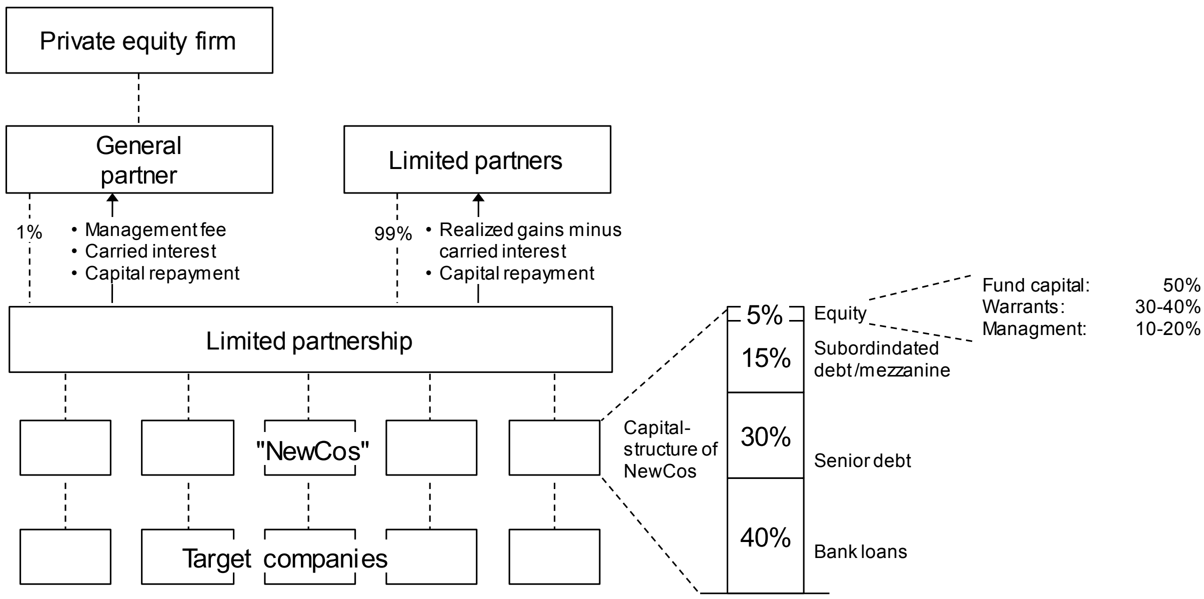

Figure 6: Typical Structure of Private Equity Fund Investments

Source: Based on (Müller 2008, p. 17), Gilligan, John and Mike Wright (2008), (Baker and Smith 1998, p. 176)

The limited partnership itself is the fund vehicle that raises capital and conducts investments. Limited partners are institutional and private investors who contribute about 99% of the subscribed capital and commit their capital contribution during the fund raising stage. The amounts committed cannot be withdrawn before the agreed limited lifetime of the fund (Kaplan and Strömberg 2009, p. 123). The general partner is a special purpose entity that is established and owned by the private equity firm and provides about 1% of the fund capital.

The limited partnership agreement details the legal relationship between the partners, the fee structure and the distribution of results. The general partner receives a management fee which is typically 1.5-2.5% of invested volume (Gompers and Lerner 1996, p. 481). While management fees used to be a fixed percentage based on committed capital (capital less any distributions), during the 1990s the fee structures were increasingly agreed on the basis of invested capital (Fenn et al. 1998, p. 38). This change in the fee structure is attributable to investors' calls for lower fees in general and for fee schedules that reflect the actual work load inherent in an investment. Typically, this work load is more intense during a fund's investment period and diminishes during the later stages of a fund's life time.

In addition to the management fee, the general partner receives performance-related remuneration known as "carried interest" that usually consists of 20% of realized gains from investments (Kaplan and Strömberg 2009, p. 124; Metrick and Yasuda 2010, p. 2339). On average, this makes up one third of the of the average private equity fund manager's compensation (Gilligan et al. 2008). While 20% is a widespread standard, the basis for calculation varies substantially across funds and has changed over time. Earlier agreements based carried interest on single investments, in contrast to more recent fee arrangements which are typically based on the performance of the entire portfolio managed by a private equity firm. The shift toward portfolio-performance-based fees favors limited partners, as the single investment fee approach establishes an incentive for fund managers to put all their efforts into the best-performing investments and to neglect underperformers (Fenn et al. 1998, p. 38).

In a typical structure for each investment, a special-purpose vehicle, referred to as "Newco", is established that raises funds to acquire the target company. These funds consist of fund capital, bank leverage and management participation Gilligan et al. (2008) and are used to acquire the target company. After the transaction, Newco is merged with the target company in a "debt-push-down merger", resulting in a transfer of debt to the target company.

A recent trend in private equity transactions involves so-called "club deals" in which private equity firms team up to invest jointly in the same target company (Officer, Ozbas and Sensoy 2010, p. 2014). The most common rationale for such joint endeavors concerns deal size and location. Most funds have restrictions regarding the absolute and relative size of single investments, as well as a regional or industry focus that might require additional expertise or resources if a single firm was to successfully manage complex deals on its own. In such cases, the lead investor typically structures the deal and conducts large parts of the due diligence process, while the input of the co-investors may vary as a function of the needs of the given investment (Fenn et al. 1998, p. 31).

2.2 Wave Patterns in the History of Private Equity

2.2.1 The Emergence of Private Equity in the US during the 1980s

2.2.1.1 *The Rise of Private Equity in the Junk Bond Market of the 1980s*

While the establishment in 1946 of the American Research and Development Corporation (ARD), a publicly traded closed-end investment company, can be considered the origin of a market for professionally managed private equity investments (Fenn et al. 1998, p. 10), private equity rose to fame in the junk bond market of the 1980s in North America.

Similar to the boom and bust of private equity in Europe in the late 1990s and early 2000s, buyout activity in Northern America experienced an impressive emergence and subsequent downturn within a decade. The rise and fall of the first private equity wave in the US was even more dramatic than recent developments in Europe: The private equity race began with less than $1 billion in 1980, reached a peak of more than $60 billion in 1988 and finally declined to less than $4 billion in 1990 (Kaplan and Stein 1993, p. 313). Three main factors can be identified that triggered the rise of private equity:

First, private equity arose in the 1980s when numerous public-to-private transactions reversed the earlier rise of conglomerates, paving the way to corporate specialization and a focus on core business (Shleifer and Vishny 1990, p. 745). Many buyouts were used to disentangle divisions of large diversified corporations that had failed to meet return expectations or did not fit in with corporate strategy (Brealey, Myers and Allen 2008, p. 917–918).

Second, structural changes and trends in certain industries sparked off takeover (Mitchell and Mulherin 1996, p. 219) and restructuring activities. For example, increasing competition in mature industries such as automotive engineering and steel led to consolidation. The emergence of the computer industry impacted the communication and entertainment business. Huge transactions in the oil industry were induced by the price instability resulting from the actions of the Organization of Petroleum Exporting Countries (OPEC) (Weston, Mitchell and Mulherin 2004, pp. 176–177).

A third important driver of this activity was financial innovation in the 1980s. Private equity pioneers gained recognition and the attention of the general public thanks to their novel and excessive use of debt to finance transactions, accompanied by complex tax strategies (Cheffins and Armour 2008, p. 7). In particular, the establishment of a liquid junk bond market by Michael Milken, chief bond trader at Drexel Burnham Lambert, made it possible to undertake such transactions. Milken discovered that junk bonds significantly outperformed investment-grade bonds even when adjusted for the additional default risk. Since investors and financial institutions were demanding alternative investment opportunities with attractive yields, Milken and other raiders were successfully able to underwrite and sell large volumes of below-investment-grade debt (Sudarsanam 2003, p. 285).

The private equity wave of the 1980s differed from previous takeover waves in the hostility and pace of activity (Kaplan 1997, p. 1). It peaked in 1989 with the RJR Nabisco megadeal, which was the result of a bidding contest among LBO firms. The winning bid came from Kohlberg, Kravis, Roberts (KKR), who bought the company for USD 25 billion. (Burrough and Helyar 2004). It took 17 years before KKR broke its own record with the acquisition of the hospital chain HCA (Cheffins and Armour 2008, p. 3).

2.2.1.2 *Private Equity as the Capital Markets' Reaction to Government Deficits*

Kaplan contends that takeover activity in the 1980s was fueled by the increased size and power of financial markets, mainly resulting from the growing volume of assets in pension funds and prevailing inefficiencies in the way companies were run (Kaplan and Holmstrom 2001, p. 16). Seen from this angle, private equity was the product of a combination of empowered investors and the need for superior performance.

Evidence supports the view that LBOs in the 1980s successfully fought inefficiencies and improved the operating performance of the target companies (Kaplan and Holmstrom 2001, pp. 8–9). One could ask why capital markets were better able to achieve efficiency gains than company managers. The answer given by academia is that the problem was the management itself, and that the capital markets simply reacted to corporate governance deficits (Jensen 1989, p. 7; Kaplan 1997, p. 3; Shleifer and Vishny 1990, p. 745).

The managers of US corporations were regarded as unable to respond to the structural changes imposed by deregulation and technological change (Kaplan and Holmstrom 2001, p. 2), lavish in spending cash (Jensen 1989, p. 5) and striving for corporate growth beyond value-maximizing sizes in order to pursue their own personal agendas (Jensen 1989, p. 9–10). These ill-advised growth strategies showed themselves in managers' reluctance to reduce overcapacity (Jensen 1993, p. 854) and unwillingness to dismantle the conglomerates built up during the 1960s and 1970s (Shleifer and Vishny 1990, p. 745).

Jensen considered private equity to be a superior form of organization that could displace the public company. He considered private equity to be more effective in maximizing shareholder value and in resolving owner-manager conflicts, for three reasons: First, high leverage and the resulting cash requirements to pay down debt have a disciplining effect on managers, who are otherwise prone to waste cash. Second, increased management ownership provides strong incentives for managers to improve performance. Third, close monitoring by a board that actively influences both corporate strategy and the composition and actions of the management prevents inefficiencies (Jensen 1989, p. 7). Compared to the boards of public companies, which tended to be large and to consist of outsiders with small equity stakes, the small LBO company boards dominated by LBO firm representatives with considerable ownership stakes have proven to be the more effective control mechanism (Kaplan 1997, p. 3).

2.2.1.3 *The End of the Junk Bond Era*

Before tackling questions about the dynamics of the booms and busts in the 1990s and early 2000s in Europe, it is important to understand the reasons for the collapse of the 1980s market. Given the beneficial effects of private equity on corporate governance, it is puzzling why a spate of defaults in the late 1980s should have caused the emergence of private equity to grind to a sudden halt.

The rise of private equity was stopped abruptly by the collapse of the junk bond market, linked to the indictment of Michael Milken and the bankruptcy of junk bond dealer Drexel Burnham Lambert in 1990 (Weston et al. 2004, p. 177). The junk bond market dried up for two main reasons: first, the growing number of defaults; and second, unfavorable changes in regulations as governments responded to the public criticism of LBOs (Cheffins and Armour 2008, pp. 51, 62).

Kaplan and Stein (1993) find that only 2% of deals made in the first half of the 1980s defaulted, whereas the default rate jumped to 27% for deals completed between 1985 and 1989 (Kaplan and Stein 1993, p. 314). The latter defaults can be attributed partly to corporations suffering from the nascent recession (Cheffins and Armour 2008, p. 51). However, there is documentary evidence that most LBO companies defaulted due to their high debt burdens, not due to their operating performance. They were still realizing efficiency gains. However, these were not enough to service interest payments and debt repayments (Andrade and Kaplan 1998, p. 1443; Curran 1990).

The end of the junk bond era can be attributed to an overheated market (Jensen and Chew 2000, pp. 14–15). The successful deals of the beginning of the decade attracted more capital into the market, resulting in a competition for deals. As a consequence, many transactions in the second half of the 1980s were overpriced and incredibly leveraged with high-risk debt (Kaplan and Stein 1993, p. 316). This explanation is consistent with Gomper's finding that moral hazard increases for private equity firms when fund liquidity is high following periods of high returns (Gompers and Lerner 2000, p. 322). In other words, the pressure to invest rises as fund liquidity increases, followed by a subsequent deterioration in deal quality.

The hostility with which deals were pursued and the numerous defaults resulting from their risky nature accompanied by insider trading prosecution and other regulatory violations sparked a public controversy and calls for regulation (Jensen and Chew 2000, p. 14). LBO transactions were blamed for cuts in jobs, reduction of investments and R&D expenses, as well as for growing financial instability due to heavy debt burdens (Shleifer and Vishny 1990, p. 745). Governments responded with regulatory amendments that adversely affected deal activity. Changes in tax legislation – specifically, restrictions to the tax deductibility of interest – are estimated to have claimed 3% to 6% of transaction value (Cheffins and Armour 2008, p. 62). Junk bonds were also attacked by the 1989 Financial Institutions Reform, Recovery and Enforcement Act. This act prohibited savings and loan institutions, which held about 8% of total junk bonds, from holding below-investment-grade bonds, forcing the urgent divestment of all high-yield debt.

2.2.2 The Evolution of Private Equity in Europe

2.2.2.1 *European Private Equity as a Research Object*

Studying European private equity as a research object raises the question "What is so special about European private equity that justifies investigating it separate from the rest of the world?" So far, research findings in the field of private equity have to a large extent relied on US data. This is mainly due to the longer history of private equity in the US and to the availability of data from US transactions. Conversely, researchers frequently complain about the lack of complete and long-term time-series data sets for the European private equity industry (Strömberg 2009, p. 2).

Aside from the data availability issue, there are also some fundamental differences. Private equity firms in Europe operate in an environment that is significantly different to the US market in terms of less developed exit markets, stricter regulatory policies, more concentrated ownership (Andres, Betzer and Weir 2007), less established knowledge networks and stricter employment practices (Popov and Roosenboom 2009, p. 38).

While it is reasonable to assume that some major findings concerning the US private equity industry will also hold for Europe, there are also some important differences in empirical results. For example, Wright et al. (2006) argue that the disciplining effects of heavy debt burdens seem to be of secondary importance for UK transactions. Hege et al. (2008) attribute the underperformance of European Venture Capital funds (compared to their US peers) to less sophisticated control tools and to less effective use of debt syndication. Axelson et al. (2007) find that US buyouts are predominantly leveraged by bonds, unlike the European deals that rely much more on bank debt (Axelson et al. 2007, p. 18).

2.2.2.2 *The Private Equity Wave of the early 2000s*

The spectacular rise of European private equity investments from less than EUR 7 billion per year in the mid-1990s to more than EUR 70 billion in 2006 can be attributed to three main factors: high volumes and easy availability of cheap credit, tremendous growth in fund liquidity (Acharya et al. 2007: 45–46; Chew and Kaplan 2007, p. 10), and regulation (Popov and Roosenboom 2009, pp. 12–13; Persaud 2008, p. 76). While debt and fund liquidity were two of the driving forces behind private equity on a global scale, regulatory drivers too must be considered in the European context. Among the regulatory drivers that directly or indirectly fueled private equity in Europe are the new Basle accord on the capital adequacy of internationally systemic banks (Basle II) and EU Directive 2003/41/EC on the activities and supervision of institutions for occupational retirement provision (IORPS).

For example, German firms faced more and more restrictive bank lending policies in the 1990s following Basle II. The resulting shortage of financing alternatives for an economy that had traditionally heavily relied on bank financing together with financial investors' appetite for risk contributed substantially to the private equity boom in the 1990s (Weber 2005). Persaud (2008, p. 76) takes this thought further, arguing that European financial markets were largely driven by "regulatory arbitrage" that arose at least to some extent from Basle II requirements. As banks originated and securitized transactions that were then rated by agencies and transferred to investors, risk was simply shifted from the regulated sector to the unregulated sector.

Not until 2002 did the European Commission prohibit national legislation that prevented insurance companies and pension funds from investing in venture capital markets. After the release of these investment restrictions, pension funds in 2006 became the largest source of raised funds as risk capital investment as a share of GDP approached US levels in some European countries, e.g. Denmark, Finland and Sweden (Popov and Roosenboom 2009, pp. 12–13).

The decline in private equity activity in 2007 and 2008 coincided with the global financial crisis. What had started as a crisis of US-based mortgage institutions at the beginning of 2007 quickly spilled over to other financial institutions and other continents (Eichengreen, Mody, Nedeljkovic and Sarno 2009). While the US subprime collapse was small in global economic terms, it was powerful enough to trigger a credit squeeze. By the end of 2008, the subprime crisis had escalated into a global economic recession (Mannepalli and Victor 2009).

Needless to say, the crisis gave private equity firms in Europe and elsewhere a hard time. The market for syndicated loans to back leveraged buyouts – once the driver of the debt market as a whole – shrank by 80% to just \$41.3 billion in the US in 2008 (Reuters 2008). The number of promising investment targets diminished as, in the course of the recession, fewer companies were still generating sufficient cash flow to cover high debt repayments. On the contrary, plenty of formerly high-profile targets had to file for bankruptcy (Mannepalli and Victor 2009). The former "masters of the universe" had become fallen angels and had to concede substantial write-downs on their portfolio companies (Cao et al. 2009). They also had to realize that fund raising had become a fruitless endeavor (Arnold and 2009).

2.2.3 Comparison of the Private Equity Waves of the 1980s and the 2000s

When exploring the underlying forces behind private equity waves, it is useful to understand the similarities and differences between the two spectacular boom and bust cycles. In both periods, transactions were fostered by high capital inflows into the private equity industry (Chew and Kaplan 2007, p. 11), low interest rates (Acharya et al. 2007, p. 49) and the widespread availability of easy credit (Acharya et al. 2007, pp. 45-47; Cheffins and Armour 2008, pp. 20, 27). Other common features complemented these fundamental aspects of the financial environment, however. Both waves occurred after periods during which banks had experienced low operating returns, so the banks were looking for alternative investment opportunities (Quinn and Schulz 1992). Both waves had also been promoted by financial innovation. While the transactions of the 1980s were nurtured by the establishment of the junk bond market, the deals of the 1990s where characterized by the excessive use of syndicated debt, which was often traded in the secondary market or packaged in structured products such as collateralized loan obligations (CLOs) (Altman 2007, p. 17). In both waves, the boom continued until markets overheated and a freeze of debt markets, aided by an economic downturn, forced private equity players to slam the brakes on their investment activities (Jensen and Chew 2000; Kaplan and Stein 1993).

At the same time, there are also important differences. Deals in the late 1990 were less hostile in nature compared to the earlier wave, since defensive tactics had improved in the meantime, making hostile takeovers more expensive (Kaplan and Holmstrom 2001, p. 3). Moreover, leverage is considered to have been slightly lower in the more recent boom. While private equity firms used roughly 80-90% leverage in the 1980s, the comparable figure in the late 1990s and early 2000s fell to 70-80% (Kaplan and Stein 1993, p. 325; Kaplan and Holmstrom 2001; Chew and Kaplan 2007, p. 13).

3 Theoretical Framework

The boom in private equity as an investment class and its recent bust in the turmoil of the global credit crunch have inspired a lot of research in this field. After rising from less than EUR 7 billion worth of European investments in 1996 to a peak of more than EUR 70 billion in 2006, the private equity investment volume slipped back to less than EUR 54 billion in 2008 EVCA (2009). Favorite topics under investigation have been return characteristics (Ljungqvist and Richardson 2003a; Kaserer and Diller 2004; Cochrane 2005; Kaplan and Schoar 2005; Conroy and Harris 2007; Ljungqvist et al. 2008; Gottschalg and Phalippou 2009), value creation drivers (Loos 2006; Pindur 2007; Gou, Hotchkiss and Song 2009), employment effects (Achleitner and Klöckner 2005; Davis, Haltiwanger, Jarmin et al. 2008; Amess, Girma and Wright 2008), post-buy-out changes in innovation (Bruining and Wright 2002; Lerner, Strömberg and Sørensen 2009) and operating performance (Kaplan 1989, Kaplan and Strömberg 2009), governance (Kaplan and Holmstrom 2001; Andres et al. 2007; Cumming, Siegel and Wright 2007; Gou et al. 2009; Acharya, Hahn and Kehoe 2009) and distressed private equity (Kucher and Meitner 2004; Krassoff and O'Neill 2006). Even within this growing body of literature, however, the fluctuations in private equity investment activity have so far attracted little attention as a research object in their own right. This section aims to review relevant literature in the light of the dynamics of private equity investment activity and to develop a theoretical framework for private equity investment cycles.

As shown in Figure 7, financial theory provides at least four starting points to tackle the investigation of drivers of private equity investments: the neoclassical theory, the concept of information asymmetries, the agency theory and the market timing theory.

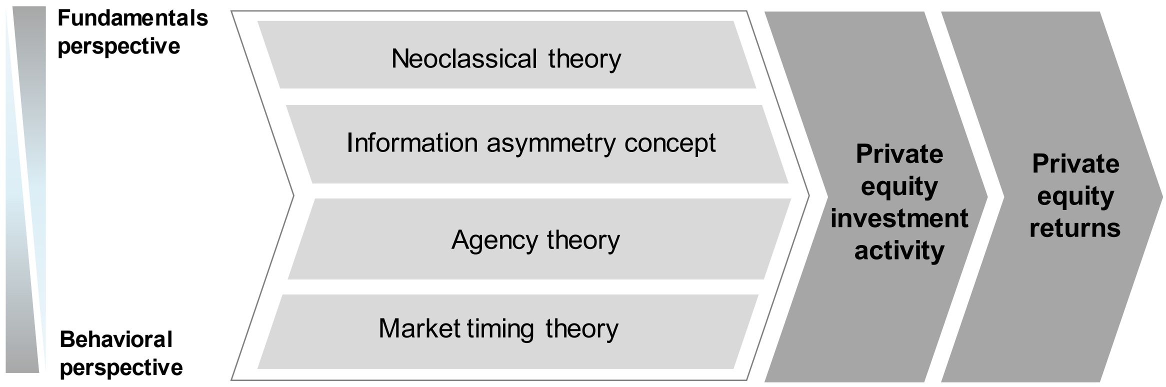

Figure 7: Theoretical Framework for Drivers of Private Equity Investments

The neoclassical view attributes changing levels of private equity investment activity to business cycles, variations in the liquidity of debt markets and industry-specific shocks. The information asymmetry view centers on time-varying information asymmetries regarding the value of the target company between potential investors on the one hand and incumbent management and shareholders on the other. The agency theory of private equity investments focuses on conflicts of interest between private equity firms and their agents, the fund investors, that lead to changing levels of deal activity. Finally, market timing theories accommodate a behavioral element in their reasoning. The central idea is that investors unreasonably extrapolate observed past performance and misestimate future returns (Gompers, Kovner, Lerner and Scharfstein 2008, p. 2) which enables issuers of private equity to take advantage of temporary misvaluations. These four different perspectives differ in their basic assumptions about the perfection of the private equity market. The neoclassical theory is posited on economic fundamentals and the notion of rational, fully informed and wealth-maximizing individuals (Weintraub 1993, p. 2). From the top of the framework illustrated in Figure 7 to the bottom, each successive theory moves a step further away form a strong form of market efficiency and increasingly embraces a behavioral bias view. Starting from strict perfect market assumptions in line with neoclassical reasoning, the information asymmetry concept weakens the full market transparency hypothesis by adding the assumption of incomplete information about the value of the target company. Applying agency theoretical aspects to private equity investments further modifies the market perfection assumptions toward reality, as private equity firms act as intermediaries or agents on the capital market (Achleitner 2002) and thereby cause problems arising from conflicts of interest. Agency theory might indeed be viewed as "an extension to the neoclassical theory of the firm", since standard neoclassical theory assumes principals to be fully informed about the tasks that agents have to perform and able to monitor their agents without incurring costs (Dollery and Wallis 2003, p. 809). It should be noted that all three perspectives are consistent with rational behavior. However, the latter viewpoint, market timing theory, may also consider irrational behavior to be the driving force behind private equity market cycles, as it assumes that managers are able to time their market activities to exploit temporary misevaluations (Butler, Cornaggia, Gustavo and Weston 2009). Nevertheless, irrationality is not a necessary assumption for the market timing view. Recently, academics have presented theoretical approaches that are able to explain market bubbles and periods of collective euphoria or depression that rest on the rational behavior of market participants (Minsky 1993).

3.1 Neoclassical Theory of Private Equity Investments

The neoclassical perspective has been adopted from a related financial research area. In studies of merger waves, the neoclassical approach refers to the idea that takeovers tend to cluster in time because of economic, technological or regulatory shocks to certain industries (see, for example, Shleifer and Vishny 2003; Harford 2005; Yan 2006).

3.1.1 Fundamentals of a Neoclassical View of Private Equity Investments

Neoclassical economics is a metatheory: a set of widely shared principles that form the basis for reasonable economic theories (Weintraub 1993). In particular, neoclassical theories rest on three major assumptions about the behavior of individuals and organizations. First, they act rationally. Second, they seek to maximize either profits or their utility. And third, individuals act independently on the basis of full information (Hovenkamp 2009, p. 377). Based on these principles, a number of financial theories have been developed over time of which the efficient capital market hypothesis is particularly relevant to the present topic. The efficient market hypothesis assumes that market participants act rationally on the basis of the same information, which is always already reflected in security prices (Fama 1970; Fama and French 1992).

To apply these principles and theoretical concepts to private equity investments, it must be remembered that private equity waves occur only if demand for and the supply of capital are simultaneously at high levels. Consequently, the following section distinguishes between the implications of private equity transactions for the capital demand and supply sides. The demand side comprises operating companies seeking financing, while the supply side consists on the one hand of private and institutional investors looking for investment opportunities with attractive risk-return characteristics and on the other hand of banks and other debt providers.

On the capital demand side, the three basic neoclassical assumptions (rationality, profit maximization and full information) imply that profit maximizing corporations should have a higher capital demand when the economic outlook is favorable, because rational company managers pursue the primary goal of realizing NPV-positive investments (Hirshleifer 1958). It follows that the need for private equity should be higher in times of positive economic prospects when more attractive investment opportunities exist. On the other hand, demand for private equity should be unaffected by trends or bubbles, as rational company managers and shareholders have no preference – apart from transaction costs – for particular financing alternatives, e.g. equity versus debt or private versus public capital (Modigliani and Miller 1958). Assuming a sufficient supply of capital, private equity investments should be closely linked to economic fundamentals, in particular to changing demand for capital at operating companies as a result of the business cycle or of economic shocks to certain industries (Mitchell and Mulherin 1996).

The capital supply for these transactions is contributed by private equity funds and providers of debt or mezzanine funding to leverage the transactions Gilligan et al. (2008). From the perspective of fund investors, private equity represents a growing alternative asset class in the capital market. According to the neoclassical corporate finance theory, shareholders or investors are interested in nothing but maximizing their risk-adjusted returns (Hovenkamp 2009, p. 381). As long as capital markets are efficient and private equity does not represent a separate asset class, all private equity investments have close substitutes among public firms (Gompers and Lerner 2000,

p. 287); and investors have no preferences regarding investment opportunities other than the risk-return relationship. This means that the supply of capital for private equity investments should be exogenous and unrelated to capital demand or past private equity returns (Gompers and Lerner 2000, p. 287). Based on the assumption of a perfect market, all capital flowing into private equity funds will instantly be invested at a risk-adjusted return equal to the cost of capital of the target companies (Ljungqvist et al. 2008, p. 4). In other words, the capital supply from fund investors should neither be a constraint nor a promoter of private equity transactions.

The second component of capital supply is the availability of moderately priced credit to finance transactions (Harford 2005, p. 530). Harford documents the moderating role of the liquidity of debt markets in a neoclassical theory of merger waves. It is a stylized fact that peaks in private equity activity coincide with high liquidity in debt markets (Acharya et al. 2007, p. 45; Kaplan and Strömberg 2009). Conversely, limited access to leverage imposes constraints on otherwise profitable deals (Shleifer and Vishny 1992, p. 1362).

To summarize: According to neoclassical reasoning, private equity investment activity should respond to changes in investment opportunities (Gompers et al. 2008, pp. 1–2) and thus be driven by aggregate capital demand, subject to the constraints on deal financing imposed by the limited liquidity of debt markets.

3.1.2 Neoclassical Drivers of Private Equity Investments

3.1.2.1 *Capital Demand*

Operating companies' demand for capital arises from the availability of NPV-positive investment opportunities. A growing economy entails more attractive investment opportunities for entrepreneurs and established companies; and this requires funds to finance new business ventures and expansions. Proxies for the availability of these investment opportunities that have been investigated in similar research contexts include GDP growth (Leachman, Kumar and Orleck 2002, p. 28; Lowry 2003, p. 14) and Tobin's q (Gompers et al. 2008, p. 1). That capital structure decisions are closely linked to the business cycle is further supported by evidence provided by Choe, Masulis and Nanda (1993) and Korajczyk and Levy (2003).

Leachman et al. (2002) report that the impact of GPD growth on venture capital investments was mixed across different European countries during the 1990s. In particular, their results exhibit insignificance for some countries and contradictory signs for the GDP coefficient for the remaining countries, where GDP growth is a significant determinant of venture capital activity (Leachman et al. 2002, p. 28). These findings suggest that GDP may not be an appropriate proxy for changes in capital demand. A possible alternative explanation could be that industry dynamics are not captured by GDP growth across the whole economy. As private equity activity is often concentrated in particular industries (Bernstein, Lerner, Sørensen and Strömberg 2010), investment activity may respond more substantially to industry-specific shocks than to the business cycle. Further complexity in using GDP as a proxy arises from the different uses to which the capital generated by private equity transactions is put. The funds may be either used to increase working capital or to invest in new assets.[1] While it may be reasonable to assume that raising fresh money for new investments through private equity transactions may be pro-cyclical, working capital requirements typically change more with industry-specific seasonality than with the business cycle. These considerations suggest that, although a relationship between GDP and capital demand sounds plausible, industry specifics may be more likely to explain the variations in private equity investment activity.

An alternative proxy of capital demand is Tobin's q which is typically defined as the ratio of the market value of a firm to the book value of its assets[2] and can be interpreted as a measure of the attractiveness of investment opportunities. A high Tobin's q indicates that a company's capital equipment is worth more than the replacement cost. Similar to the concept of the market-to-book ratio, this implies substantial growth potentials that can only be derived from the availability of attractive investment opportunities (Brealey et al. 2008, p. 831). Thus, a high Tobin's q should accompany higher demand for capital and, consequently, higher private equity investments. This reasoning is supported by evidence from venture capital

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1 For example, most US firms raising public equity use the funds primarily to increase working capital, and only secondarily for new investments Mikkelson, Partch and Shah (1997).

2 Where the market value of the firm is measured as the book value of assets plus the market value of equity less the book value of equity Gompers et al. (2008, p. 4).

investments, which have been found to respond to rises in the industry-wide Tobin's q of public firms (Gompers et al. 2008, p. 11).

3.1.2.2 *Capital Supply*

Conventional wisdom has it that "hot" private equity markets are attended by liquid debt markets and the availability of cheap credit (Acharya et al. 2007; Axelson et al. 2007; Cheffins and Armour 2008; Chew and Kaplan 2009). While the emergence of the junk bond market fueled the private equity wave of the 1980s (Cheffins and Armour 2008, p. 7), it was the development of the syndicated debt market that contributed to the boom of the 2000s (Acharya et al. 2007).

It is a truism to state that sufficient debt allows companies to realize more deals than would be possible with equity alone. For, example using a typical leverage of 70-80% (Chew and Kaplan 2007, p. 13) enables a fund to conduct investments at a value of four to five times its committed capital. However, private equity firms would rarely reduce leverage below 50% simply because of a lack of sufficient debt, because high leverage is also an important value driver in private equity transactions (Jensen 1989, p. 7; Loos 2006; Gou et al. 2009, p. 1–4). High leverage and the resulting challenging cash requirements for interest and down-payment of debt is believed to discipline managers such that they do not waste cash, but instead use funds to increase the value of the firm (Jensen 1989, p. 7). Finally, leverage is inevitable to achieve the returns of 20-30% p.a. typically expected by private equity fund investors (Chew and Kaplan 2009, p. 18), as leverage increases risk by simultaneously raising the return on investment.

The huge impact of the availability of leverage and private equity firms' investment postulated by a number of industry observers (Acharya et al. 2007) is also backed by academic research. Studying 153 LBOs completed in the United States and Europe between 1985–2007, Axelson et al. (2007, p. 25) conclude that private equity investments rise under favorable financing conditions, e.g. if debt financing is cheap and readily available to private equity funds.

3.1.3 Timing of Buyouts relative to Venture Investments during the Business Cycle

The previous sections have focused on the capital demand of operating companies in line with the business cycle and the constraints imposed by debt markets to finance transactions. Behavior of investors has been loosely assumed to be unaffected by the business cycle. However, reality teaches a different story: Fama and French found that stocks of small caps and stocks of firm with a high book-to-market ratio systematically outperform the market. They concluded that size and book-to-market ratio capture additional unobservable risk factors that are not reflected in the beta of stocks. These additional risk factors are referred to as SMB (small minus big) which mimics a portfolio that is long in stock of small and short in stocks of large firms and HML (high minus low) which relates to a portfolio that is long in stocks with a high book-to-market ratio and short in low book-to-market ratio stocks (Fama and French 1993).

Since these factors had been discovered in 1993, considerable research progress has been made regarding the interpretation and return implications of these risk factors. Spremann (2006, p. 344) argues that the risk factors SMB and HML link capital markets to the real economy in that they reflect the exposure of a stock to the business cycle more precisely than beta alone. This means, while beta is assumed to capture part of the macroeconomic risk, some stocks seem to be more sensitive to the business cycle than others. Investors care about this cyclicity and are willing to pay premiums for stocks that are less sensitive to the business cycle. This is due to the fact that most investors have a job or their own business that already exposes them to the business cycle risk. Thus, they have a rational preference for stocks that are less dependent on the business cycle (Spremann and Scheurle 2009). This preference, however, is dynamic as well and varies with the business cycle, too. According to Scheuerle and Spremann (2010) SMB exhibits positive returns when small firms are preferred over big ones which is particularly the case at the beginning of the business cycle. This can be interpreted as SMB rewarding the risk of investing at a stage of the business cycle, where it is still uncertain whether the economy will take up or fall back into a recession. Conversely, HML experiences positive returns when value stocks are preferred over growth stocks. The preference for value stocks has been attributed to later stages of the business cycle in that uncertainty raises whether the economic activity will hold or cool down and the growth potential appears limited.

These findings have two important implications for private equity investments. First, if sensitivity to business cycles matters to investors, also industry matters. Since there are on the one hand cyclical industries such as automotive engineering or building and construction and on the over hand stable sectors such as food or healthcare, private equity firms may as well prefer particular industries during certain stages of the business cycle. Second, different preferences for SMB and HML during the business cycle could have different implications for buyouts and venture capital. Driessen, Lin and Phalippou (2007, p. 5) find that venture capital funds load positively on SMB and negatively on HML while buyout funds load negatively on SMB and positively on HML. These results are consistent with the typical characteristics of both asset classes. Venture capital backed firms are usually small growth companies whereas buyouts are typically associated with large mature companies, that correspond to value stocks. Assuming that the factor loadings for venture capital and buyouts are stable over time, venture capital activity should lead buyout activity during the business cycle.

3.2 Information Asymmetry View of Private Equity Investments

Private equity investments are usually subject to significant information asymmetries between investors and the incumbent management and shareholders of the target company. The extent of the latter's informational disadvantage may change over time, however. For example, the impact of technological change will be more transparent to industry and company insiders. Consequently, periods characterized by technology shocks lend themselves to greater information asymmetries. The impact of changes in the extent of information asymmetries is ambigious in light of existing theories. On the one hand, the "adverse selection cost view" associates more substantial information asymmetries with higher transaction costs and, consequently, with less deal activity. On the other hand, the "value add view" centers around the idea that reducing information asymmetries between limited partners and target companies is a key value driver in the activities of private equity managers. This view predicts a positive relationship between the extent of information asymmetries and deal activity, as such periods provide more opportunities for private equity firms to offer their valuable services.

3.2.1 Information Asymmetries in Private Equity Transactions

3.2.1.1 *Adverse Selection Cost View*

Potential acquirers of a stake in a company face a "lemons" problem. The existing owners have superior information about the prospects of the firm and consequently about its value. They will therefore only be willing to accept an offer if the price exceeds their estimation of the firm value (adverse selection). Anticipating this behavior, bidders will lower their offers accordingly (Akerlof 1970, pp. 489–490). Assuming that capital markets are semi-strong efficient, the behavior of bidders should ensure that private equity investments are correctly priced on average.

However, the pecking order theory of Myers and Majluf (1984) states that issuing equity signals insider information about the value of the firm on the part of the incumbent management and raises adverse selection costs. In the issuance of equity, adverse selection costs represent the downward adjustment of prices offered by bidders in anticipation of superior information about the firm's value, e.g. information that the value of the firm is actually lower than the information available to company outsiders would suggest.

This causes managers to prefer to rely on internal sources of financing and may even prevent companies with NPV-positive projects from raising the equity they need to finance their investments. Firms only have an incentive to issue equity if the benefits of doing so exceed direct transaction costs and adverse selection costs. When information asymmetries are extraordinarily high, there may be occasions where the cost of issuing equity offsets the benefits from NPV-positive investments. In this case, firms will prefer to postpone transactions until the cost of equity issuance declines again. Empirical evidence to support this view has been provided by Wagner (2008) and Lowry (2003, p. 36). A theoretical model has been developed by Korajczyk et al. (1992).

3.2.1.2 *Value Add View*

Wright and Robbie (1998) argue that the most significant difference between public and private equity is the extent of information asymmetries between (potential) investors and company management. However, the informational imbalance between company insiders and outsiders also constitutes one of the best opportunities for private equity firms to add value, i.e. by mitigating these information asymmetries (Sahlmann 1990; Gompers and Lerner 1998; Wright and Robbie 1998; Cumming and Johan 2008). Private equity firms engage in sophisticated pre-investment screening and implement extensive post-investment monitoring processes to mitigate the adverse selection discussed in the previous section. Accordingly, private equity firms are perceived to target companies for which information asymmetries are significant, as these investments allow them to create exceptional value.

Value creation potential is especially pronounced in venture capital investments, as typical venture capital targets are usually exposed to tremendous information asymmetries. These asymmetries arise from the fact that venture capital is normally invested in new or radically changing companies (Wright and Robbie 1998) in high-technology sectors (Gompers 1995). Venture capitalists are considered to possess the skills and expertise required to effectively monitor such companies.

In the case of buyouts, the information asymmetry problem is undoubtedly more obvious than in public equity investments, but less severe than in venture capital investments. Unlike most venture capital investments, the typical buyout candidate runs a fairly mature businesses with a proven business model and stable cash flows (Oxman and Yildrim 2006; Mathew, Bye and Howland 2009).

To summarize: The value add perspective implies that private equity firms target companies that experience considerable information asymmetries, since these investments provide excellent opportunities to add value. Consequently, the value add view is not contrary to the adverse selection view. Instead, it can be regarded as an extension to the adverse selection cost perspective.

3.2.2 The Impact of Time-Varying Information Asymmetries

3.2.2.1 *Adverse Selection Cost View*

The theory of Myers and Majluf (1984) implies that the transaction cost of issuing equity should also fluctuate if information asymmetries vary over time. Changing levels of information asymmetry would lead to fluctuations in adverse selection costs and time-varying levels of transaction activity. However, this kind of reasoning has so far only been investigated for public firms issuing seasoned equity and IPOs.

Korajczyk, Lucas and McDonald (1992) develop a model in which firms with significant information asymmetries postpone investment opportunities until the information asymmetries and resultant adverse selection costs are reduced by a positive information release. The model also predicts that some firms even forego NPV-positive investments, and that equity issuances are clustered in time as information release dates tend likewise to come in clusters. Consistent with this model, Autore and Kovacs (2009) argue in a study of equity issuance behavior at individual company level that firms are more likely to conduct seasoned equity offerings if information asymmetry regarding the value of their stock is low relative to the recent past. Lowry (2003) studies the aggregate IPO volume and finds that the level of information asymmetry plays a minor but statistically significant role in the timing of initial public offerings (Lowry 2003, p. 36). These results and related findings by Wagner (2008) support the idea that firms are concerned about high adverse selection costs and would rather choose to postpone their equity issues or opt for debt, which entails fewer adverse selection cost problems (Korajczyk et al. 1992, p. 408).

Apart from public-to-private transactions, most private equity deals are by nature associated with greater information asymmetries than acquisitions of listed companies, where trading on stock exchanges provides a market valuation (Brav 2009, p. 269). To determine the value of the target company, private equity investors typically employ several valuation techniques to estimate the fundamental value of a target company. Besides the discounted cash flow method (the most popular method), more than half of European LBO firms also use a market-value-based approach (Achleitner, Zelger, Beyer and Müller 2004, p. 702). In market-value-based approaches, earnings multiples of comparable companies are used for valuation. These multiples can be "trading multiples" of listed companies or "transaction multiples" of recent investments in private transactions (EVCA 2009, p. 15).

The use of transaction multiples reveals an interesting feature with regard to time-varying information asymmetries. Private equity investors seeking to estimate the value of a target company begin by identifying similar companies that have recently been acquired and for which details of the purchase price were disclosed. Where there have been no comparable transactions during the preceding months, investors face considerable uncertainty about the value of a company. This situation is equivalent to high information asymmetries between management and potential investors, with accordingly high adverse selection costs. However, where there have been plenty of comparable acquisitions in the recent past, uncertainty about the company value declines and information asymmetries decrease. This reasoning may help to explain why private equity waves persist for a while, as every new transaction lowers information asymmetries and adverse selection costs, which in turn encourages new transactions. Conversely, low deal activity decreases the likelihood of prospective transactions due to the lack of reference transactions and the resultant high uncertainty about the value of comparable companies.

3.2.2.2 *Value Add View*

According to the value add perspective, private equity firms prefer to invest in companies that are exposed to substantial information asymmetries, as these asymmetries give fund managers the chance to add value. If the extent of information asymmetries changes over time, the value add view predicts that clusters of deals will emerge at times when information asymmetries are pronounced, while deal activity will be less busy when market-wide information asymmetries are smaller. In other words, the relationship between information asymmetries and deal activity predicted by the value add view is contrary to the implications of the adverse selection cost view.

3.3 Agency Theory of Private Equity Investments

3.3.1 Agency Conflicts in Private Equity Investments

Agency theory addresses the problems arising between contractual parties "when one, designated as agent, acts for, on behalf of, or representative for the other, designated the principal, in a particular domain of decision problems (Ross 1973, p. 134) "in the presence of external effects as well as asymmetric information" (Spremann 1989, p. 3). As both parties are assumed to maximize their own utility, the agent will not always act in the best interests of the principal, but will exploit the fact that its actions and efforts are not fully transparent to the principal (Alchian and Demsetz 1972, pp. 779–781). The principal can reduce the agent's deviations from his or her interests by monitoring the agent's activities, creating incentive mechanisms and applying other contractual devices. However, all such efforts and contractual means to manage conflicting interests generate "agency costs", especially monitoring and bonding costs and the residual loss resulting from the principal's welfare loss due to the agent's deviations (Jensen and Meckling 1976, pp. 5–6).

Agency theory refers to two kinds of behavior exhibited by the agent at the expense of the principal's interest: moral hazard and adverse selection. Moral hazard describes the neglect of due effort by the agent (Eisenhardt 1989, p. 61). For example, company management acting as agents for the owners may spend less working hours than were agreed and would be necessary to run the company effectively. Adverse selection refers to the misrepresentation by the agent of skills that are important to the agent's tasks. These kinds of behavior result from information asymmetries and, in particular, from the fact that the actions of the agents are not fully transparent to the principal. In this sense, moral hazard arises from "hidden actions" and adverse selection is caused by "hidden information" (Amit, Brander and Zott 1998, p. 441).

Private equity transactions typically involve multiple parties: existing shareholders, potential new shareholders, company management, private equity firms and an army of financial intermediaries (such as investment banks) who provide deal processing, refinancing, debt structuring and securitization services, plus other advisors who provide due diligence services and legal advice (Fenn et al. 1998). These parties interact in complex legal structures with even more legal entities than those engaged directly, resulting in an abundance of contractual relationships and ensuing agency problems, all of which have the potential to influence the timing and size of a private equity transaction.

Limited partnerships are the most common organizational form of private equity investments and usually have a limited lifetime, typically 10 years (Müller 2008, p. 16). The private equity firm acts as general partner (GP) to the fund vehicle and controls the fund's activities. The investors serve as limited partners (LPs) and monitor fund performance without participating in day-to-day fund management (Gompers and Lerner 1996, p. 469).

The following section focuses on private equity transactions at the level of the individual deal (not at fund level) and the respective transaction parties. The main parties of interest are the old shareholders, who are pre-buyout owners of the company, the (incumbent) company management, the general partner and the limited partners as illustrated in Figure 8. Throughout this section, the term limited partners is used to refer to individuals or legal entities who directly or indirectly acquire a stake in the target firm without distinguishing between the fund vehicle, the limited partners as individuals and general partners who co-invest with the limited partners. Accordingly, the term general partners denotes those individuals or entities who are in charge of the fund activities, subsuming the private equity firm as a legal entity, associated investment advisers, and investment professionals. As the closing of a private equity transaction affects the (partial) transfer of ownership from the old to the new company owners, it also changes essential agency relationships. A distinction is therefore drawn between pre-buyout and post-buyout relationships.

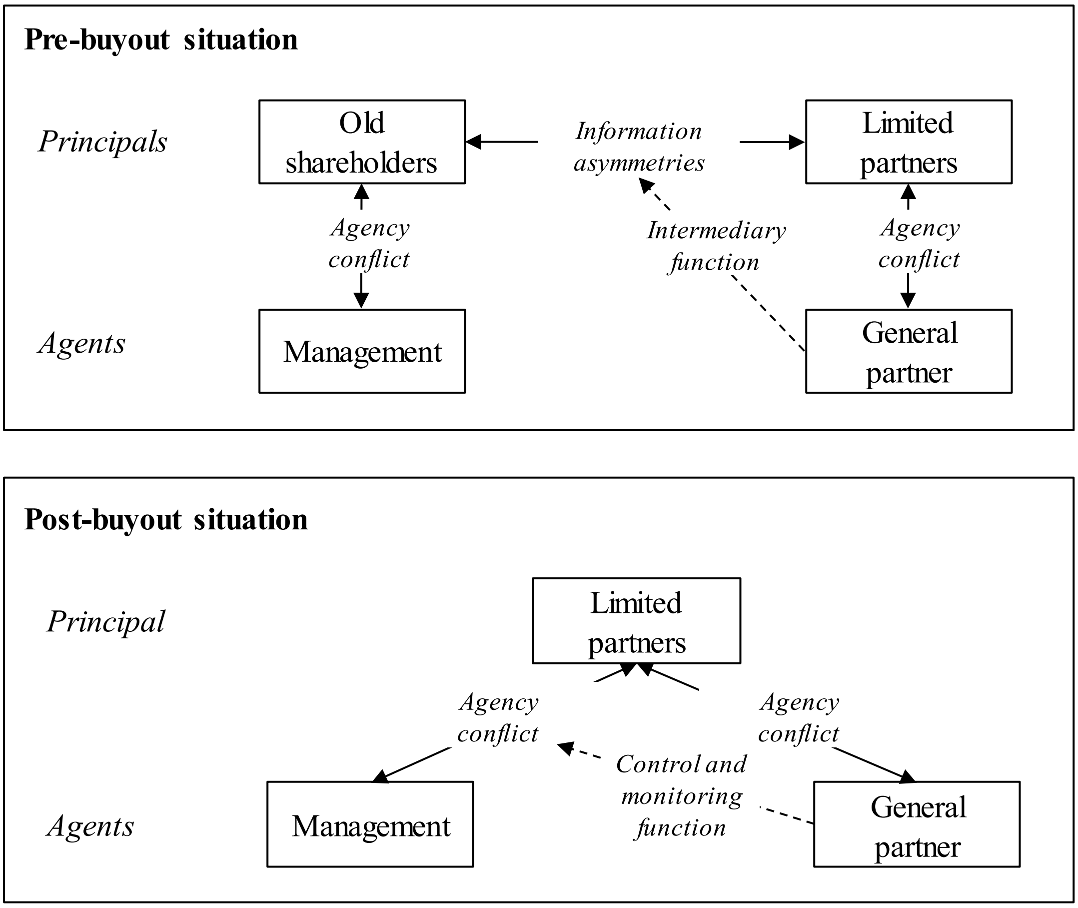

Figure 8: Major Agency Relationships in Pre-Buyout and Post-Buyout Situations

3.3.1.1 *Pre-Buyout Agency Conflicts*

As briefly discussed in chapter 3.2, a potential acquirer of a stake in a company faces the problem of adverse selection. Since the existing owners have superior information about the value of the company, they will only be willing to accept a purchase offer if the price is higher than their private valuation of the company based on insider information. In anticipation of this behavior, bidders will lower their offers accordingly to reduce adverse selection costs (Akerlof 1970, pp. 489–490). Drawing on their expertise and manpower to identify promising investment targets, private equity firms perform thorough due diligence processes and efficiently execute transactions. Private equity firms hereby act as agents for potential acquirers and, as such, partly resolve the adverse selection problem of investing in private companies (Amit et al. 1998, p. 445). Seen from this angle, private equity firms act as intermediaries for potential buyers who do not wish to invest directly in non-public companies whose valuation is subject to considerable uncertainties (Sahlmann 1990).

While private equity firms' intermediary role in the market for entrepreneurial capital (Achleitner 2002) reduces the adverse selection problem between pre- and post-buyout shareholders, other problems arise from the principal-agent relationship between the private equity firm and the people or entities who invest with them (Sahlmann 1990, p. 493).

First, private equity firms have an incentive to maximize the risk associated with investments. The general partner holds an option-like stake in their funds, since typical carried interest arrangements entitle them to 20% of any gain in value. Since the value of the option increases as risk increases, fund managers have an incentive to raise their option value by taking on additional risk – potentially at the expense of LPs (Sahlmann 1990, p. 496). The risk associated with a fund can be increased by excessive use of debt or by a lack of diversification, e.g. by investing relatively large portions of the fund's capital in a small number of target companies (Gompers and Lerner 1996, p. 480). Second, general partners may invest in industries or asset classes in which they have little experience and expertise in order to achieve a learning-curve effect and establish a track record in additional asset classes (Müller 2008, p. 28). Third, conflicts of interest may arise between different funds managed by the general partner. Fund managers may spend too much time on fund raising and monitoring particular funds and, in so doing, neglect target screening and selection activities for other funds. Moreover, fund managers could keep the most attractive investments for funds in which they themselves have the highest stakes (Fenn et al. 1998, p. 35).

Once limited partners have committed capital to a particular fund, they have only limited recourse to their investment (Lerner et al. 2007, p. 733). Consequently, potential conflicts of interest between the private equity firm and its investors are addressed in the limited partnership agreement. These individual contractual elements may include minimum manpower that the general partner must devote to managing the fund, foregoing new fund raising until a certain percentage of the existing fund is invested, and other clauses (Sahlmann 1990, p. 492).

Finally, there are intrinsic conflicts of interest between the incumbent management and the old shareholders (Jensen and Meckling 1976, pp. 5–6). In pursuing their own interests, e.g. non-pecuniary benefits such as power and prestige, management have an incentive to prevent transactions that could result in a loss of influence, such as the divestment of single entities or business units (Jensen 1989, p. 10). This is in particular true in the context of hostile takeovers (Kaplan and Holmstrom 2001, p. 3). On the other hand, management also has incentives to pursue transactions that include management participation if this enables them to exploit superior information (Smith 1990, p. 144).[1] Apart from these deal-related conflicts of interest, an inherent conflict of interest exists between these two parties (Jensen and Meckling 1976, pp. 5–6) that are transferred from the pre-buyout owners to the post-buyout owners when the deal is closed. This constellation is covered in the section below.

3.3.1.2 ***Post-Buyout Agency Conflicts***

Once ownership has been transferred to the new shareholders, the role of the private equity firm changes. From acting as intermediary between two parties in a purchase transaction, the private equity firm advances to become an organizational body that monitors and exercises control over the company management (Acharya et al. 2009, p. 1). The limited partners thus face two agency relationships, as illustrated by Figure 8: one with the company management and one with the general partner acting as intermediary to the first agency relationship.

The post-buyout owners' principal position in their relationship with the company management is inherited from the old owners. While the basic conflicts of interest between managers and owners remain unchanged by the transfer of ownership, the agency costs change significantly when a private equity transaction takes place. A considerable body of private equity literature focuses on this agency conflict and the reduction of agency costs in LBOs through control and incentive mechanisms (Jensen 1989, p. 7; Jensen 1991; Gou et al. 2009: pp. 1–4; Acharya et al. 2009, p. 1).

The general idea developed by Jensen and Meckling (1976) assumes that management which acts as an agent for the company owners has an incentive to pursue its own personal agendas at the expense of the owners' wealth. In particular, management allegedly wastes free cash flow or accumulates excess cash flow in order to gain

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[1] However, empirical evidence provided by Smith (1990) and Kaplan (1989) does not support the hypothesis that management is indeed able to take advantage of insider information in MBOs.

influence and prestige. For example, managers may be tempted to invest in empire-building through unprofitable expansion and takeover activities and, in so doing, destroy shareholder value (Jensen 1986, pp. 323–324; Jensen 1989). Private equity is regarded as an organizational form that successfully reduces the agency costs of the manager-owner relationship through the disciplining effects of high leverage, management participation and effective monitoring and control devices (Jensen 1989, p. 7). Empirical evidence provided by Kaplan and Strömberg (2003) documents that the allocation of control and cash flow rights play a central role in the mitigation of these agency problems for venture capital investments. While private equity firms help reduce the agency costs of the manager-owner conflict, other agency conflicts arise from their role as agent for the post-buyout owners. Similar to the pre-buyout circumstances, in the post-buyout situation private equity firms may ease their monitoring efforts and increase the risk associated with the fund (Gompers and Lerner 1996, pp. 464, 480) even after investments are completed. They might do this by pursuing a risky operational strategy at the target companies, e.g. realizing risky investment opportunities at corporate level.

3.3.2 Agency Theoretical Drivers of Private Equity Investments

When investigating private equity investment activity, it is vital to understand what motives of the parties described above have an impact on the timing of a transaction and the decision to close a deal at all. As described in chapter 3.3.1, most parties involved in private equity transactions may have in incentive to complete transactions for their own sake. However, to cluster transactions on an aggregate level, this is crucial if there are *systematic* interests in a high or low deal activity and contractual elements in the agency relationships that support these interests. For example, there may be occasions when the pre-buyout owners try to push a transaction because they see high purchase prices for comparable companies. However, there is no reason to conclude that pre-buyout owners have a general interest in brisk deal activity, as they will withdraw planned transactions if they observe low transaction prices for comparable companies. This is because their main interest is to obtain a high price for their stake in the company.

Among the parties to the transaction, only private equity firms seem to exhibit a clear interest in brisk deal activity for its own sake. Reputation is a key asset for private equity firms as it underwrites future fund raising activities and a steady flow of deals (Sahlmann 1990, p. 513; Jensen 1989). Private equity firms build their reputation by demonstrating success in investments. This therefore requires a sufficient number of completed transactions, i.e. an established investment track record,[1] and impressive realized fund performance. A long list of underperforming transactions is worse than a handful of profitable investments. That the number and volume of transactions matters to private equity firms' reputation is supported by the findings of Ramón and Pellón (2003) who provide evidence that the invested volume of a private equity firm has considerable impact on the reputation and future fund raising. (Ramón and Pellón 2003, p. 16)

However, especially in the early stages of a private equity firm the "reputational capital" may be insufficient to prevent general partners from engaging in high-risk investments (Fenn et al. 1998, p. 37). Ljungqvist et al. (2008) find that pressure to develop an investment track record can accelerate the investment behavior of buyout funds. However, their findings differentiate between established private equity firms and younger players: While established firms adjust their investment activities to the availability of investment opportunities, the investment behavior of younger private equity firms is less sensitive to market conditions and riskier due to pressure to build an investment track record (Ljungqvist et al. 2008, p. 1). Related findings include results provided by Gottschalg and Phalippou (2009), who report that first-time funds underperform established funds (Gottschalg and Phalippou 2009). This finding is consistent with related work by Strömberg (2007), who found that investments made by more experienced private equity firm are less likely to experience financial distress (Strömberg 2007). Moreover, private equity fund performance has been found to be highly persistent (Kaplan and Schoar 2005; Gottschalg and Phalippou 2009). This means that funds with above-average performance are more likely to outperform in the future as well. These findings suggest that established private equity partners make wiser investment decisions on average and are less prone to overinvestment than their younger competitors.

[1] The term "track record" is often used for both the number and performance of transactions. In this section, track record refers primarily to the number of executed transactions.

For their part, overinvestment incentives are constrained by pressure to maximize fund performance. However, this effect is neutral with respect to deal activity and unlikely to compensate for the pressure to generate deal flow, since a higher number of recent investments whose performance has been slightly above average is more helpful to raise new funds than one exceptional success years ago.

In addition to reputational concerns, the fee structure of limited partnerships provides further incentives for private equity firms to indulge in excessive investment. Private equity firms typically receive a management fee of 1.5-2.5% of the invested volume (Gompers and Lerner 1996, p. 481; Wright and Robbie 1998, p. 534). Jensen (1991) argues that such arrangements encourage situations in which too many low-quality deals are made, as they pay dealmakers (who have no reputation to protect) to invest in overvalued deals.

Carried interest typically consists of 20% of realized gains from investments (Kaplan and Strömberg 2009, p. 124; Metrick and Yasuda 2010, p. 2). On the one hand, this provides an incentive to maximize fund performance and should thus keep fund managers from overinvestment. However, 20% participation in positive performance also represents a call on the fund value. Since the value of the option can be increased by raising the investment risk, fund managers have an incentive to increase risk beyond the risk preferences of the fund investors (Sahlmann 1990, p. 496). The risks inherent in a fund can be increased in various ways. However, for the purposes of clustered transactions, two considerations are particularly important. First, raising the risk tolerance without adjusting the target for expected returns causes the number of suitable targets to increase. Second, leveraging can help formerly unprofitable deals break even, thereby increasing both the riskiness of investments and the number of potential investee companies. Notably, both ways have considerable potential to increase deal activity by increasing the number of potential targets.

Overall, private equity firms have a measure of incentive to realize any investment that is not directly damaging to their reputation. They certainly benefit from vigorous investment activity more than their principals do. The incentives to overinvest are particularly strong for funds with a lot uninvested capital at late stages of the fund's life, since pressure to invest increases the likelihood of overpriced investment (Axelson et al. 2007, pp. 6, 24).

For other parties to such transactions, their main interests in the deal can be regarded as neutral with respect to deal activity. While post-buyout owners may be interested to acquire heavily in a "buyer's market" when transaction multiples are low, the opposite is true for pre-buyout owners and management (protecting owners' interests), who prefer to sell in a "seller's market", and vice versa.

Table 1 summarizes the motivations and key interests of general partners as outlined above. In addition, the table lists the major motives and interest of the other transactions parties, e.g. limited partners and incumbent management and shareholders. The author argues that these deal participants are mainly interested in maximizing their own wealth in transactions or in maximizing the wealth of their principals. The latter point is applicable for the incumbent management acting as agent for the incumbent shareholders hereby pursuing to protect the rights of the shareholders. These parties should be mainly concerned of the purchase price and other conditions of the sale and purchase agreement of the transaction. They do not have an interest in a brisk deal activity for its own sake. Therefore the impact of their interests in the transactions is regarded as "neutral" with regard to the deal activity.

Involved party	Motivation	Interest in transaction	Impact on deal activity
General partner	Improve reputation	Build investment track record	positive
		Maximize fund performance	neutral
	Increase mangement fee	Maximize assets under management	positive
	Increase carried interest	Maximize fund performance	neutral
		Increase risk of a fund	positive
Limited partners	Maximize own wealth	Maximize fund performance	neutral
Old shareholders	Maximize own wealth	Maximize purchase price	neutral
Management	Protect old shareholders	Maximize purchase price	neutral

"positive": fostering impact on deal activity; "neutral": no fostering impact on deal activity

Table 1: Interests of Transaction Parties in Private Equity Deals and Impact on Investment Activity

The incentive for private equity firms to overinvest does not, in isolation, explain the existence of private equity waves. The next essential ingredient for private equity waves are fluctuating refinancing conditions. Steven Kaplan has developed a market timing theory of private equity "boom and bust cycles".[1] According to his theory, private equity markets frequently "overheat" in that deals are structured with increasing recklessness and numerous low-quality deals are made in lack of suitable targets (Kaplan and Stein 1993, p. 348). This reasoning is consistent with Jensen (1991), who argues that markets "overshoot" when lots of capital flows into funds and new entrants rush into the private equity market (Jensen 1991, p. 27). Figure 9 illustrates the basic reasoning. The cycle starts when investors and debt providers observe high returns of private equity investments and provide more and more fund

1 The evolution of this theory can be traced in a number of publications, e.g. Kaplan and Stein (1993), Kaplan and Schoar (2005), Kaplan and Strömberg (2009), Chew and Kaplan (2009, 2007).

liquidity and debt to leverage transactions. This abundant liquidity fosters deal activity and, together with attractive returns, encourages new entrants to the private equity market (Kaplan and Schoar 2005). As the number of suitable targets is limited, private equity firms compete for deals and are likely to overpay (Jensen 1991, p. 27). This reasoning is supported by empirical evidence provided by Kaplan and Schoar (2005), who run regressions of fund performance on the number of funds entering the industry per vintage year. They find that, in periods when more funds enter the fray, vintage year returns are lower than in periods when the number of new entries is more moderate. Gompers and Lerner (1996) demonstrate that venture capitalists employ less restrictive covenants in funds that where raised in years of higher capital inflows into the venture capital industry (Gompers and Lerner 1996, p. 464). These findings suggest that deal quality deteriorates when new private equity firms enter the industry. As a result, default rates increase in due course and fund returns diminish. The supply of fresh money for fund investments then freezes, resulting in a sharp decline in deal activity (Kaplan and Stein 1993, p. 348).

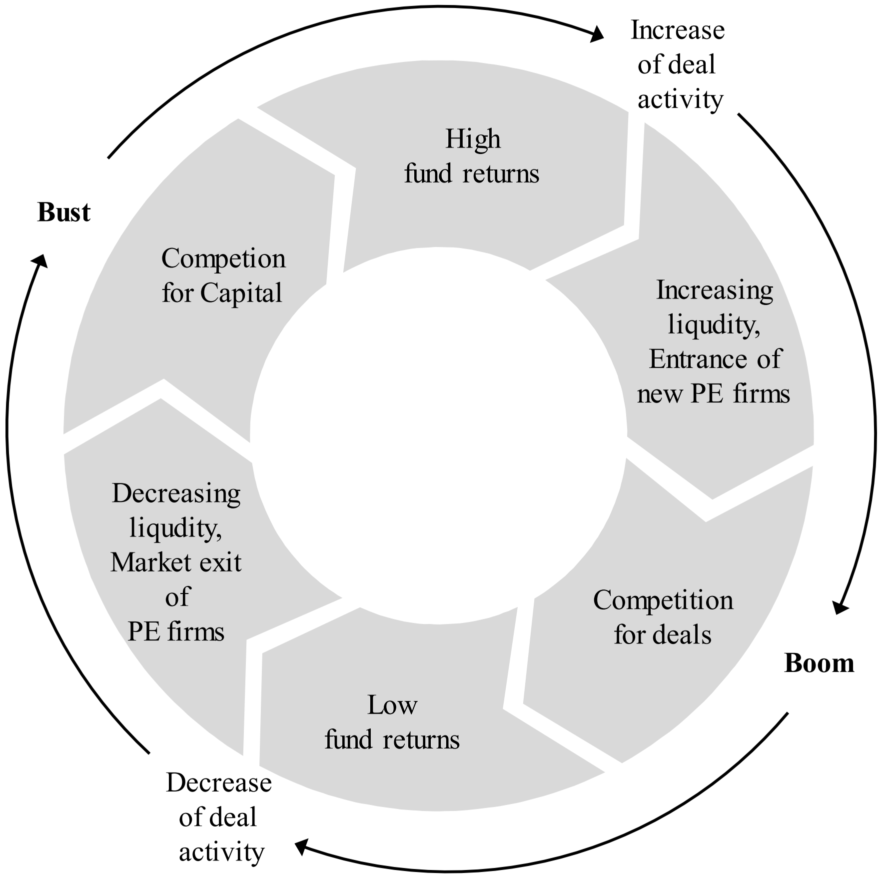

Figure 9: Boom and Bust Cycles in Private Equity Investments

In 2010, after the global credit crunch and at a difficult time for the private equity industry, Guy Hands, chief executive officer of Terra Firma Capital Partners Ltd., said this about the relationship of past and future private equity returns: "If ever there was a time when past performance is not going to be an indicator of future performance, now is that time" (Cauchi and Hodkinson 2010). However, the boom and bust cycle theory and observation of the actual behavior of market participants suggest that the performance attitude of investors is exactly the opposite. In particular, investors seem to extrapolate observed recent performance and to provide disproportionately huge amounts of liquidity in times of superior performance and to hold back liquidity, when private equity experiences poor returns.

The ups and downs in the level of deal activity are fostered by agency problems arising from debt syndication, which is increasingly used to leverage private equity investments (Axelson et al. 2007). By sharing the economic risk, banks diversify and can increase their exposure to buyout lending, thereby increasing the aggregate amount of financing available for private equity transactions. The establishment of a market for CLOs has also accelerated risk transfer and thus facilitated refinancing conditions for private equity transactions. Consequently, it has contributed to the recent boom in private equity deals (Altman 2007, p. 17). However, debt syndication also precipitated the sudden drying-up of debt markets during the financial crisis of 2007/2008. Acharya et al. (2007) argue that syndicated debt exposes originating banks to further moral hazard, as they have less incentive to monitor risk once they have passed it on to others. Moreover, in the event of default, the numerous parties involved and (sometimes) the lack of information about the ultimate debt holder impede negotiations in the out-of-court restructuring of nonperforming loans. Accordingly, default scenarios are more likely and may trigger other defaults, resulting in increasingly tight liquidity when it comes to debt financing for private equity transactions. A related view is offered by Jensen (2010, p. 78) who contends that banks have substantially decreased their financial stakes in borrowing companies due to regulatory and risk diversification issues. This trend towards passive investors holding micro stakes with limited control rights have left corporate managers unmonitored, which has led to inefficiencies and thus increase the likelihood of defaults.

To summarize: The agency theoretical view states that private equity firms have an interest in busy deal activity due to their pressure to build a track record and the typical fee structures imposed by limited partnership agreements. However, only certain periods provide the financial resources, e.g. fund liquidity and liquid debt markets, that are needed to accommodate private equity firms' pressure to invest. In other words, private equity firms have an incentive to overinvest; and this incentive is encouraged or constrained by the liquidity situation surrounding the financing of such transactions.

3.4 Market Timing Theories for Private Equity Investments

3.4.1 Capital Structure and Market Timing

Market timing theories have become increasingly popular in research into corporate capital structures (Owen 2006; Frank and Goyal 2009) and merger waves (Harford 2005). Of late, private equity too has been added to the list of market timing opportunities (Kaplan and Strömberg 2009). At the center of market timing theories is the view, adapted from behavioral finance, that some market players can exploit temporary misvaluations on capital markets. The idea that firms "time" equity issues was introduced by Myers (1984), who argued that firms are more likely to issue equity after a decline in stock prices (Myers 1984, p. 586). This thought has also been put forward by Baker and Wurgler (2002). Following their reasoning, capital structures are the result of past attempts to time market activities, e.g. by issuing equity instead of debt when market values are high and repurchasing stock when market values are low (Baker and Wurgler 2002, p. 3). In merger waves, a similar view is that mergers tend to cluster in time because of temporary misevaluations that allow acquiring companies to swap their overvalued stock in acquisitions of undervalued companies (Shleifer and Vishny 2003, p. 296).

Most advocates of market timing theories do not oppose the neoclassical reasoning, nor do they deny the explanatory power of traditional capital structure theories (Frank and Goyal 2009), e.g. the trade-off theory or pecking order theory. According to the trade-off theory, firms in corporate financing decisions face a trade-off between the costs and benefits of borrowing. The capital structure has to balance the value of interest tax shields against the cost of bankruptcy or financial distress. The pecking order theory predicts that, due to adverse selection costs in financing decisions, firms prefer retained earnings over debt and debt over equity. More generally, since any announcement of an issuance will drive valuations down, firms choose internal financing rather than external financing and safe securities such as debt rather than risky ones such as equity (Myers 1984). For an overview of rival capital structure theories, see Frank and Goyal (2009). Over the last years dynamic capital structure theories have been developed and empirically tested that focus on the question why capital structures change over time, see, for example, Fischer, Heinkel and Zechner (1989); Berk, Stanton and Zechner (2009) and Getzmann and Lang (2010).

However, defendants of market timing theories do argue that the aforementioned reasoning is incomplete, since it fails to convincingly explain the fact that market players prefer to conduct equity issues during times of buoyant stock prices (Lowry 2003, p. 14; Shleifer and Vishny, 2003). While it is obvious that firms and their shareholders are keen to take advantage of temporary overvaluations, the question is: Why should investors not recognize this and lower their valuations to make transactions less attractive for equity issuing firms and for shareholders who want to dispose of their shares? To answer this question, two main strands of literature have developed (Baker and Wurgler 2002, p. 4). The first assumes rational investors and managers. As explained earlier in the section on the information asymmetry view, managers adjust their level of equity issuance to changing levels of information asymmetries and the resultant fluctuations in adverse selection costs (Myers 1984, p. 586; Myers and Majluf 1984).

The other strand of literature argues that investors are often overly optimistic about equity issues. They irrationally underestimate the adverse selection problem; and this allows firms to issue overvalued equity (Baker and Wurgler 2002, p. 4). In addition, survey evidence provided by Graham and Harvey (2001) support the view that managers care a lot about the timing of equity issues. One problem with market timing theories on both capital structures (Baker and Wurgler 2002, p. 4) and merger waves (Harford 2005), however, is that they often rely on the market-to-book ratio as an indicator of overvaluation. A high market-to-book ratio suggests a high market valuation relative to book assets and may imply overvaluation. This thought has been fed by the enduring empirical finding that high market-to-book stocks underperform the market. However, the interpretation given by Fama and French (1992) is that such ostensible underperformance is caused by an unobservable risk to which firms with a high book-to-market ratio are exposed. Thus, capital markets demand a premium of stock with a high book-to-market ratio (value stocks) resulting in a relative underperformance of stocks with a low book-to-market ratio (growth stocks). This view is consistent with the efficient market hypothesis and denies investor irrationality by arguing that the market is correct on average.

The idea of irrational behavior is not new to corporate finance and economic theory (Becker 1962). Psychological aspects that deviate from the rational homo economicus have spawned a whole research area which, under the umbrella of "behavioral finance", explores the behavior of individual economic agents and the resultant effects on asset pricing, regulation and management (Yale School of Management 2010). Opponents of behavioral theories argue that behavioralists suffer from data mining in that most behavioral models work only for the anomaly and time frame they are designed to explain, but that findings are not robust enough to stand up to different methodologies and rarely produce refutable hypotheses (Fama 1998, p. 291). Frank and Goyal (2009, p. 5) thus conclude that "the market timing theory needs considerable theoretical development".

However, in the aftermath of the financial crisis, a more moderate perspective somewhere between the rational and irrational behavior assumptions has become popular. Scholars have increasingly been seeking explanations for phenomena such as the Internet bubble in the early 2000s and the subprime bubble – and why it subsequently burst – in the mid-2000s (Whalen 2008). In this context, the work of economist Hyman Minsky too has been revived (Cassidy 2008). In his financial instability hypothesis, Minsky (1993) argues that, during periods of prosperity, capitalist economies tend to move from a stable financial structure to unstable speculative financing schemes. Two key considerations set his work apart from other economic perspectives. First, unlike other economic theories, his explanation of swings in the economic and financial system does not rely on external shocks. Instead, he stresses that boom and bust cycles are inherent in the system. Second, the banking sector does not only act as intermediary within an economy, but is a profit-making sector like any other entrepreneurial activity that generates returns by innovating. At times, banks and other financial intermediaries extend borrowing to excessive levels, often with the help of financial instruments: high-yield bonds in the 1980s and debt securitization in the mid-2000s, for example. Fueled by worrying levels of debt, growing financial instability reaches its peak and is followed by financial and economic crisis (Minsky 1992). Minsky's theory implies that periods of collective euphoria followed by economy-wide depressions can occur even under the assumption of rational behavior.

For the purposes of this study, Minsky's work allows to investigate market timing without assuming irrational behavior. Following his argument, entrepreneurs and the incumbent management and shareholders of target companies may be able to exploit market situations in which cheap and easy credit facilitate transactions that would not be feasible in other market situations. The fact that financial markets vacillate between stability and instability is inherent in the system and is not primarily attributable to irrational behavior.

3.4.2 Timing of Private Equity Transactions

While the cyclical nature of the private equity market is widely acknowledged by practitioners and scholars alike (Kaplan and Schoar 2005), there have been astonishingly few attempts by academics to explain these waves. Although the phenomenon appears closely related to the merger waves and "hot issue markets"[1] in which market timing theories are frequently investigated, the putative link between private equity and market timing hypotheses has so far experienced only very modest coverage. The term "boom and bust cycles" was coined by Jensen. However, he does not attribute changing levels of deal activity to market timing in line with behavioral biases. Instead, he makes agency conflicts between private equity firms and their principals responsible for the overheating of private equity markets (Jensen 1991, p. 26). "Boom and bust cycles" have nevertheless found their way into practitioners' regular vocabulary[2] (Acharya et al. 2007, p. 45). Kaplan's "boom and bust cycle" theory asserts that fund investors and debt providers follow returns and adjust their provisioning of capital to the private equity returns observed in past periods. This leads to temporary excess liquidity and competition for deals (Kaplan and Stein 1993, p. 348)

Behavioralists frequently attribute this overheating of markets to irrational behavior on the part of investors and private equity firms who pay unreasonable premiums as fund managers overreact to investment opportunities (Gupta 2000), or on the part of

1 The term "hot issue markets" refers to periods of unusually high IPO activity and high abnormal initial returns. First introduced by Ibbotson and Jaffe (1975, p. 1027), the subject has been discussed in corporate finance literature for decades, see for example Ritter (1984) and Lowry (2003).

2 At the Aspen Global Leadership conference, Carlyle Group founder David Rubenstein stated "There will be boom and bust cycles 50 years from now" (Hamm 2009).

investors who overestimate the probability of investing in one of the big winners (Gottschalg and Phalippou 2009, p. 1773). Such behavioral biases, which center around beliefs about future cash flows and investment risk but have little factual basis, are often subsumed under the term "investor sentiment" (Baker and Wurgler 2007, p. 129).

The lending behavior of banks and other debt providers who usually contribute the lion's share to transaction finance has attracted particular interest. Acharya et al. (2007) argue that the boom and bust of private equity bubbles results from irrational overreactions by lenders. These authors compare the drying up of debt markets for M&A transactions with traditional bank runs. However, they do not hold irrational behavior responsible for such overreactions, but rather point to the information externalities that occur in the complex contractual relationships that surround debt syndication (Acharya et al. 2007, p. 52). Kaplan and Stein (1993), however, argue that a "demand push" from the public junk bond market provided overly favorable terms for transactions during the 1980s (Kaplan and Stein 1993, p. 316). Kaplan and Strömberg (2009) even hypothesize that private equity investors take advantage of temporary mispricings between the debt and equity markets. They argue that spreads for private equity borrowing exhibited abnormal behavior during the recent boom, suggesting that debt was unusually cheap compared to equity. For example, spreads relative to the London Interbank Offered Rate (LIBOR) doubled from 250 base points in 2006 to 500 base points in 2008. Assuming that this development does not reflect changes in private equity-specific risk, private equity firms and entrepreneurs may have created value by borrowing in times of favorable lending terms. The abnormally high valuation multiples for transactions effected at these times are seen as indicator of overvalued deals (Kaplan and Strömberg 2009, p. 136). This kind of arbitrage would be in contrast to the efficient market hypothesis. It is a valid question, whether the efficient market concept makes sense for the private equity market since the market works entirely different from the stock market due to the illiquidity of the investments, the high barriers to enter the market, and the intransparency of the asset class. The fundamental conditions of an efficient market are (i) no transaction costs, (ii) information is costless and available for all market participants, (iii) agreement among investors about the implications of information (Fama 1970, p. 387). Compared to the stock market, private equity's compliance with these efficiency requirements is relatively low. Transaction costs include huge legal fees, due diligence costs, and advisory fees. Gathering of information is time-consuming and often only accessible with the help of superior contacts. However, the market may still be efficient, as long as a "sufficient number" of investors have access to information. Moreover, violations of these principles do not necessarily imply market inefficiency, they rather represent potential sources of inefficiencies (Fama 1970, p. 388).

One must be cautious in interpreting the execution of seemingly overpriced and overleveraged deals as examples of market inefficiency or irrational behavior, because this kind of reasoning begs a lot questions that are still unanswered by academia or at least controversially discussed. First, with the benefit of hindsight, many industry observers now believe that a lot of acquisitions were made at premiums over market levels in the 1980s, in the subsequent private equity booms, and also during the most recent bubble before the credit crunch in 2007. However, to challenge the notion of market efficiency, Fama argues, these "anomalies" have to be predictable (Cassidy 2010). Moreover, a boom and a subsequent bust is nothing but a market overreaction followed by a market underreaction. Yet if anomalies randomly split between overreaction and underreaction, they are consistent with the efficient market hypothesis (Fama 1998, p. 291). One frequently misunderstood aspect of the market efficiency hypothesis is that it allows individual players to make mistakes while the market as a whole remains correct on average.

Second, an important question is whether deals made during periods of high activity perform better or worse than private equity investments made in times of low activity. On this point, empirical findings are contradictory. While Kaplan and Schoar (2005), Acharya et al. (2007) and Lerner et al. (2007) report a negative relationship to private equity investment activity, Gompers et al. (2009) identify a positive relationship. If deals made during a boom outperformed those made during a slump, this would indicate that private equity firms do indeed invest heavily at certain times because they find more promising investment opportunities. In other words, outperformance in busy vintage years would imply that private equity firms adjust their investment activity to the availability of attractive investment opportunities. Such behavior is both rational and in the best interests of the principal investors.

Third, if the opposite were true, the question of who is to blame for irrational behavior would still remain open. Are investors responsible, irrationally providing too much liquidity for this asset class? Or are the private equity firms to blame, tempted by overinvestment and paying abnormally high prices for target companies? From the investor's point of view, it is rational and reasonable to increase their capital commitments to private equity funds when traditional asset classes produce only marginal returns. By concluding limited partnership agreements, investors engage professional fund managers who should create value and invest only in highly attractive deals. If these dealmakers then engage in underperforming investments, it is hard to verify whether such poor transactions occurred due to irrational expectations or were the result of misaligned incentives between private equity firms and their principal investors. The fact that, toward the end of the last private equity boom, billions in committed capital remained uninvested in funds (Axelson et al. 2007, p. 3; Kelly 2009) may provide evidence that private equity funds at least in part resisted the temptation to invest available funds at any price.

This said, it is a challenging task to construct and rigorously test a sound theory of the market timing of private equity investments on the basis of irrational behavior. There are several reasons why this is so. First, to the knowledge of the author there is no widely accepted theory of irrational behavior within the finance theory. This makes it difficult to develop sound refutable hypotheses. Second, operationalizing behavioral hypotheses is even harder as there is little academic consensus on how to measure "irrational behavior", "investor sentiment" or "optimism" (Zhang 2008). Third, as explained above, most of the behavioralists' arguments actually point to the information asymmetry view or agency theory of private equity investments. In particular, predictions of behavioral boom and bust theories, e.g. the clustering of transactions in times of favorable lending conditions and high transaction multiples, are also consistent with alternative theories. To summarize, it appears that the supposedly "irrational" behavior of private equity markets can be explained just as well – or perhaps even better – by the predictable or "rational" response of market participants to limited information, agency problems (Chew and Kaplan 2009, p. 18) and fluctuations of financial markets between stability and instability (Minsky 1992, 1993). Consequently, in this study the investigation of a market timing theory of private equity waves will abstain from the assumption of irrational behavior.

3.5 Synopsis of the Theoretical Framework

The different theoretical approaches to private equity investment activity are summarized in Figure 10. For each viewpoint, a simplified causal chain of the main drivers of private equity deal activity is depicted. The direction of the postulated impact on deal activity and subsequent returns is indicated by a (+) or (-) symbol.

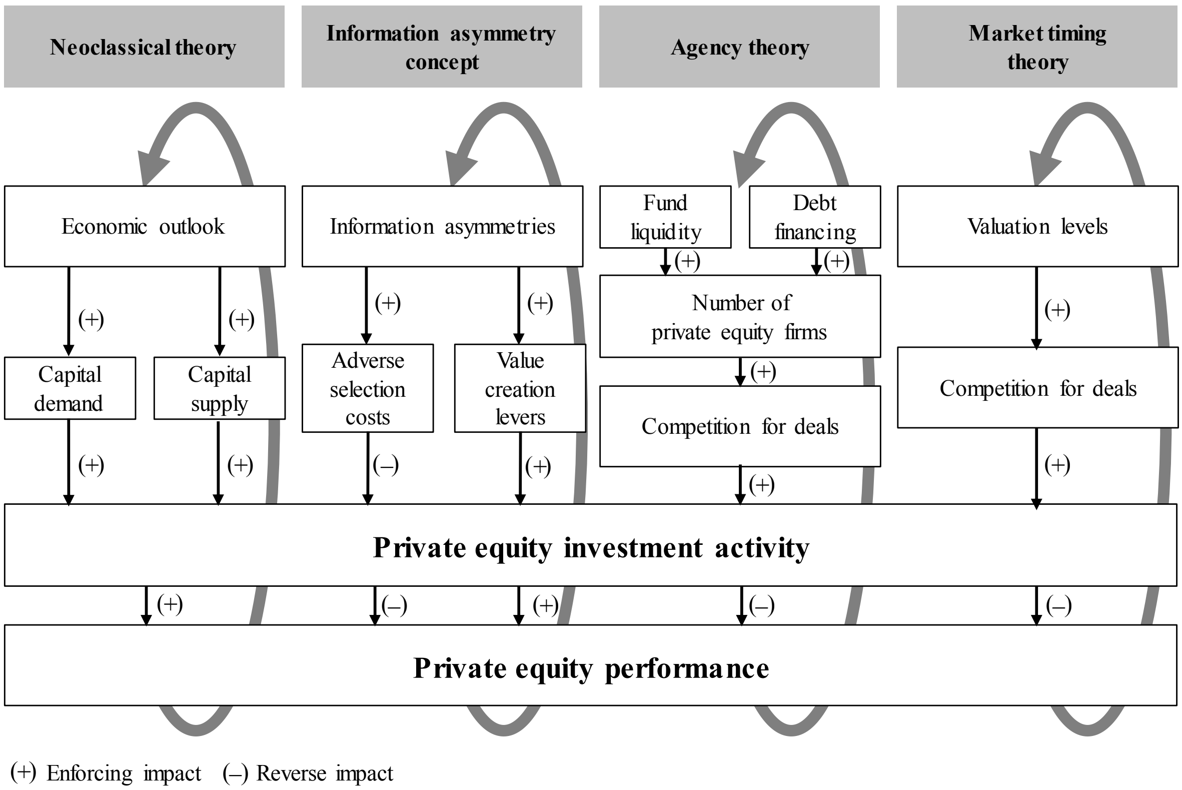

Figure 10: Synopsis of the Theoretical Framework

As shown in Figure 10, the basic premise of the *neoclassical theory* is that deal activity should simply fluctuate with the business cycle. A positive economic outlook increases the availability of NPV-positive investment opportunities for operating companies, which stimulates their demand for capital to finance these investments. The change in the economic environment can be economy-wide or the result of a shock to certain industries. Increasing capital demand is met by the sources of capital supply as both investors and providers of debt cash in on promising business opportunities for the companies seeking financing. This results in an increase in investments made by private equity firms that outperform investments made during periods of low activity, as performance reflects the beneficial economic environment and resultant growth opportunities at the time of investment.

Applied to private equity investment activity, the *information asymmetry concept* states that changing levels of information asymmetries are responsible for private equity waves. However, there are two competeting views. First, the adverse selection cost view states that time-varying information asymmetries lead to fluctuations in adverse selection costs for companies raising private equity. As a result, they adjust their corporate financing decisions accordingly and may postpone or withdraw private equity transactions when adverse selection costs are extraordinarily high. The performance implication of this reasoning is a negative activity-return relationship. To illustrate this point, consider a firm with an unchanging company value. If the company were to raise private equity in times of high information asymmetries and low deal activity, it would have to accept a high downward adjustment. The relatively low price paid by the acquiring private equity fund would, over time, turn out as outperformance. However, if the same company were to issue its shares when information asymmetries were particularly low and private equity transactions were booming, small information asymmetries would require only a minor price adjustment by potential acquirers, who may even submit competitive bids. As a result, the same company would be sold at a higher price, resulting in long-term underperformance compared to the deal done when information asymmetries were running high. To put that another way: The higher the information asymmetries, the lower the deal activity and the higher the subsequent performance and vice versa.

Second, the "value add view" asserts that reducing information asymmetries between limited partners and target companies is a key value driver for private equity managers' activities. This view predicts a positive correlation between the extent of information asymmetries and deal activity, as such periods create more opportunities for private equity firms to offer their valuable services.

Approaches that focus on *agency theory* are hard to fit into a single model (although Figure 10 might suggest that this is not the case), because this kind of reasoning is very fragmentary in academic literature. However, the author's synopsis identifies two main agency problems between fund investors and private equity firms that imply an incentive for private equity firms to overinvest. First, the fee structure of limited partnerships encourages excessive investments due to the customary 20% carried interest fee that constitutes an option-like stake in the fund, as it does not require fund managers to participate in losses. Moreover, management fees linked to the managed volume create an incentive to invest in targets of lower quality too. Second, the pressure to build a track record may tempt younger private equity firms in particular to overinvest as they have no reputational capital that stands to be damaged. If investors and banks observe positive private equity returns, they will provide more liquidity for this asset class to accommodate high investment activity. This ample liquidity, together with the extrapolation of past returns, in turn attracts new players onto the private equity market and creates competition for a limited number of promising investment targets. This "money-chasing-deals" effect causes acquisition prices to be bid up, which again attracts more capital, private equity players and also low-quality targets (Gompers and Lerner 2000, p. 322). As the quality of investments deteriorates, and as rising default rates make this apparent over time, fund raising becomes tough and the debt financing environment becomes tense and expensive. This imposes serious constraints on private equity transactions until, a few years later, the situation brightens up again and a fresh cycle commences, triggered for example by economic shocks. Further agency problems arising from the growing trend toward debt syndication and securitization are believed to enforce this effect. Given that banks are prone to moral hazard if loans do not remain the economic risk of the originating bank, they are likely to foster deal activity and increase the risk of default. On the other hand, lack of information about the identity of the ultimate holders of debt may result in a few large defaults, causing new funding to dry up (Acharya et al. 2007, p. 47).

It should be noted that, when investors and debt providers supply more funds in response to observed past returns, this does not necessarily imply irrational behavior. This kind of response to market development may result (in combination with the information asymmetry hypothesis) from informational externalities. Effectively, if details of more and more transactions are published, this reduces information asymmetries and encourages investors and debt providers to provide capital for formerly intransparent and, hence, risky transactions.

Finally, the *market timing theory* of private equity investments rests on the idea that past returns encourages or hampers private equity activity. If private equity returns have been favorable in the recent past, market players extrapolate these returns, causing acquisition prices to rise to extreme levels and resulting in a cluster of overvalued transactions. Conversely, market players also react to defaults and disappointing performance, causing the flow of liquidity and transactions to dry up when news of defaults is publicized.

With the exception of the neoclassical view and the value add perspective of information asymmetries, all other theories predict a negative activity-return relationship, implying that the performance of private equity investments made during boom phases should be worse when compared to investments conducted in periods of low activity. The alternative theories are not mutually exclusive. They may all help to explain the pattern of private equity investments cycles.

4 Data and Methodology

4.1 Data Collection

Two types of data are needed if the research questions are to be answered properly. First, transaction data are needed to define the level of investment activity. Second, performance data are needed to establish a correlation between performance and deal activity.

Data availability is probably one of the biggest challenges in research into private equity, for two main reasons: First, unlike in the case of public equity transactions, none of the parties are under any legal obligation to disclose private equity deals or the financial details thereof (McCahery and Vermeulen 2010). Second, general and limited partners generally keep information about deals very confidential and are reluctant to share financial information. This is the case in particular if such information reveals inferior investment performance. The challenge is even greater in the European market, as this market is less mature than its US counterpart. Consequently, researchers frequently bemoan the lack of complete and long-term time-series data sets for the European private equity industry (Strömberg 2009, p. 2). Nevertheless, progress has been made in recent years as databases have grown and have increasingly included European transactions.

Phalippou (2010b) describes the current state of private equity data bases for academic purposes and classifies data sources into four groups: The first group – *publicly traded vehicles* – comprise data of listed private equity provided by CapitalIQ. However, extracting a list of private equity firms which have been public at least since 2005 and are not illiquid results in only 19 observations which is far too little to conduct the necessary analyses. The second group are *round valuation data* that include the valuations of target companies for each financing round. Such data are collected by Sand Hill Econometrics. For the purpose of this study these data are not much utilizable since the data base focuses mainly on venture capital and entirely on US investments. The third data type represents *investment data* and typically comprise investment level data of the acquiring fund, characteristics and financials of the target companies, investment and exit details including cash flow amounts and date for each portfolio company. Some researchers obtain such data through an access to data of large LPs. In recent years, one comprehensive data set of investment level data has been collected by the Center of Private Equity Research (CEPRES). While such investment level data would be ideal to also track the performance relative to deal activity, this data base has the drawback of providing only a limited sample size. As of June 2008, this database contained only about 4,000 mature investments (Gottschalg 2010a). This would make it difficult to conduct the analyses of drivers over an 80-quarter period and drilling it down to the industry level.

The forth and final kind of data, which has also been chosen for this study, is *fund data*. Probably the most comprehensive data set for the European market is provided by Thomson Reuters in collaboration with the EVCA. The data can be accessed via the Private Equity module of Thomson One Banker to obtain investment data and via the Thomson Reuters' Private Equity Performance database to obtain fund level performance data. The investment data are described in the following section, performance data are portrayed in section 7 of this study.

4.2 Sample Description

The transaction data retrieved from the private equity module of Thomson One Banker covers venture capital and buyout transactions conducted in Europe between 1990 and 2009. During this period, 61,580 private equity transactions were completed.

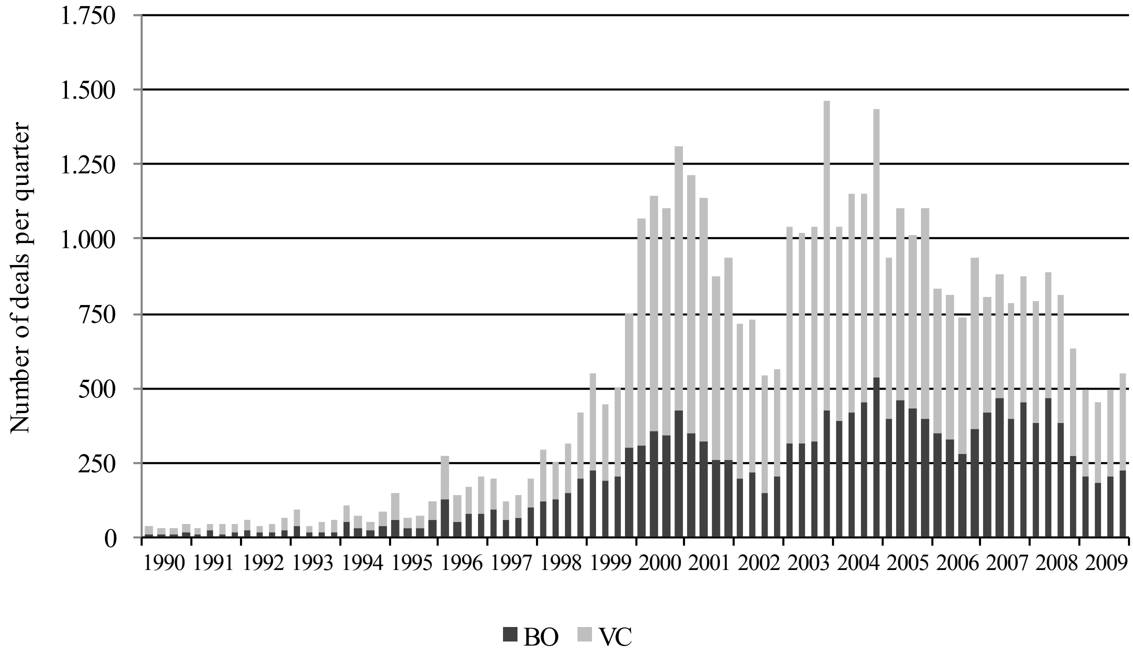

Figure 11: Time Series of Buyout and Venture Capital Investments in Europe

In this data set, each investment by a private equity firm in a target company is counted as one "transaction". This results in a double counting of "club deals" in which multiple investors invest simultaneously in the same target. Consequently, a shift towards syndicated deals would result in an increase in investment activity without establishing any relationship to the postulated hypotheses. This effect is best controlled for by counting parallel investments as only one transaction. Doing so reduces the sample to 40,682 deals under observation. The sample is then split into a buyout (BO) subsample and a venture capital (VC) subsample. As shown in Figure 11, private equity investment activity in Europe experienced significant fluctuations during the 80 quarters of the sample period.

The descriptive statistics presented in Table 2 highlight the characteristics of private equity investment activity in Europe and indicate significant differences between buyout and venture capital activity.

Variable	Number of deals per quarter		
	BO	VC	Total
Observations	80	80	80
Mean	200.5	308.0	508.5
Median	193.0	264.5	463.0
Standard deviation	157.4	264.4	410.7
Minimum	7	17	26
Maximum	529	928	1,397
Total number of deals 1990-2009	16,041	24,641	40,682

Table 2: Descriptive Statistics on Private Equity Investments in Europe, 1990-2009

This table shows descriptive statistics for the number of private equity investments per quarter between 1990 and 2009. Where multiple investors simultaneously acquired the same target company, this is counted as only one transaction event.

Of the 40,682 completed deals, more than 60% were venture capital transactions. 529 private equity transactions were executed on average every quarter. The mean is 10% higher than the median, indicating a slight left skewness of the distribution of the number of deals. However, this skewed distribution of the total number of deals is attributable solely to the venture capital subsample. Whereas the mean and median for the buyout subsample differ only slightly, the median of the venture capital sample is remarkably different to the mean. This means that quarters with below-average venture capital activity were more frequent than quarters with above-average activity. In other words: quarters of booming venture capital activity are comparatively rare, but if they occur, the activity raises to extreme levels. The standard deviation of 411 of the combined sample reflects the high volatility of the deal volume referred to above. This volatility is largely driven by fluctuations in the venture capital subsample, which exhibits a considerably higher standard deviation than the buyout sample.

4.2.1 Deal Activity by Industry

Private equity activity varies not only over time but also across economic sectors (Bernstein et al. 2010). Table 3 shows the distribution of transactions across various industries in terms of the percentage of deals. Differences emerge regarding the dominant industries for buyout and venture investments. While buyouts seem to concentrate on traditional businesses such as industry/energy and consumer products and services, venture capitalists also engage in the industry/energy segment, although they too obviously prefer to target high-tech companies such as software and biotechnology firms. The proportion in the different sectors varies as a function of industry trends. The internet bubble, mirrored by rising deal activity in the late 1990s and a decline in the early 2000s, is clearly discernible. Telecommunications too underwent massive structural changes due to deregulation and the increasing prevalence of mobile phones (European Foundation for the Improvement of Living and Working Conditions 2005). These two trends triggered substantial restructuring activities that had to be financed around the turn of the millennium and resulted in increased deal activity.

Panel A: Percentage of BO Transactions per Industry																				
Industry	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Biotechnology	2	5	5	4	4	3	4	5	4	3	5	5	7	6	6	6	4	4	3	6
Business Products and Services	2	12	11	5	1	10	6	8	7	8	9	8	6	7	8	7	8	8	8	7
Computers and Peripherals	2	-	-	1	1	-	-	1	2	1	1	2	1	1	2	1	1	1	1	1
Consumer Products and Services	20	17	11	20	11	13	13	11	13	11	7	10	12	11	10	12	14	13	12	11
Electronics/Instrumentation	2	-	1	1	1	5	2	1	2	1	1	1	1	3	2	3	2	1	2	1
Financial Services	-	14	10	5	4	3	4	2	3	4	4	3	4	5	5	5	6	6	6	6
Healthcare Services	5	2	1	1	1	5	2	2	2	1	1	2	3	2	3	3	3	3	3	4
Industrial/Energy	41	20	25	27	35	36	34	36	36	31	20	23	28	28	30	29	32	31	30	25
IT Services	5	8	7	4	7	1	2	2	3	4	5	3	4	2	2	2	1	2	2	3
Media and Entertainment	9	7	11	17	8	3	7	8	5	8	12	11	8	7	6	8	7	8	7	8
Medical Devices and Equipment	2	3	2	4	7	2	5	4	1	2	2	2	3	2	3	4	4	3	3	5
Networking and Equipment	-	2	1	1	-	1	-	0	1	1	2	2	2	1	1	1	1	1	1	1
Other	-	2	2	-	1	3	2	2	1	1	1	2	1	5	4	4	2	3	5	3
Retailing/Distribution	5	3	8	5	9	6	9	5	6	5	5	5	5	6	5	5	6	5	7	5
Semiconductors	-	2	1	1	1	3	1	1	1	2	1	1	1	2	1	2	1	1	1	2
Software	5	3	1	4	5	3	5	7	8	11	14	13	8	8	8	8	7	7	6	7
Telecommunications	-	-	1	1	6	4	3	3	5	5	9	8	5	4	4	3	3	4	3	5

Table 3: Percentage of Deals per Industry

This table reports the percentage of transactions per industry for each year from 1990 to 2009

Panel B: Percentage of VC Transactions per Industry																				
Industry	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Biotechnology	10	7	12	9	9	8	9	14	13	7	7	8	12	10	11	13	12	11	11	13
Business Products and Services	2	7	6	5	3	5	4	7	4	6	6	7	5	4	6	6	5	6	6	5
Computers and Peripherals	4	3	2	-	1	2	1	2	2	2	2	1	2	2	2	1	2	1	1	2
Consumer Products and Services	16	7	7	10	9	10	11	6	11	7	4	6	6	7	7	7	7	8	6	6
Electronics/Instrumentation	-	-	2	1	1	3	2	2	3	1	2	2	2	3	3	3	3	2	2	2
Financial Services	-	8	6	3	2	2	4	3	3	3	3	2	3	3	3	3	4	5	3	3
Healthcare Services	1	2	1	1	3	3	2	1	1	2	1	2	2	1	2	2	2	1	2	2
Industrial/Energy	16	21	19	19	26	28	21	22	20	14	9	11	15	19	20	17	20	19	22	19
IT Services	2	7	7	3	5	1	2	2	4	6	8	6	6	3	3	3	2	3	4	4
Media and Entertainment	13	9	10	13	10	7	7	8	4	11	14	11	7	6	6	6	6	9	10	6
Medical Devices and Equipment	10	7	7	10	6	5	7	7	3	3	2	3	3	4	4	6	6	5	4	7
Networking and Equipment	-	1	2	1	-	2	0	1	2	2	2	3	3	2	2	2	2	2	1	1
Other	1	1	2	1	3	3	2	1	1	1	1	1	1	5	3	3	1	2	3	1
Retailing/Distribution	6	5	4	7	7	7	6	2	3	4	4	3	3	4	3	3	3	3	4	3
Semiconductors	2	4	2	4	2	2	1	1	2	2	2	2	4	3	4	3	4	3	3	5
Software	15	9	11	10	7	7	14	17	16	21	21	22	20	18	16	14	15	13	13	15
Telecommunications	1	2	1	2	7	5	5	6	6	9	11	10	8	6	6	6	5	6	6	7

Table 3 (continued)

The various industries experience differences not only in the timing of peaks and slack periods. The volatility of deal activity too varies substantially across the different sectors and between buyouts and venture capital deals. Table 4 summarizes the total and average number of deals per quarter for each industry as well as the standard deviation and mean weighted standard deviation for both subsamples.

In both subsamples, biotechnology, industrial/energy and medical devices and equipment belong to the sectors that exhibit comparatively low volatility in terms of the mean weighted standard deviation of the quarterly number of deal. However, the subsamples differ with regard to the industries with the highest fluctuations in deal activity. While media and entertainment seems to be comparatively stable in the buyout sample, this industry is one of the sectors in which fluctuations of venture capital activity is exceptionally volatile.

	Total no. of deals	Mean	Std. deviation	Mean weighted std. deviation
Panel A: BO transactions				
Biotechnology	793	9.9	9.0	91.1%
Business Products and Services	1,230	15.4	13.1	85.3%
Computers and Peripherals	183	2.3	2.4	106.2%
Consumer Products and Services	1,810	22.6	18.1	79.9%
Electronics/Instrumentation	283	3.5	3.7	103.7%
Financial Services	752	9.4	9.0	95.3%
Healthcare Services	417	5.2	4.9	93.6%
Industrial/Energy	4,608	57.6	45.8	79.5%
IT Services	408	5.1	4.7	92.2%
Media and Entertainment	1,272	15.9	13.4	84.1%
Medical Devices and Equipment	469	5.9	5.2	88.5%
Networking and Equipment	178	2.2	2.5	112.6%
Other	447	5.6	7.0	125.7%
Retailing/Distribution	874	10.9	8.7	80.0%
Semiconductors	220	2.8	2.7	97.6%
Software	1,350	16.9	15.6	92.7%
Telecommunications	747	9.3	9.0	96.1%
Total	16,041	200.5	157.4	78.5%
Panel B: VC transactions				
Biotechnology	2,532	31.7	27.4	86.5%
Business Products and Services	1,348	16.9	16.0	95.2%
Computers and Peripherals	404	5.1	4.8	94.7%
Consumer Products and Services	1,633	20.4	16.8	82.1%
Electronics/Instrumentation	587	7.3	7.9	108.0%
Financial Services	785	9.8	9.1	93.0%
Healthcare Services	417	5.2	4.8	91.9%
Industrial/Energy	4,148	51.9	44.4	85.7%
IT Services	1,075	13.4	16.1	119.7%
Media and Entertainment	2,039	25.5	27.4	107.6%
Medical Devices and Equipment	1,089	13.6	11.5	84.3%
Networking and Equipment	509	6.4	6.8	106.6%
Other	510	6.4	9.2	145.0%
Retailing/Distribution	878	11.0	9.8	88.8%
Semiconductors	736	9.2	8.9	96.7%
Software	4,200	52.5	50.7	96.5%
Telecommunications	1,751	21.9	23.0	105.3%
Total	24,641	308.0	264.4	85.9%

Table 4: Volatility Characteristics per Industry

4.2.2 Deal Activity by Country

Another dimension of variation is the geographical distribution of deals. Table 5 illustrates the share of deals by European countries. The development of the share of deals are remarkably similar for buyouts and venture capital investments. At the beginning of 1990 about half of all deals was conducted in the UK. In the subsequent years a growing number of deals in continental Europe resulted in a decrease of UK's share of transactions to less than 30%. The second biggest market is France, followed by Germany and the Netherlands.

The table features that the individual countries experienced the respective waves with different intensity. For example, Germany's venture capital industry, probably enthused by the creation of the establishment of an IPO exit channel of high tech firms ("Neuer Markt"), even surpassed the French market in 2000 and 2001 in terms of the number of deals conducted. Similarly, French deal activity in 2003 and 2004 exceeded even UK levels for both buyout and venture capital deals.

While the four mentioned countries contribute about 60-70% to the total number deals in European, the remaining countries each exhibit single digit percentage shares of deal activity.

Panel A: Percentage of BO Transactions per Country																				
Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
United Kingdom	48	56	58	46	42	47	47	45	52	45	38	38	39	26	27	28	26	26	26	27
France	20	14	12	12	13	11	16	10	9	13	16	16	16	28	30	17	21	20	15	19
Germany	5	7	2	11	10	8	9	7	8	7	11	10	10	8	9	10	12	12	10	12
Netherlands	-	3	4	5	4	8	5	7	4	6	6	5	5	8	6	6	4	5	4	4
Italy	5	3	5	4	4	2	5	2	3	4	5	4	6	5	5	6	6	5	7	4
Spain	5	2	2	4	1	4	2	5	3	3	4	5	5	3	4	5	6	7	7	6
Sweden	7	5	2	4	5	2	3	3	3	4	3	4	5	3	4	6	6	5	5	7
Finland	7	5	1	4	1	2	2	3	2	3	3	3	3	4	3	5	2	2	3	1
Denmark	2	-	7	1	1	2	2	1	1	3	2	3	2	3	3	2	1	3	2	3
Belgium	-	2	1	-	1	-	2	1	2	2	2	2	2	1	2	2	3	2	1	2
Poland	-	-	-	2	3	5	2	5	5	3	2	2	2	1	1	1	1	1	2	1
Switzerland	-	-	1	1	1	1	0	3	2	2	2	2	2	1	1	1	2	2	2	3
Norway	-	2	1	-	-	-	0	1	0	0	1	1	1	2	1	2	2	2	3	1
Austria	-	-	-	-	-	-	-	1	1	1	1	1	1	1	1	2	1	1	1	1
Ireland	2	-	1	5	2	2	2	1	1	1	2	1	1	1	0	1	1	1	1	1
Portugal	-	2	1	2	5	1	2	-	1	0	0	0	0	1	1	1	1	1	1	1
Others	-	-	-	-	5	4	2	5	4	4	3	2	2	4	2	4	5	7	8	7

Table 5: Percentage of Deals per Country

This table reports the percentage of transactions per industry for each year from 1990 to 2009

Panel B: Percentage of VC Transactions per Country																				
Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
United Kingdom	47	43	52	37	37	33	35	34	32	32	27	26	29	17	19	24	26	29	30	26
France	21	23	18	22	32	28	25	13	10	14	13	14	15	27	29	13	17	18	15	21
Germany	8	8	4	10	10	10	13	13	13	16	18	16	15	6	6	8	10	14	13	13
Netherlands	4	4	3	3	1	6	5	4	4	5	6	3	4	6	5	6	6	4	3	4
Italy	1	5	2	1	2	-	1	2	3	2	3	3	3	1	2	3	3	3	3	2
Spain	4	2	3	3	2	3	2	4	2	3	3	4	4	4	4	4	4	5	7	4
Sweden	1	4	2	3	3	3	2	4	4	5	6	7	6	4	6	10	7	5	7	8
Finland	3	2	-	1	1	2	2	4	3	2	5	5	4	7	4	5	4	2	3	1
Denmark	3	-	4	2	1	2	1	1	2	2	2	3	3	5	5	6	3	2	3	2
Belgium	1	-	1	1	2	-	1	3	4	3	3	3	2	3	3	2	3	3	2	4
Poland	-	-	-	1	1	3	4	4	5	3	2	2	2	2	1	1	1	1	1	1
Switzerland	1	-	1	1	1	1	1	3	4	2	2	3	3	2	2	3	3	3	2	3
Norway	-	-	1	1	-	-	0	1	1	1	1	2	2	4	3	4	2	2	2	2
Austria	-	-	1	1	1	0	0	0	1	2	2	1	1	1	1	2	2	2	1	1
Ireland	1	1	1	2	1	2	2	2	4	3	2	3	5	3	2	3	3	2	2	2
Portugal	1	7	4	8	5	3	1	2	1	1	0	0	1	2	2	2	2	1	1	1
Others	1	1	3	1	1	3	3	6	7	5	5	4	3	5	4	5	5	6	7	4

Table 5 (continued)

4.2.3 Deal Activity by Private Equity Firms' Experience Level

This section is motivated by the much-vaunted pattern whereby increasing deal activity attracts new players to the private equity market, which in turn increases competition among private equity firms and lowers the quality of deals (Jensen 1991; Kaplan and Stein 1993; Kaplan and Schoar 2005; Chew and Kaplan 2007, 2009; Kaplan and Strömberg 2009). Tables 6 and 7 therefore focus on the experience possessed by private equity firms at the time of a transaction. For the purposes of this analysis, the sample considered club deals to be multiple transactions. According to this definition, 61,580 investment events were observed over the sample period, of which 21,836 were buyouts and 39,744 venture capital investments. The median figure for years of experience denotes the number of years since the private equity firm was launched at the time of the transaction. This figure does not support the allegation that private equity peak times are primarily driven by inexperienced newcomers, as it correlates closely with the growing number of deals. Also, the number of buyout firms does not seem to vary with changing demand for private equity services. On the contrary, the number of firms participating in transactions has grown steadily since the beginning of the 1990s. The only exception is 2009, in which year the number of active general partners declined by about a third. However, the number of firms making initial investments also increased almost in proportion to the number of transactions, as indicated by the correlation coefficient of 0.86. Nevertheless, the share of transactions attributable to new firms correlates negatively with the number of deals and is therefore smaller than at the beginning of the 1990s. Consistent with the trend in the median figure for years of experience, this implies that early deals in the 1990s were to a large extent sponsored by relatively young buyout firms, whereas deals effected after the turn of the millennium were increasingly completed by more experienced buyout firms.

These results suggest that increasing private equity activity indeed attracted new players. However, the newcomers' growing investment activity was generally unable to keep pace with the surging business acquired by more established buyout firms. Moreover, it seems that only a very few new entrants were forced to leave the market. Instead, newcomers accumulated more and more experience, as reflected in the increasing median figure for years of experience.

Year	Number of deals	Median years of experience	Number of active firms	Number of new entrants	Deal share of firms with less than 5 years
1990	71	6	32	17	41%
1991	72	7	36	3	36%
1992	98	8	33	3	23%
1993	102	10	44	1	20%
1994	170	9	62	10	30%
1995	204	11	68	4	21%
1996	400	12	95	12	13%
1997	450	14	129	34	15%
1998	793	16	175	57	15%
1999	1,210	16	264	80	16%
2000	2,021	16	370	163	20%
2001	1,665	17	368	98	21%
2002	1,046	19	309	24	20%
2003	1,737	15	403	73	23%
2004	2,428	19	508	85	19%
2005	2,267	19	526	62	15%
2006	1,781	18	525	72	15%
2007	2,278	18	694	122	17%
2008	2,008	18	690	111	19%
2009	1,035	14	430	44	17%
Total	21,836		5,761	1,075	
Average	1,092	14	288	54	21%
Correlation with number of deals	1.00	0.87	0.94	0.86	-0.47

Table 6: Experience Possessed by Buyout Firms

This table provides statistics summarizing the experience of private equity firms from 1990 to 2009. The sample consists of 21,836 buyouts. The median figure for years of experience is taken from all private equity firms that made an investment in a given year and the number of years between the firm's inception and the time of the transaction. It is weighted by the number of investments per firm. The number of active firms represents the total number of private equity firms that made at least one investment in a given period. The number of new entrants refers to all private equity firms with up to one year's experience that made an (initial) investment in a period. The share of deals accounted for by firms with less than five years' experience is calculated as the number of transactions made by firms that have existed for less than five years divided by the total number of transactions.

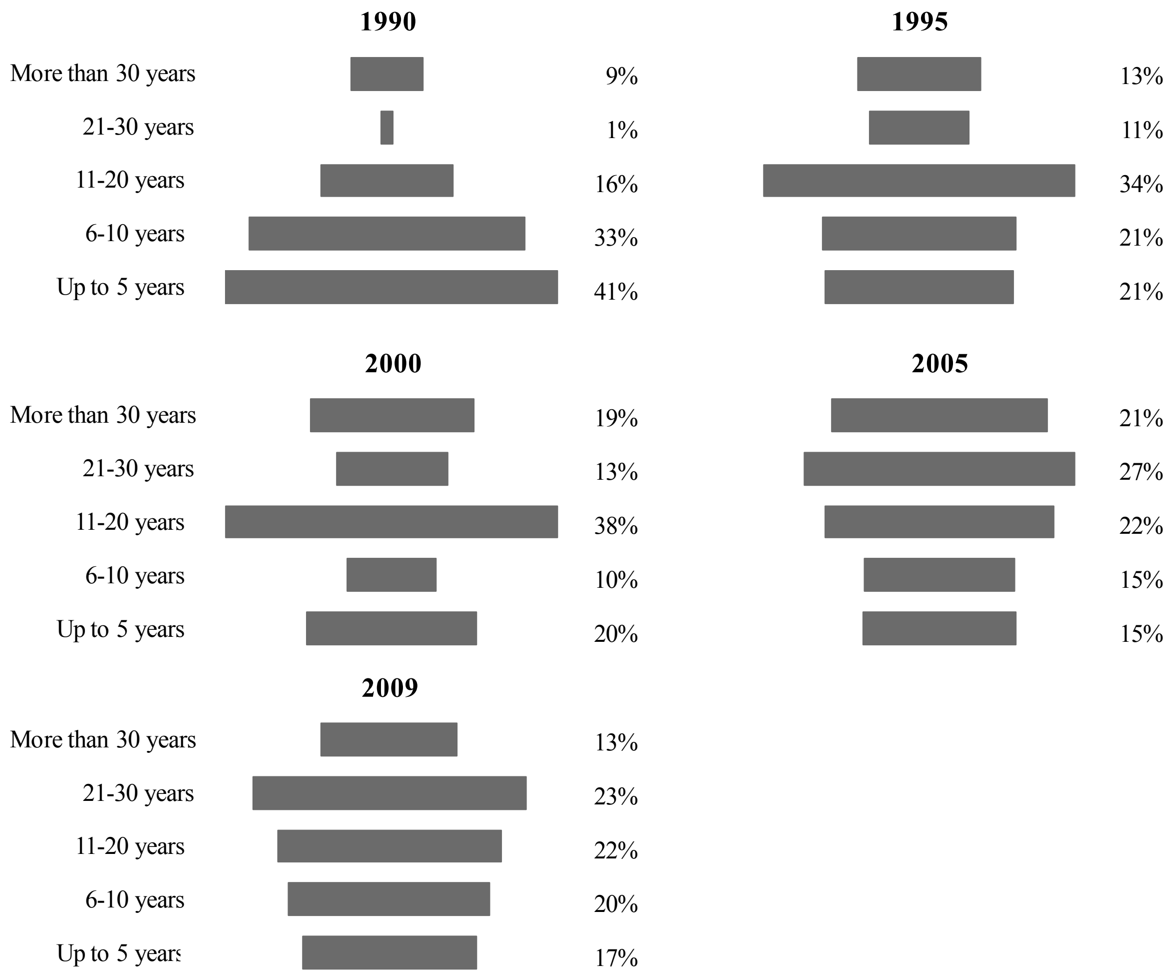

Figure 12: Distribution of Buyout Deals by Sponsor's Years of Experience

Figure 12 highlights the experience distribution of the buyout firms that executed deals in selected years since this asset class was established in Europe. The figure illustrates that the deals of the early 1990s were dominated by young private equity firms. Remarkably, 41% of deals were executed by general partners who had been operating in the business for less than five years. In the ten years that followed, the focal point of deal activity shifted to more experienced buyout companies. In particular, firms with 10 to 20 years' industry experience sponsored the largest proportion of deals in this year. In 2005, the dealmakers were even more mature firms. As a result, only 30% of transactions were carried out by companies with 10 years' experience or less (down from a share of more than 50% in 1990). By 2009, the distribution had been slightly rejuvenated again. However, the majority of deals was executed by firms with more than 10 years' experience.

Year	Number of deals	Median years of experience	Number of active firms	Number of new entrants	Deal share of firms with less than 5 years
1990	119	8	43	9	18%
1991	127	12	42	3	16%
1992	141	12	49	4	4%
1993	174	15	58	2	3%
1994	212	14	80	8	9%
1995	275	18	88	15	12%
1996	541	14	142	23	15%
1997	470	13	185	51	17%
1998	1,001	14	322	123	21%
1999	2,056	12	564	281	24%
2000	5,472	10	1,058	807	26%
2001	4,526	12	987	545	21%
2002	2,572	14	727	117	15%
2003	4,049	13	763	146	8%
2004	4,407	11	812	171	8%
2005	3,657	15	766	85	7%
2006	3,053	18	706	104	7%
2007	2,506	12	773	140	9%
2008	2,455	12	806	99	8%
2009	1,931	13	656	72	7%
Total	39,744		9,627	2,805	
Average	1,987	13	481	140	13%
Correlation with number of deals	1.00	-0.15	0.95	0.75	0.16

Table 7: Experience Possessed by Venture Capital Firms

This table provides statistics summarizing the experience of private equity firms from 1990 to 2009. The sample consists of 39,744 venture investments. The median figure for years of experience is taken from all private equity firms that made an investment in a given year and the number of years between the firm's inception and the time of the transaction. It is weighted by the number of investments per firm. The number of active firms represents the total number of private equity firms that made at least one investment in a given period. The number of new entrants refers to all private equity firms with up to one year's experience that made an (initial) investment in a period. The share of deals accounted for by firms with less than five years' experience is calculated as the number of transactions made by firms that have existed for less than five years divided by the total number of transactions.

The collective experience of venture capital dealmakers reflects a somewhat different development. As shown in Table 7, the median figure for years of experience does not correlate to the growing number of deals. This suggests that the average venture capital firm today has no more years of experience than those that were active in the 1990s. Together with the high correlation between the number of firms and number of deals, this indicates that the number of venture capital firms aligns itself more closely to changing demand for their services in the form of new entries and exits. Unlike buyout firms, whose numeric growth was nearly continuous, the population of active venture capital firms is more volatile. The Internet bubble made 2000 a spectacular year in which more than 5,000 deals were carried out by about a thousand firms, of which 800 had only been in the business for one year or less. However, the majority of transactions where still executed by more experienced companies, as reflected by the 26% share of deals handled by firms with less than five years' experience. The subsequent decline in the number of firms and rise in the median experience suggest that a lot of those firms that joined the fray during the internet bubble and discontinued their activities after the bubble burst.

Interestingly, the average share of deals handled by venture capital firms with less than five years' experience (13%) is less than that for young buyout firms. This finding is consistent with a commonly acknowledged difference between the two asset classes. Buyout firms often specialize in deals of a certain size. Deals worth billions of euros are typically entrusted to well-established firms with a solid reputation and an impressive track record. These firms however, generally do not engage in small deals worth no more than a few million euros, say. The fact that such low-cap deals are usually targeted by younger private equity firms increases the probability that less well-established firms will be able to build a track record too. Alternatively stated, there is deal segment that will be almost mainly sponsored by less established buyout firms. Venture capital investments, however, tend to be small by nature. In this segment, therefore, the size criterion does not necessarily exclude more established firms from competing for small deals. Conversely, that makes it more difficult for inexperienced companies to gain market share. Figure 13 illustrates this pattern in comparison to the distribution of buyouts in Figure 12. While the distribution for buyouts shifts increasingly toward greater experience, no such trend is observable for venture capital deals.

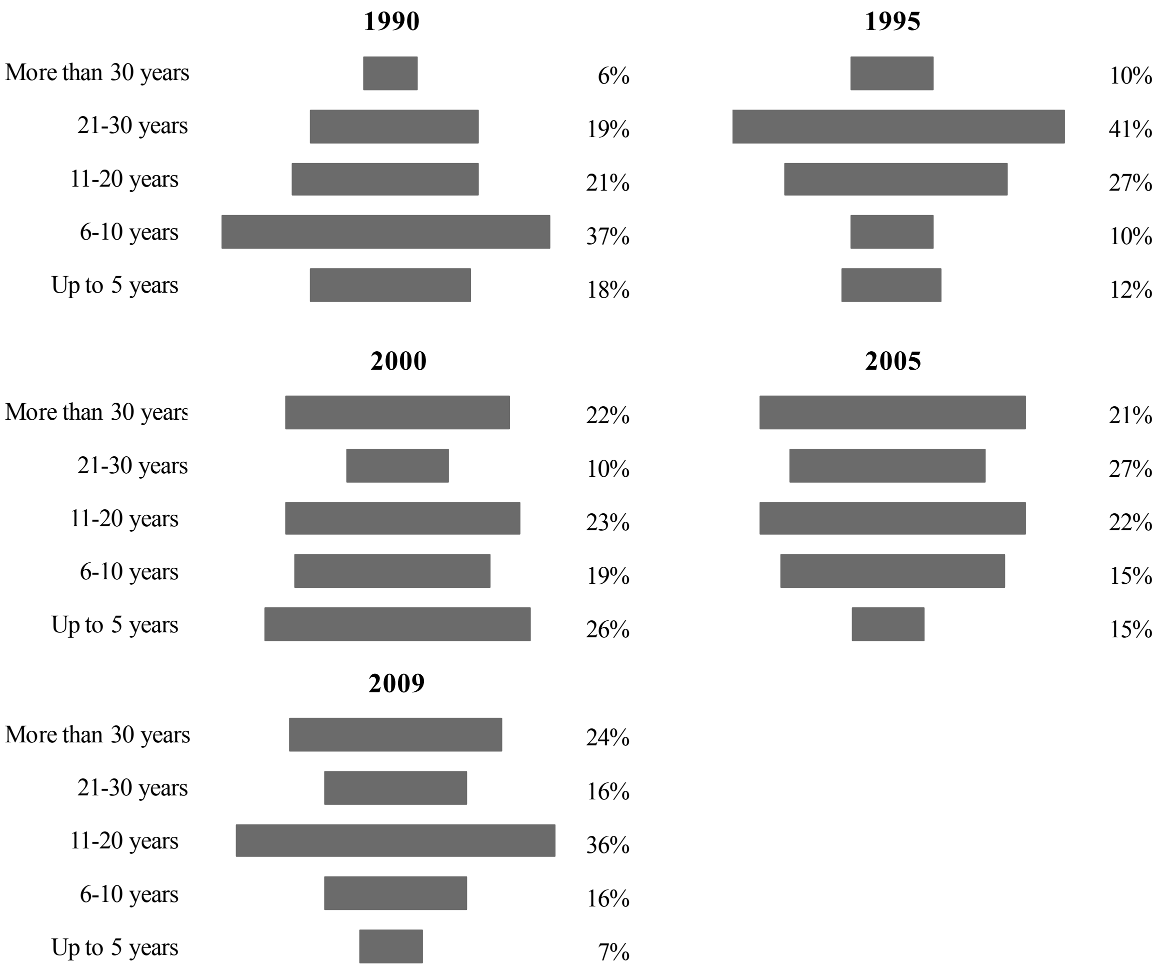

Figure 13: Distribution of Venture Capital Deals by Sponsor's Years of Experience

Overall, the results suggest that the venture capital industry is more volatile with respect to both the number and composition of market participants. Whereas the buyout industry seems to have grown more or less steadily, with average experience levels increasing along the way, venture capitalists seem exposed to greater fluctuation – probably due to more entries and exists in this asset class.

4.2.4 Volume Characteristics

So far, deal activity has been defined solely in terms of the number of deals. While it would naturally also be very interesting to use the deal volume denoted in euro amounts as an alternative, or even as the main measure of investment activity, concerns about data quality necessitate caution in the use of this approach. In particular, plausibility checks of deal volume in Euro amounts in the Thomson data suggests that severe measurement errors are included in the data (examples will be provided in the following). The data quality in this regard appears too poor to base statistic work on it.

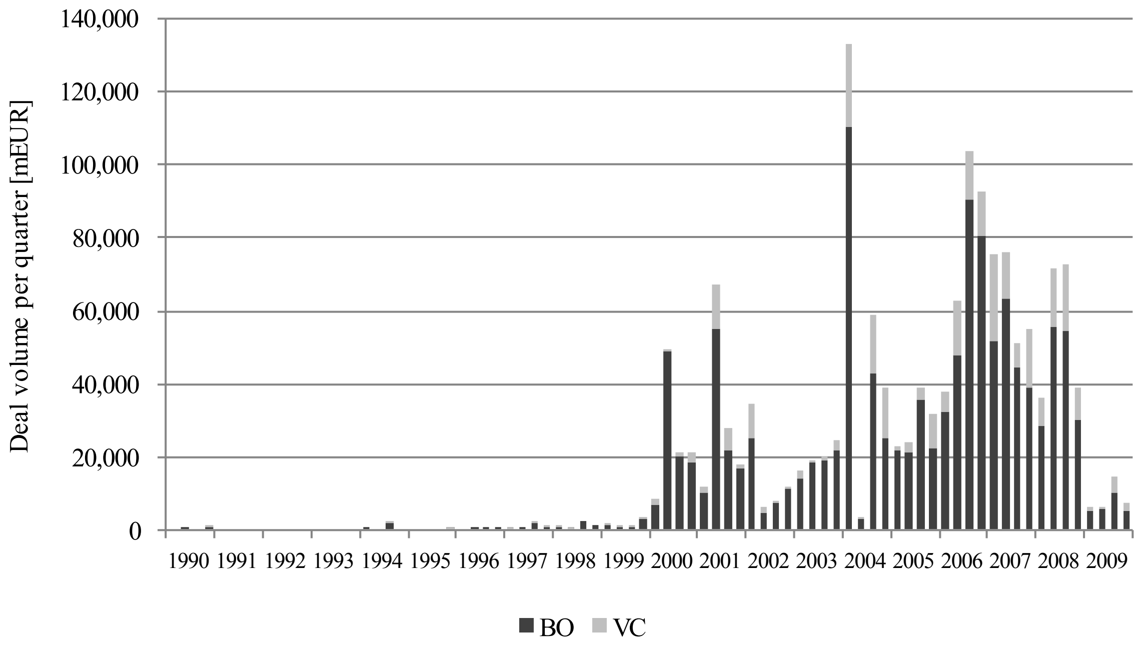

Figure 14: Deal Volume per Quarter

Figure 14 illustrates that the documentation of significant deal volumes in the Thomson data base started with the busy years that followed 2000. For the years prior to 2000, the database contains less than 150 deals with a reported deal volume. Some of the biggest transactions have been checked for data consistency (with inadequate results) regarding the estimated deal volume. For example, in 2003 the biggest transaction in terms of deal value was the acquisition of British vehicle information provider HPI by Phoenix equity for no less than EUR 9,971 million. That would have ranked as the top deal in what was generally a sluggish year. A news research from Factiva reveals that the press reported acquisition volumes of GBP 31 million (EUR

45 million) (Meehan 2003 and Herman 2004), while the acquirer itself claimed to have spent GBP 70 m (Phoenix Equity 2003). Assuming that a figure in the tens of millions of euros is in fact correct, the deal value in the database is overvalued by a factor of at least 100. An example of even poorer data quality is the management buy-in of HSS, backed by 3i, in 2004. The seller announced via RNS (the corporate news service operated by the London Stock Exchange), that it had sold the company for GBP 145 million (Davis Service Group 2004), which is consistent with press coverage (Treanor 2003). However, the deal is valued at EUR 20,380 million in the Thomson private equity database. Worse still, the entry exists three times in the same database.[1] Upon request of the author, these erroneous entries have been corrected by Thomson Reuters in the data base. However, no statement regarding the overall reliability of the volume information or systemic data errors could be obtained from Thomson Reuters.

Other details, such as the names and locations of the selling and buying companies and the approximate deal dates, have not been found to be incorrect. Nevertheless, the data on transaction values appears too unreliable for use in scientific research. Even so, Table 8 summarizes the deal volumes provided in the Thomson One Banker private equity module. For the buyout sample, coverage of deal values increases significantly as of the turn of the century and has come close to 30% of total deals in recent years. The mean deal volume in 2004 seems to have been inflated by the fact that the HSS transaction was counted three times over (see above).

For the venture capital sample, coverage of deal volume information is even worse than for buyouts. Also, mean deal sizes appear surprisingly close to buyout deal values, although the latter are commonly perceived to be larger than venture capital investments. Notwithstanding, triple-digit average amounts for each round of financing seem unrealistic and contrast with the findings of Gompers (2004), who reports the amounts invested in US venture capital deals from the 1960s to the 1990s.

Unfortunately, it appears that reported deal values suffer from two severe limitations. First, there are too few of them relative to the whole sample. Second, what little

[1] The number of deals variable is unaffected by such duplication, since any simultaneous investments by several private equity firms on the same date in the same target company have been counted as only one investment event.

information there is contains critical inconsistencies, in particular for high-value transactions, as illustrated above.

Year	BO			VC		
	Number of deals	% of deal values available	Mean deal size [mEUR]	Number of deals	% of deal values available	Mean deal size [mEUR]
1990	71	13%	69	119	1%	116
1991	72	0%	-	127	0%	-
1992	98	0%	-	141	0%	-
1993	102	0%	-	174	0%	-
1994	170	5%	214	212	1%	29
1995	204	0%	4	275	0%	4
1996	400	2%	54	541	0%	-
1997	450	3%	188	470	1%	32
1998	793	5%	109	1,001	0%	165
1999	1,210	4%	133	2,056	0%	42
2000	2,021	14%	336	5,472	1%	108
2001	1,665	15%	413	4,526	1%	348
2002	1,046	20%	232	2,572	3%	170
2003	1,737	15%	276	4,049	2%	100
2004	2,428	12%	608	4,407	2%	575
2005	2,267	19%	234	3,657	3%	165
2006	1,781	26%	547	3,053	5%	321
2007	2,278	30%	294	2,506	10%	234
2008	2,008	34%	247	2,455	10%	204
2009	1,035	28%	91	1,931	5%	77
Total	21,836	18%	318	39,744	10%	230

Table 8: Volume Characteristics of Private Equity Investments

This table summarizes deal volume data for venture capital and buyout investments between 1990 and 2009. The number of deals is comprises all entries in the Thomson One Banker database, including the double counting of club deals and potentially erroneous duplicates.

For experimental purposes, some of the analyses conducted in this study on the basis of the number of deals have also been replicated with the deal volume in Euro amounts provided in the Thomson data base. However, those regressions have led to sometimes obscure results and a severe loss of significance when compared to the other results based on the number of deals. To illustrate this point, Table 73 and Table 74 in Appendix 10.3 report Newey-West regressions of neoclassical models of buyouts and venture investments with deal volume in Euro amounts as dependent variables. Compared to the equivalent analyses with the number of deals as dependent variables in Table 31 and Table 35 in section 5.5, significance is considerably reduced. In addition, the low explanatory power signified by the adjusted R^2 of the respective models document that the models poorly explain the deal activity measured in Euro amounts. This divergence of results is, however, predictable as the volume times series include severe measurement errors as well as implausible and missing values. For that reason, the analyses of this study focus on the deal activity in terms of the number of transactions.

4.3 Methodology

4.3.1 Research Approach

To address the question "Why do private equity investments fluctuate so much?", one has to decide between two alternative approaches. First, in a qualitative research design, case studies or surveys of private equity firms could be conducted to investigate the drivers of investment activity – i.e. the fund managers – at source. Second, in a quantitative research design, investments could be studied ex-post through time-series analysis of transaction data using proxies for the postulated drivers.

For several reasons, this dissertation strongly argues in favor of the quantitative approach. Qualitative research design is commonly related to theory generation in relatively immature research areas (Punch 2005, p. 235). However, initial hypotheses have already been formulated for the research question concerning private equity cycles and must now be validated. This exercise is usually associated with quantitative research design. Moreover, qualitative research poses several problems with regard to the study design. First, asking fund managers to name the drivers of their investment behavior in interviews or surveys could expose the study findings to cognitive biases, as human behavior is often subject to a discrepancy between intention and actual behavior (Ajzen 1985, p. 12). This discrepancy has been found in the behavior of private individuals (Tobin 1959, p. 10) as well as that of entrepreneurs or corporate managers (Väre, Weiss and Pietola 2005, p. 1). To put that another way: "If you ask a hypothetical question, you get a hypothetical answer" (Hyman 1981, p. 99). For the purposes of the research question, this means that asking investment professionals about the reasons for their investment decisions will probably lead to copybook answers along the lines of "maximizing net present value". However, theory and practice may well diverge when unpredictable circumstances such as the global credit crunch arise. A further consideration is that, while arguing about optimal investment decisions and the logical reasoning behind investment conditions may provide compelling reading. However, actually realizing transactions can be more difficult than assumed. This may result in investment behavior that differs from the usual perceptions and the answers that would be given in surveys or interviews.

Second, studying private equity waves as a research object takes a macro-level view of the topic that contrasts with the decision-making perspective of fund managers. Potential interview partners and survey respondents at private equity firms build their investment decisions primarily on the micro-level, i.e. based on an individual evaluation of single target companies.

Third, as agency problems resulting from misaligned objectives between private equity firms and investors are postulated to impact deal activity, this issue can be better addressed with an unobtrusive data collection method. In particular, if deal activity is to some extent driven by private equity firms pursuing other interests than return maximization, this would be hardly revealed in interviews, let alone in questionnaires.

Fourth, surveys of private equity firms typically exhibit poor response rates, as the industry is known for its restrictive information policy (Povaly 2007, p. 9). This problem is exacerbated by the fact that the private equity market is very heterogeneous in terms of investment strategies and profiles (Munari et al. 2006). The latter concern also raises the issue of external validity. Any research design exhibits an inherent trade-off between the internal and external validity of the research methodology (Sekaran and Bougie 2010, p. 149). While "internal validity" refers to the logical correctness of the assumed cause-effect relationship (Gibbert, Ruigrok and Wicki 2008) and to which extent the correlation between variables can be correctly interpreted (Punch 2005, p. 254), "external validity" is concerned with the generalizability of research results (Gibbert et al. 2008). For the proposed research methodology, the author decided to give precedence to external validity at the expense of internal validity by using a quantitative research design that analyzes a large sample of transactions. The resultant weakness in internal validity stems in particular from the fact that the intended analysis relies to a large extent on time-series regression to investigate a cause-effect relationship. While regressions are an appropriate tool to establish correlation between two or more variables (Hair, Black, Babin and Anderson 2009), the statistical significance of the regression model alone does not necessarily imply causality (Gujarati and Porter 2009, p. 22).

Moreover, the use of proxies threatens construct validity. Construct validity refers to the operationalization of hypotheses, e.g. the appropriateness of the study design. This means in particular whether the study is actually measuring what it claims to measure (Gibbert et al. 2008). The proxies used in the statistical tests may be imperfect indicators of the postulated drivers. This issue is addressed by the use of alternative proxies and by referring to proxies commonly used in finance literature.

4.3.2 Research Design

4.3.2.1 *Research Model*

Building a research model complements the research design by assigning appropriate statistical methods to the causative relationships under investigation. Figure 15 illustrates that the research designs implies different analyses at the aggregate level and at industry level.

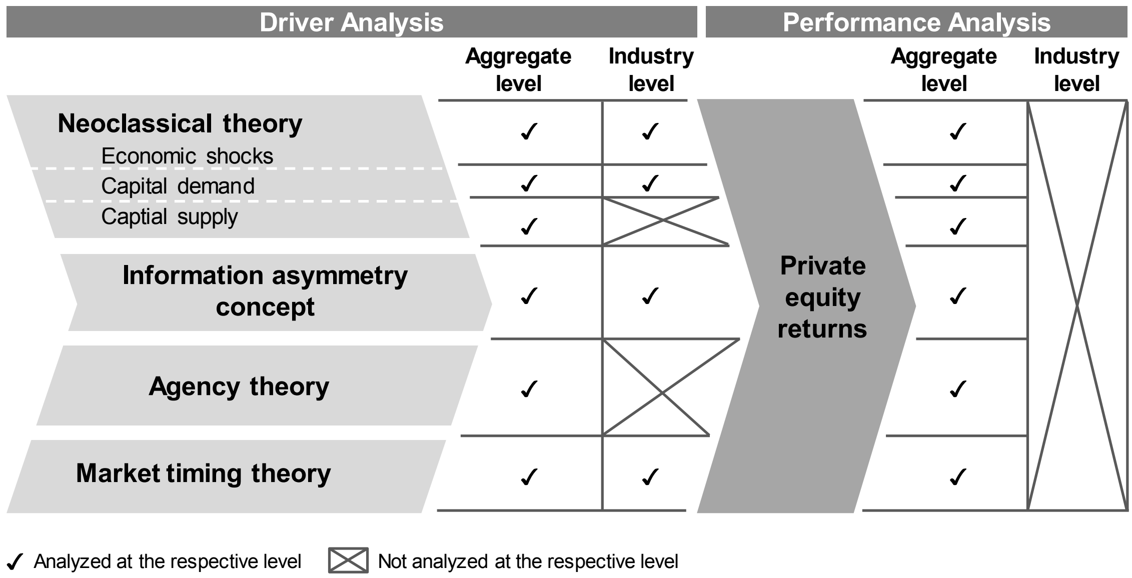

Figure 15: Research Model

At the aggregate level, all four competing theoretical perspectives are investigated with their respective drivers. At industry level, only those drivers are examined that are supposed to be subject to considerable industry dynamics. For example, economic shocks and capital demand have been found to be subject to industry specific cycles and to drive merger activity at industry level (Mitchell and Mulherin 1996; Harford 2005; Bartholdy et al. 2009) and IPOs waves (Lowry 2003). Along similar lines, there is also evidence for industry dynamics of information asymmetries (Autore and Kovacs 2009) and valuation levels (Harford 2005; Alti 2006) which might be associated with market timing opportunities.

However, capital supply which is provided as debt or fund liquidity is rarely earmarked for particular industries. Although this is occasionally done in funds with a particular industry focus or banks may avoid particular cyclical industries in certain stages of the business cycle, there are no long horizon time series that could serve as measures of capital supply to particular industries. For the agency theoretical aspects, it does not make sense either to assume industry specific effects, since it is hardly imaginable that particular industries should provide more opportunities for private equity firms to take advantage from overinvestment.

Finally, the performance analysis is conducted on aggregate level only, as performance data is only available at fund level.

4.3.2.2 *Operationalization*

Building on the theoretical framework and the research model, operationalization links the theoretical concepts to data (Punch 2005). The postulated causative relationships have to be translated into three kinds of measurable variables as shown in Figure 16.

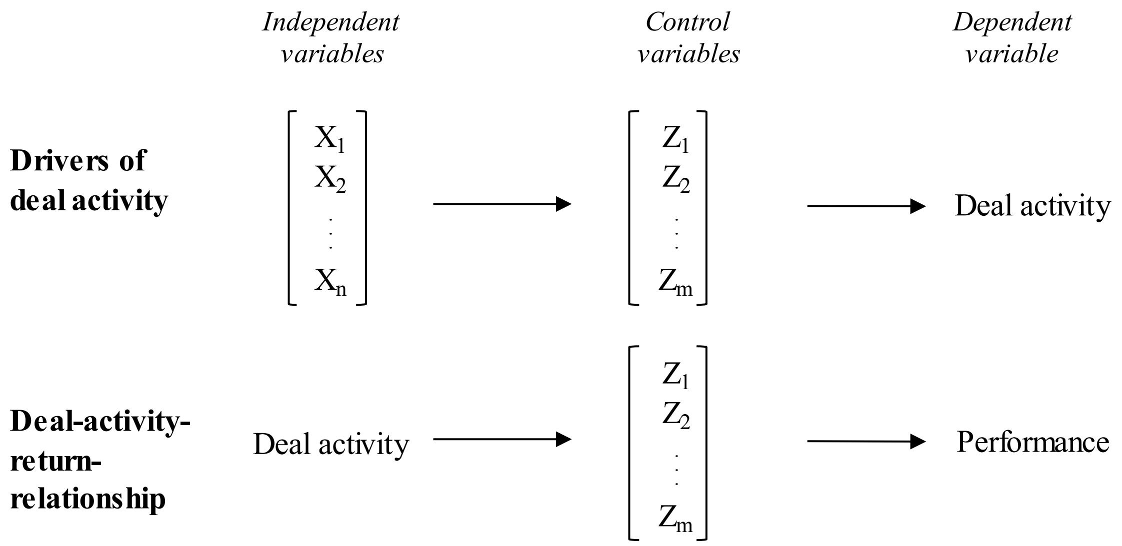

Figure 16: Overview of Variables to Be Included in the Research Model

First, dependent variables denote the outcome variable of the investigated relationship (Punch 2005, p. 47), in particular deal activity and performance. Deal activity is measured mainly in terms of the number of transactions. In light of concerns about data reliability, it is only rarely measured in euro amounts for transaction values within a given period. The period defined is typically a quarter, although some analyses rely on annual data. For the second research focus – the investigation of performance in relation to deal activity – the dependent variables are vintage IRRs and excess vintage IRRs using listed European stocks as performance benchmark.

Second, the independent variables are the supposed drivers of deal activity while, for the investigation of performance, deal activity itself is the independent variable. Since most drivers cannot be observed directly, proxies have to be constructed (Wooldridge 2006). For example, it seems reasonable to assume that positive "economic conditions" will on the one hand stimulate the capital demand of target companies to realize projects with a positive NPV. On the other hand, positive "economic conditions" will also increase the attractiveness of target companies from the perspective of private equity firms. In this setting, gross domestic product (GDP) may serve as a proxy for the "economic conditions" (Deb and Mukherjee 2008) that are likely to be a major but unobservable force in private equity deals. The proper design of proxies is a key aspect of operationalization. Since proxies are by nature imperfect measures of independent variables, the study employs alternative proxies in most of the analyses. This policy is even more important given that some proxies are used for divergent purposes in academic literature.

Third, control variables are included in the model to take account of aspects that are supposed to have an impact on deal activity but are of no particular interest within the conceptual framework (Kleinbaum 1998, p. 12; Creswell 2008). Since the study does not focus on any particular set of drivers but rather tries to incorporate a broad driver model, any variable that is believed to affect deal activity is of primary interest and is thus regarded as an independent variable. Accordingly, control variables are rarely used. They are, however, included to control for trivial timing effects. To control for the clustering of transactions in a particular quarter, for example, quarter dummy variables are used in some of the regressions.

4.3.2.3 *Analysis*

The respective types of statistical tests are mainly determined by the fact that deal activity is a non-stationary and highly persistent time series. A detailed analysis of this pattern is provided in paragraph 5.2.

These time series characteristics disqualify the use of ordinary least squares (OLS) regressions which are otherwise an appropriate method to investigate cause-effect relationships between several variables (Waters 1998). However, in the presence of a consistent and non-stationary dependent variable the error terms in regression models are most likely to suffer from serial correlation, which results in inflated test statistics and thus leads to biased inference.

There are in principle three ways to address the problem of non-stationarity. First, the time series can be transformed into a stationary time series. Ordinary least squares (OLS) regressions can then be applied (Hamilton 1994). Transformation can be done by using first-order differences or by deflating the number of deals by observations from the previous quarter (Kirchgässner and Wolters 2007). However, this methodology has the disadvantage that valuable time series information is lost (Kennedy 1998).

The second alternative is to apply models that do not use the non-stationary time series as a dependent variable. This can be done by transforming deal activity into a binary variable that equals one if the corresponding time interval marks the beginning of a wave period and zero if it does not. Rank or logit models that are unaffected by the time series characteristics of deal activity can then be applied. This approach is adopted for the industry level analysis.

The third option is to employ procedures that produce unbiased results in the analysis of non-stationary time series. The methods applied in this thesis include the use of robust standard errors, cointegration models, weighted least squares (WLS) and feasible least squares (FGLS) regressions for the aggregate level analysis.

The statistical approaches for the industry level and aggregate level differ for the following reasons: For rank and logit models as employed in this thesis, the relevant observations are the occurrence of waves in 18 industries not the number of transactions. This approach leads to 24 observations as basis for the respective dependent variables in each test setting for each subsample. However, for the aggregate level, this method would result in only two observations, which does not allow to apply statistical tests. Consequently, rank and logit models are only applied on industry level.

On the other hand, time series regressions are only applied on aggregate level since the regressions are conducted on quarterly level with non-industry specific time series that are mostly largely available on quarterly level for long time horizons. The industry specific proxy data such as performance data, growth rates and other KPIs are only available on yearly level for a time periods of 20 years.

The cited methodologies are used to investigate the drivers of deal activity by testing hypotheses about various cause-effect-relationships that are each derived from competing theoretical viewpoints. Investigating the activity-performance relationship using robust time-series regressions validates the robustness of the activity analysis, as each of the competing theoretical perspectives has a specific return implication.

5 Empirical Part I: Drivers at Aggregate Level

5.1 Introduction

The aggregate analysis uses time series regressions to tackle the research question with the number of deals as dependent variable and proxies for potential drivers as independent variables. First, in order to determine legitimate statistical tests, the time series characteristics of the dependent variables is analyzed in section 5.2. Then, hypotheses are formulated and proxies are developed in section 5.3. This is followed by univariate and multivariate time series regression in sections 5.4 and 5.5. Finally, the results are summarized in section 5.6.

5.2 Time Series Characteristics of Deal Activity

5.2.1 Introduction

Economic time series tend to depend on their own history and often trend upward (Baltagi 2008, p. 365), which usually implies that they are non-stationary. This causes the most severe problems in handling and analyzing time series data. Granger and Newbold (1974) showed that OLS regressions of independent non-stationary variables often produce statistics that lead to an erroneous rejection of the null hypothesis – a phenomenon, called "spurious regressions" (Stewart 2011). A similar demonstration of the problem was later provided by (Davidson and MacKinnon 1993). The central limit theorem used in OLS requires time series to be stationary and weakly dependent (Wooldridge 2006, p. 379), otherwise regression equations are likely to be positively autocorrelated. This results in an underestimation of the variances of the regression parameters and, therefore, in an overestimation of the *F* and *t* statistics (Cochrane and Orcutt 1994; Hjalmarsson 2008). As a consequence investigated relationships between two or more time series may appear significant just because each of them is growing without any cause-effect relationship between them. Hence, caution and a precise understanding of the statistical attributes of the data are vital when applying econometrical methods to time series.

5.2.2 Time Series Diagnostics

This section aims to investigate the time series characteristics of deal activity to legitimate the proper use of the statistical test conducted thereafter. This is done in five steps: First, an autoregressive (AR) model is formulated for the dependent variables. Second, the time series are tested for autocorrelation. Third, the model is specified by determining the order of autocorrelation and coefficients of the autoregressive model. Forth, the time series are tested for stationarity. Fifth, the time series are tested for conditional heteroskedasticity and the model is completed to an autoregressive heteroskedasticity (ARCH) model.

5.2.2.1 *The Autoregressive Model*

In this study, private equity activity has been characterized by two main features: First, deal activity follows a wave pattern and, second, it generally grows in magnitude (see Figure 11, p.65 and descriptive statistics provide in section 4.2) These two aspects can be translated into a model as follows: A wave generally implies a certain persistence over time, which can be described by an autoregressive (AR) process. Increasing activity over time suggests that a deterministic or stochastic time trend will be found in the data, which is the reason for the problems with OLS procedures.

Therefore, let Y_t be the number of deals in period t. A pth-order autoregression, denoted as AR(p), is then specified by the following model (Hamilton 1994):

$$Y_t = c + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \cdots + \phi_p Y_{t-p} + \varepsilon_t, \qquad t = 1, 2, \ldots, \tag{1}$$

where c and φ_i, i =1…p are constants and $\{\varepsilon_t\}$ is an independent and identically distributed (i.i.d.) white noise sequence with a mean of zero and a variance of σ^2.

Let us further assume that the time series are integrated of order one (I(1)), e.g. that they are non-stationary, with the consequence that the asymptotic standard normal distribution for the t statistic does not apply, even for large samples (Wooldridge 2006, p. 631). The postulated statistical characteristics are investigated in the section below. In particular, analyses serve to clarify whether the time series of buyout and venture capital transactions are AR(1) processes and whether the conditions of OLS regressions – stationarity and weak dependence – are violated.

5.2.2.2 *Autocorrelation*

Table 9 provides the autocorrelation coefficients of the first six lags in the time series. The first order gives an initial rough indication of whether the time series are either weakly dependent or highly persistent. If this value exceeds 0.8, this indicates that the time series is highly persistent (Wooldridge 2006, p. 394).

	Lag					
	1	2	3	4	5	6
BO	0.9439	0.9014	0.8444	0.7974	-0.7279	0.6842
VC	0.9152	0.8760	0.8144	0.7721	0.6778	0.6289

Table 9: Autocorrelation Coefficients of the Times Series

This table presents autocorrelations of the number of deals variables from the first to the sixth lag. BO and VC refer to the time series of the quarterly number of buyout transacations and venture capital investments, respectively.

As the first order autocorrelations exceed this critical value and the coefficients remain high for several lags, persistence seems more than likely and will be investigated in more detail later. In addition, the high autocorrelation in the initial lags also supports the view that the time series are autoregressive processes.

5.2.2.3 *Model Specification*

Specifying the autoregressive models requires two steps: First, the lag length for the autoregression must be selected. Second, the parameters must be estimated. The first step can be done using the *F* statistic approach, as proposed by Stock and Watson (2007, p. 549). This procedure starts with an estimate of the maximum number of lags, such as p. AR(p) is then estimated as in equation (1), but with p lags instead of only one. If the coefficient on the pth lag is not significant, it is dropped and AR(p-1) will be estimated; and so forth. As the time series are assumed to be non-stationary, estimates of parameters that are based on OLS are likely to be biased. Nevertheless, since the bias is of the kind that inflates test statistics, OLS can still be used to rule out insignificant lags.

Table 10 lists the estimated parameters. Following the *F* statistic approach (Stock and Watson 2007, p. 549), models with seven lags are estimated in row one. From rows two to seven, the number of variables is reduced stepwise in each model. In row eight, all lagged variables are combined that have been significant at the 10% level in all previous regressions, i.e. the first and seventh lagged variables for both the buyout and venture capital sample.

The models are all highly significant, as suggested by the high *F* statistics. The adjusted R^2 exceeds 90% in all buyout models and is well over 80% in the venture capital activity models. However, only the first lagged variable is robust in respect of various combinations with other lagged variables. The fifth lagged variable is significant at least at the 10% level in models one to three. When combined with the first lagged variable, however, its significance disappears. Hence, with the exception of the coefficient for the first lagged variable, the null hypothesis that the parameters are different from zero has to be rejected.

Panel A: BO transactions								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	12.515	12.647	13.740	13.006	13.227	12.751	13.353	14.261
BO_{t-1}	0.896 ***	0.910 ***	0.857 ***	0.849 ***	0.842 ***	0.822 ***	0.946 ***	0.999 ***
BO_{t-2}	0.188	0.153	0.201	0.244	0.255 *	0.128		
BO_{t-3}	-0.128	-0.110	-0.130	-0.190	-0.152			
BO_{t-4}	0.177	0.176	0.234	0.044				
BO_{t-5}	-0.430 ***	-0.408 ***	-0.222 *					-0.061
BO_{t-6}	0.163	0.230 **						
BO_{t-7}	0.089							
F-statistic	121.5 ***	142.7 ***	164.9 ***	194.9 ***	166.9 ***	396.2 ***	786.1 ***	393.6 ***
Adjusted R^2	91.4%	91.5%	91.2%	90.9%	90.9%	90.9%	90.9%	90.9%
Panel B: VC transactions								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	24.025	25.996	27.439	24.439	25.015	24.183	29.067 *	31.427 *
VC_{t-1}	0.722 ***	0.737 ***	0.705 ***	0.692 ***	0.686 ***	0.664 ***	0.916 ***	0.968 ***
VC_{t-2}	0.313 **	0.247 *	0.274 **	0.310 **	0.326 **	0.271		
VC_{t-3}	-0.051	-0.009	-0.009	-0.114	-0.081			
VC_{t-4}	0.253 *	0.253 *	0.280 **	0.047				
VC_{t-5}	-0.440 ***	-0.398 ***	-0.331 ***					-0.062
VC_{t-6}	-0.027	0.094						
VC_{t-7}	0.164							
F-statistic	77.8 ***	89.3 ***	107.5 ***	119.1 ***	160.5 ***	242.1 ***	448.1 ***	223.7 ***
Adjusted R^2	94.6%	95.3%	87.1%	85.7%	85.8%	85.9%	85.0%	84.9%

***; **; * Significance at the 1%, 5%, and 10% levels in two-sided significance tests

Table 10: Parameter Estimation for Autoregressions

Since the parameter for the first lagged variable was estimated using OLS, the significance may be biased, given that non-stationarity is assumed for the time series. Therefore, the OLS standard errors are corrected using the Newey-West method (Gujarati and Porter 2009; Newey and West 1987). This estimation approach is used to try to overcome autocorrelation and heteroskedasticity in the error terms of regression models. The results are presented in Table 11.

		OLS				Newey-West			
	Coefficient	Std. error	t-statistic	*p*-value	F-statistic	Std. error	t-statistic	*p*-value	F-statistic
Panel A: BO transactions									
Intercept	13.353	8.536	1.560	0.122		5.617	2.380	0.020	
BO_{t-1}	0.946	0.034	28.040	0.000		0.038	25.110	0.000	
					786.1				630.4
Panel B: VC transactions									
Intercept	29.067	17.461	1.660	0.100		11.600	2.510	0.014	
VC_{t-1}	0.916	0.043	21.170	0.000		0.057	16.060	0.000	
					448.1				258.1

Table 11: OLS versus Newey-West Standard Errors in First-Order Autoregressions

The dependent variable is the number of buyout deals per quarter in Panel A and the number of venture capital deals per quarter in Panel B. Autoregressions are run with one lag.

Although the Newey-West standard errors for the coefficients of the lagged variables are higher than in the OLS regressions, significance at the 1% level remains unchanged. Even the intercepts that were not significantly different from zero in the OLS regression are now significant.

The results of an alternative estimation approach, following Prais and Winsten (1954) and using feasible generalized least squares (FGLS) as suggested by Greene (2000, p. 546), are presented in Table 12. This approach has the advantage that the standard errors are corrected for heteroskedasticity and autocorrelation (Verbeek 2008, p. 100).

	BO	VC
Intercept	11.300	18.926
	(0.136)	(0.156)
BO_{t-1}	0.956 ***	
	(0.000)	
VC_{t-1}		0.949 ***
		(0.000)
F-statistic	1,043.1 ***	839.5
Adjusted R^2	93%	91%

***; **; * Significance at the 1%, 5%, and 10% levels in two-sided significance tests

Table 12: Prais-Winsten AR(1) Regressions

This table provides regression results for the AR(1) parameter estimation using the Prais-Winsten estimator, where the number of deals is regressed by one quarter over its lagged time series.

The parameter estimates do not differ substantially from the estimates in Table 12, the intercepts, however, require further attention as their p values suggest that they are not significantly different from zero in all regressions. In particular, the coefficients seem to be highly dependent on the estimation method used. However, to follow the more conservative approach, the intercepts are omitted in the first-order autoregressive models (AR(1)), which can now be specified as follows:

$$BO_t = \ 0.956\, BO_{t-1} + \varepsilon_t, \qquad t = 1, 2, \ldots, \tag{2}$$

$$VC_t = \ 0.949\, VC_{t-1} + \varepsilon_t, \qquad t = 1, 2, \ldots, \tag{3}$$

Since the coefficients are close to one, further evidence for the existence of a time trend is indicated which will be analyzed in more detail in the section below.

5.2.2.4 *Stationarity*

Stationarity and weak dependence are vital characteristics of time series to ensure that OLS estimates are efficient and unbiased (Wooldridge 2006, p. 400). The high autocorrelation coefficients in Table 9 and the first-order autoregression coefficients in Table 10 and Table 11 have already given some indication of non-stationarity. Indeed, the estimated parameters in equations (2) and (3) are indistinguishable from one, as illustrated by Table 13.

	Coefficient	OLS			Newey-West		
		Std. error	t-statistic	p-value	Std. error	t-statistic	p-value
Panel A: BO transactions							
Intercept	13.353	8.536	1.447	0.152	5.617	2.199	0.031
BO_{t-1}	0.946	0.034	-1.611	0.112	0.038	-1.445	0.152
Panel B: VC transactions							
Intercept	29.067	8.536	1.607	0.112	11.600	2.420	0.018
VC_{t-1}	0.916	0.034	-1.941	0.056	0.057	-1.473	0.145

Table 13: Tests of Estimated Parameters based on the Null Hypothesis that Parameters are Different from One

This table refers to the results of Table 11, in which the parameter estimates and corresponding statistics are presented. While the t statistics in Table 11 refer to the standard test (i.e. whether the parameters are different from zero), the t statistics and p values in this table test the null hypothesis that the parameters are different from one. The t statistics are therefore calculated as follows: $t = \frac{\varphi-1}{SE(\varphi)}$, where φ is the estimated parameter and $SE(\varphi)$ is the standard error of the parameter estimate.

If φ were equal to one in equations (2) and (3), this would imply that buyout and deal activity follows a random walk. Since an AR(1) process is only stationary if $\varphi < 1$ (Ruud 2000, p. 651), and given that the results in Table 13 do not allow to reject the hypothesis that φ equals one, stationarity for the time series cannot be assumed. However, a formal test is needed to create certainty about this issue. One way of detecting non-stationarity using a formal model is to test for unit roots in the time series (Kirchgässner and Wolters 2007). For a first-order autoregressive process, a unit root is equivalent to φ being equal to one in the model and is commonly interpreted as a stochastic trend of the time series (Stock and Watson 2007, p. 557).

First, a Dickey-Fuller test (Dickey and Fuller 1979; Fuller 1996, p. 553) is conducted, which is the most popular testing procedure for unit roots (Elder and Kennedy 2001, p.

140). Since the Dickey-Fuller test assumes no serial correlation for standard errors – an assumption that has not yet been investigated – the Phillips-Peron test (Phillips and Perron 1988) is performed as well, as this allows for serially correlated disturbances by using modified Dickey-Fuller statistics that are robust in respect of serial correlation.

	Test statistic		Critical values		
	Dickey-Fuller	Phillips-Perron	1%	5%	10%
Panel A: Original time series					
BO_t	-0.612	-0.564	-2.608	-1.950	-1.610
VC_t	-1.027	-0.812	-2.608	-1.950	-1.610
Panel B: Differenced time series					
$BO_t - BO_{t-1}$	-10.204	-10.137	-2.608	-1.950	-1.610
$VC_t - VC_{t-1}$	-12.009	-11.899	-2.608	-1.950	-1.610

Table 14: Unit Root Test Results

This table provides the results of Dickey-Fuller and Phillips-Perron tests for unit roots using the no-constant option in STATA, which assumes that the true process is a random walk without drift.

The results of the unit root tests in Panel A of Table 14 do not allow to reject the presence of a unit root and thus confirm prior evidence. The number of deals can therefore be described by a non-stationary process. Panel B documents the unit root tests for the differenced time series. For both subsamples and both kinds of test, the test statistics are significant at the 1% level. Consequently, the process is difference stationary and thus integrated of order one (Wooldridge 2006, p. 393).

It should be noted that interpreting unit roots is the subject of a controversy among academics. Specifically, it is argued that unit roots cannot be distinguished from non-linear trends in finite samples (Sims 1989). This is because any unit root process in any finite sample can be arbitrarily well approximated by a stationary process where φ is close to one, and vice versa (Campbell and Perron 1991, p. 21). Cochrane (1991) illustrates this with a compelling example: Interest rates are commonly found to have a unit root. However, the level of interest rates in ancient Babylon was a single digit percentage, and the level today is quite similar. This can be hardly the result of a random process. Also, changing the root of a unit root process from 1 to 0.999 results in a "close" stationary process (Cochrane 1991), which might also be the case for the models in equation (2) and (3). Although the presence of a deterministic trend can be neither rejected nor proven in infinite samples (Sims 1989), the author opts for the econometrically more conservative approach, i.e. to assume a stochastic trend and to fit models accordingly (Brooks 2008, p. 555).

5.2.2.5 *Serial Correlation and Autoregressive Conditional Heteroskedasticity*

Figure 17 shows the residuals of OLS parameter estimates for equations (2) and (3).

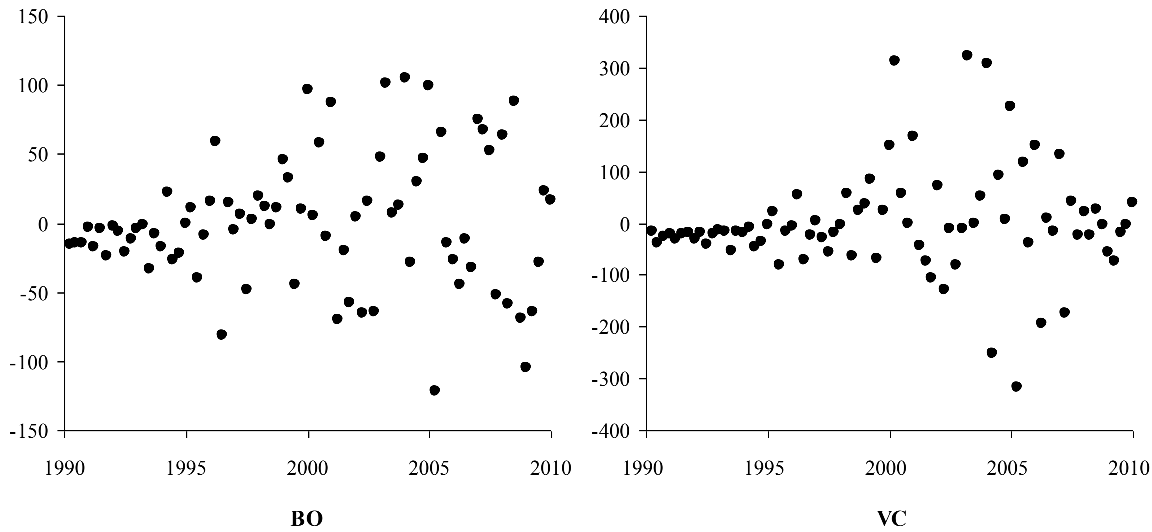

Figure 17: Residuals of OLS Parameter Estimates

The plots reveal considerable heteroskedasticity that seems to increase over time. This raises the hypothesis that the white noise modeled in equations (2) and (3) follows an autoregressive heteroskedasticity (ARCH) process.

In order to analyze the properties of the residuals two tests are performed. First, the Durbin-Watson test for serial correlation is conducted (Durbin 1970), which is based on OLS estimates of equations (2) and (3). Second, the procedure formulated by Engle (1982) employs the Lagrange multiplier principle to test the null hypothesis that the residuals of OLS parameter estimates for equation (2) and (3) are independent and identically distributed N $(0,\sigma^2)$. If the null hypothesis is rejected, the process is considered to be an ARCH process (Engle 1982, p. 987; Hamilton 1994).

	Durbin-Watson *d*-statistic	LM test		
		χ^2	df	*p*-value
BO_t	2.501	3.582	1	0.058
VC_t	2.244	5.152	1	0.024

Table 15: Serial Correlation and Autoregressive Conditional Heteroskedasticity Diagnostics

The Durbin-Watson statistics exceed the critical values at the 5% level for tests with one regressor (the lagged time series) and a sample size of 80 (see Savin and White 1977). Consequently, the null hypothesis of no serial correlation has to be rejected.

The results of the Lagrange multiplier test tell a similar story. The small p values of the χ^2 statistics imply that the null hypothesis of independent and identically distributed $\mathcal{N}(0,\sigma^2)$ residuals has to be rejected at the 10% level for buyouts and at the 5% level for venture capital investments.

A common ARCH model is given by (Brooks 2008, p. 388):

$$Y_t = c + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \cdots + \phi_p Y_{t-p} + u_t, \qquad u_t \sim \mathcal{N}(0, h_t), t = 1, 2, \ldots, \tag{4}$$

where c and φ_i, i =1…p are constants and $\{u_t\}$ is a white noise sequence with the following conditional variance:

$$h_t = \zeta + \alpha_1 u_{t-1}^2 + \alpha_2 u_{t-2}^2 + \cdots + \alpha_2 u_{t-q}^2,\ t = 1, 2, \ldots . \tag{5}$$

ARCH models are then fitted using conditional maximum likelihood estimates (StataCorp LP 2009). Model specifications for first- and second-order autocorrelations are reported in Table 16.

	(1)	(2)	(3)
Panel A: BO transactions			
AR(1)			
Intercept	12.084	18.479	10.521
	(0.993)	(0.939)	(0.997)
BO_{t-1}	0.996 ***	0.982 ***	1.001 ***
	(0.000)	(0.000)	(0.000)
ARCH			
Intercept	1371.571 ***	1453.687 ***	978.990 ***
	(0.000)	(0.000)	(0.000)
α_{t-1}	0.428 *		0.414
	(0.088)		(0.111)
α_{t-2}		0.438	0.235
		(0.102)	(0.227)
χ^2	1375.830 ***	2444.290 ***	1424.000 ***
	(0.000)	(0.000)	(0.000)
Panel B: VC transactions			
AR(1)			
Intercept	32.426	58.055	30.295
	(0.987)	(0.869)	(0.995)
VC_{t-1}	0.993 ***	0.971 ***	0.996 ***
	(0.000)	(0.000)	(0.000)
ARCH			
Intercept	6181.811 ***	11429.260 ***	6840.022 ***
	(0.000)	(0.000)	(0.000)
α_{t-1}	0.537 **		0.501 **
	(0.026)		(0.026)
α_{t-2}		-0.086 **	-0.060
		(0.043)	(0.204)
χ^2	910.270 ***	1524.320 ***	756.030 ***
	(0.000)	(0.000)	(0.000)

***; **; * Significance at the 1%, 5%, and 10% levels in two-sided significance tests

Table 16: ARCH Model Specification

This table provides parameter estimates for ARCH models using a conditional maximum likelihood approach implemented in STATA. χ^2 denotes the Wald χ^2 statistic with one degree of freedom. p values are presented in parentheses.

The χ^2 statistics and corresponding p values show that all models are highly significant. Consistent with the parameter estimates in Table 11 and Table 12, the intercepts of the AR(1) terms are indistinguishable from zero. The coefficients of the first-order autoregressions are significant at the 1% level and reasonably close to the estimates in Table 11 and Table 12, differing by less than 10%. For the buyout sample, all coefficients in the first- and second-order autoregressions are positive, implying that volatility increases over time. The coefficient of the first-order autoregression in model one is significant, but only at the 10% level, whereas the coefficients of a second-order autoregression and a combination of first- and second-order autoregressions are insignificant. For the venture capital sample, the coefficient of the first-order autoregression in model one is significant and positive at the 1% level, which is consistent with the hypothesis that volatility increases over time. Conversely, the coefficient of the second-order autoregression in model two is negative. However, although the p value suggests that the coefficient is different from zero at the 10% level, the difference is not inordinately large, as the parameter is only -0.086. As an absolute value, it is therefore much lower than the second-order coefficient in model one in particular. Accordingly, the decreasing effect is more likely to be offset by the positive first-order coefficient. In combination with each autoregression in model three, the second order coefficient diminishes to insignificance.

Model one seems to capture the time series pattern of both subsamples with the greatest accuracy. Applying these results to equations (4) and (5), the number of buyouts can be described by the following AR(1)-ARCH(1) specification:

$$BO_t = 0.996\, BO_{t-1} + u_t, \qquad u_t \sim \mathcal{N}(0, h_t), \qquad t = 1, 2, \ldots, \tag{6}$$

with the conditional variance h_t of $\{u_t\}$:

$$h_t = 1{,}371.671 + 0.428\, u_{t-1}^2, \quad t = 1, 2, \ldots . \tag{7}$$

The intercept of equation (7) signifies the time-invariant component of the error term variance in equation (6), which is equivalent to a standard deviation of 37.0 ($\sqrt{1{,}371.671}$) transactions per quarter.

The corresponding specification for the venture capital sample is as follows:

$$VC_t = 0.993\, VC_{t-1} + u_t, \qquad u_t \sim \mathcal{N}(0, h_t), \qquad t = 1, 2, \ldots, \tag{8}$$

with the conditional variance h_t of $\{u_t\}$:

$$h_t = 6{,}181.811 + 0.537\, u_{t-1}^2, \quad t = 1, 2, \dots . \tag{9}$$

The time-invariant component of the variance is 78.6 ($\sqrt{6{,}181.811}$), which is about twice as high as for the number of buyouts. This finding is comparable to the variance proportions of the two subsamples presented in Table 2.

5.2.3 Summary of Findings

The preceding analyses have revealed that the time series of the number of deals does not meet the basic assumptions that allow the proper use of OLS estimation techniques: weakly dependence and stationarity. On the contrary, the high autocorrelation found in the time series and the highly significant coefficients in the first-order autoregressions document that the time series are highly persistent. The unit root tests further revealed that the processes are non-stationary. Consequently, OLS procedures cannot be applied without further considerations.

Another pattern of the times series is further hampering the use of OLS: The autoregressive heteroskedasticity and serial correlation found in the error terms does not affect the consistency of OLS estimators, but OLS regressions will be less efficient. This is because with serially correlated error terms, the OLS estimates of the standard errors will be smaller than the true standard errors. Consequently, there will be a tendency to reject the null hypothesis when it should not be rejected.

The analyses conducted in the following will apply statistical procedures that take account of the non-stationarity problem encountered in the data in order to achieve robust and unbiased results.

5.3 Hypotheses and Proxy Development

5.3.1 Hypotheses

The neoclassical view of private equity investments assumes a link between the business cycle of the whole economy and aggregate deal activity. Economic shocks trigger investment opportunities with a positive NPV, thereby creating growth prospects for companies. As financial sponsors realize this, their appetite for investment increases, as expressed by the following hypothesis:

N1: The more positive economic shocks occur at the aggregate level, the greater the level of deal activity (economic shock hypothesis).

From the perspective of companies seeking finance, deal activity will be driven by the change in their demand for capital as they seek to exploit investment opportunities with a positive NPV:

N2: The higher the aggregate capital demand, the greater the level of deal activity (capital demand hypothesis).

One major prerequisite if private equity investments are to be effected is, of course, the availability of sufficient funds to finance transactions (Cheffins and Armour 2008). Practitioners and academics agree that transaction activity depends to a large extent on the prevailing conditions in debt markets (Acharya et al. 2007; Axelson et al. 2007; Chew and Kaplan 2009). The third neoclassical hypothesis for the aggregate level analysis is therefore as follows:

N3: The more favorable aggregate refinancing conditions, the greater the level of deal activity (capital supply hypothesis).

Regarding the impact of information asymmetries on aggregate deal activity two opposing theories may be able to explain some of the fluctuations in deal activity. First, the adverse selection cost view (Myers and Majluf 1984) predicts that high levels of information asymmetries will lead to lower levels of deal activity, as management will prefer other financing alternatives or postpone private equity transactions until information asymmetries ease:

IA1: The greater the market-wide level of information asymmetries, the lower the level of deal activity (adverse selection cost hypothesis).

The contrasting view is that private equity investors consciously focus on companies that are subject to high information asymmetries, since these are the types of investment where they can add the most value (Sahlmann 1990; Gompers 1995).

IA2: The greater the market-wide level of information asymmetries, the greater the level of deal activity (value add hypothesis).

The market timing view claims that private equity transactions will cluster over time in periods when valuation levels allow investors or equity issuing companies or disposing shareholders to exploit temporary mispricings (Kaplan and Strömberg, 2009) in the equity or debt markets.

MT: The more favorable the market-wide valuation level, the greater the level of deal activity (market timing hypothesis).

The theoretical framework summarized in Figure 10 includes a fourth dimension. Agency conflicts are believed to impact deal activity because private equity firms have incentives to invest even if doing so does not maximize fund returns (Sahlmann 1990; Ljungqvist et al. 2008). Consequently, private equity firms will accelerate investment behavior when they have raised huge amounts of liquidity or when new private equity players enter the market and are striving to quickly build an investment track record.

AC: The more favorable market conditions are to allow private equity firms to take advantage of overinvestment, the greater the level of deal activity (agency conflict hypothesis).

The market conditions referred to in the agency conflict hypothesis include abundant liquid funds, usually stimulated by high past returns and the number of new players on the market. However, this hypothesis involves two major threats to the internal validity of the research model. First, the driver reasoning and its implications cannot fully be separated from other hypotheses. For example, if private equity investors do benefit from brisk deal activity, they will also benefit from it if it is induced by neoclassical, market timing and information asymmetry-related drivers. In other words, it would be hard to hold the other factors constant and to extract an isolated "agency conflict factor". Second, reverse causality cannot be ruled out. The agency conflict view argues that private equity investors increase deal activity after they have collected huge amounts of liquid funds. However, even if this holds true, it could still be the case that private equity firms have raised these funds in anticipation of good investment opportunities. Alternatively stated, they may not be reacting to high liquidity but may simply have proactively raised funds if they anticipate improving investment prospects. Similarly, an increasing number of new entrants may not be the driver of investment activity; it may rather reflect market participants' response to improving investment opportunities.

5.3.2 Proxy Development

Depending on the type of data, proxies for the aggregate level analysis can be categorized in three kinds of time series: proxies based on financial data for listed companies, macroeconomic data and financial market data.

The first group of proxies are constructed by researching selected financial ratios described in Table 17 and Table 18 and taking the equally weighted mean across all EuroStoxx50 companies for a given quarter. This leads to a time series over 80 quarters for each proxy. Thus, each proxy measures the state of a of publicly listed companies. For some of these proxies Thomson One Banker provides quarterly financial data only for the last 10 to 12 years for most proxies. Consequently, these proxies cover only a subperiod of the sample period.

Fortunately, the second group of variables, the macroeconomic time series, are usually available for the whole sample period. However, the third data type – financial market data – is available only as a function of the development of certain financial market segments. Examples include data on the spread between investment-grade and non-investment-grade bonds or high-yield indices which were constructed around the turn of the millennium. At that time, rating became increasingly popular across Europe in line with the development of a market for debt securitization. Since then, this market has gained considerable importance in Europe (KfW 2010) and experienced corresponding coverage in databases. However, this kind of data is hardly available before 2000.

The proxies for each hypothesis are introduced in the sections that follow. Table 17 summarizes the neoclassical proxies. For the information asymmetry model, market timing and agency conflict hypothesis proxies are presented in Table 18. Unfortunately, for some of the proxies used there is no consensus in academic literature about what the variables actually measure. To accommodate this issue, alternative proxies are used for each hypothesis so that conclusions do not have to be based only on a single independent variable.

5.3.2.1 *Neoclassical Proxies*

Proxy	Description	Source	Prediction
Economic shock proxies			
GDP	GDP of the Euro area at constant prices, seasonally adjusted	OECD	+
Industrial production	Industrial production index of the Euro area	OECD	+
Business climate index	Business climate index of the Euro area	OECD	+
Δ Operating income growth	Mean of absolute change in the year-to-year percentage growth of operating income of EuroStoxx50 companies	Thomson One Banker	+
Δ Gross profit margin	Mean of the absolute change in gross profit margin as a percentage of net sales of EuroStoxx50 companies	Thomson One Banker	+
Probability of default	Fitch probability of default index for western Europe	Datastream	-
Capital demand proxies			
Fixed asset investments	Gross fixed capital formation of the Euro area, seasonally adjusted	OECD	+
Δ Sales growth	Mean of absolute change in the year-to-year percentage growth of net sales of EuroStoxx50 companies	Thomson One Banker	+
Δ Capital expenditure	Mean of the absolute change in capital expenditure as a percentage of net sales of EuroStoxx50 companies	Thomson One Banker	+
Δ Total assets	Mean of the absolute change in total assets in EUR amounts of EuroStoxx50 companies	Thomson One Banker	+
Capital supply proxies			
Domestic credit	Lending to nonfinancial corporations Euro area, outstanding amounts per end of period in billion EUR	ECB	+
High yield index	Barclays pan-European high yield index	Datastream	+
Debt issuance	Non-share securities issued by Euro area residents, outstanding amount per end of period in billion EUR	Datastream	+
EURIBOR	1 month EURIBOR	ECB	-

Table 17: Neoclassical Proxies

This table lists and describes the proxies used for the aggregate level analysis. "Prediction" refers to the predicted relationship between the proxy and the number of deals under the respective hypothesis. In particular, "+" denotes a positive relation and "-" an inverse relationship.

5.3.2.1.1 Economic Shock Proxies

GDP serves as a proxy for the "economic conditions" that are likely to be a major but not observable force in private equity deals (Leachman et al. 2002, p. 28; Deb and Mukherjee 2008). Quarterly real GDP for the euro area is published by OECD in its Main Economic Indicators (MEI) Original Release Data and Revisions Database. However, as historical data are obtainable only from Q1 1995 onward, the missing values from Q1 1990 to Q4 1994 are generated following the approach suggested by Hülsewig, Mayr and Wollmershäuser (2008), i.e. by retroactively extrapolating the weighted GDP growth of nine countries that constitute 95% of the euro area's GDP. Following similar reasoning and in line with related work on the impact of the business cycle on financing decisions by Choe et al. (1993), Dutordoir and Van de Gucht (2007) and Rau and Stouraitis (2010), the industrial production index is used to measure economic shocks that are reflected in output changes in the economy. The business climate index, which is surveyed and published monthly by the OECD for the euro area, serves as an alternative measure of perceived business prospects (Abberger 2004). The time series has been transformed to a quarterly basis using the three-month average.

In addition, two financial ratios taken from EuroStoxx50 companies that represent financial performance measures that are considered to be affected by economic shocks: operating income growth and gross profit margin. In accordance with related research on merger waves (Mitchell and Mulherin 1996; Harford 2005) and IPO waves (Lowry 2003, p. 14), those ratios are examined with a lead to the investment activity. Operating income is widely perceived as a measure of the "ongoing earnings power of a business" (Robinson, Greuning, Henry, and Broihahn, 2009). Since the proxy is constructed as the absolute change in the quarter-to-quarter percentage growth of operating income of listed companies it actually measures how much the profitability development changes at aggregate level. An overall increase in the operating income growth may be due to sales growth, price increase or cost reduction or a combination of all those factors. In order to employ also an additional proxy that is robust to volume increase, the gross profit margin is used, as this measure holds sales increases constant. Thus, the change in gross profit margin measures the development of the earnings quality in a sector by calculating revenues over operating costs. As it is assumed those profitability measures are impacted by economic shocks, developments in these proxies are attributed to economic shocks at aggregate level.

Finally, the indexed probability of default is employed to measure the economy-wide likelihood of financial distress (Aspachs, Goodhart, Tsomocos and Zicchino 2007).

5.3.2.1.2 Capital Demand Proxies

For the capital demand hypothesis (N2), the developments of three proxies taken form listed companies are investigated as lagged variables. The proxies are capital expenditure, total assets and sales growth. Capital expenditure and total assets are indirect measures of investments made by operating companies. As such, they gauge the availability and use of financial funds after a private equity wave. Spending thus serves as a lagged proxy for capital demand before investment activity has begun. The reason why lagged sales growth is used as a proxy for capital demand is that increasing sales requires funds for investments in working capital, the acquisition of additional sales personnel, startup costs for a new sales force, and so on. These funds can be obtained through private equity financing. Thus, if companies successfully use liquidity raised in private equity transactions to fuel organic growth, aggregate sales will increase after periods of busy private equity activity. These proxies are related to neoclassical proxies used by Mitchell and Mulherin (1996), Harford (2005) and Rau and Stouraitis (2010) in the investigation of merger waves, and by Lowry (2003) in her study of IPO waves.

In addition, aggregate investment in fixed assets is used in accordance with Lowry (2003) and measured as gross capital formation in the euro area. These data are obtained from the OECD statistical warehouse. In order to create proxies for capital demand prior to a transaction, proxies must be time-lagged. In particular, by measuring expansion and spending after fresh money has been raised through private equity transactions, the proxy design assumes that corresponding demand for capital will have existed beforehand. Similar reasoning is employed by Schertler and Tykvová (2010), who use expected growth as a capital demand proxy measured ex post based on GDP growth after venture capital investments.

5.3.2.1.3 Capital Supply Proxies

Four proxies have been developed as measures of the capital available to finance private equity transactions. First, domestic credit in the euro area measures overall liquidity in the bank lending market. Second, the high-yield index is used to capture the status of the high-yield market, which is an essential vehicle to finance venture capital transactions (Hege et al. 2008, p. 30) and leverage buyouts (Kaplan and Strömberg 2009). Third, debt issuance in the euro area measures the volume of the corporate bond market. Finally, EURIBOR serves as a proxy for the cost of borrowing (Axelson et al. 2007). Since the availability of reasonably priced debt is crucial to private equity transactions, the first three proxies should correlate positively to transaction activity, while EURIBOR is expected to exhibit a negative correlation.

Proxy	Description	Source	Prediction
Information asymmetry proxies			
Disp. of earnings forecasts	Equal weighted diesperion of earnings forecast of EuroStoxx50 companies, where the dispersion for a given company and a given quarter is the average of mean weighted standard deviation across all available analyst forecasts of earnings per share	I/B/E/S	-/+
Trading volume	Value weighted average of the daily trading volume of EuroStoxx50 companies	Datastream	+/-
Δ M2B non-dividend payers	Difference of the mean market-to-book ratio of dividend payers and non-dividend payers of EuroStoxx50 firms	Thomson One Banker	-/+
Market timing proxies			
Market to book ratio	Market value of assets divided by the book value of assets as per end of the period	Thomson One Banker	+
IPO volume	Gross proceeds of shares issued by Euro area residents in billion EUR	Datastream	+
Spread AAA vs. CCC	Absolute difference between the Barclays pan-European indices of AAA and CCC rated corporate bonds	Datastream	+
Agency conflict proxies			
BO/VC capital raised	Commitments to funds sponsored by members of the EVCA in billion EUR	Thomson One Banker	+
No. of first time BO/VC fund	Number of first time funds of EVCA members that raised capital in the respective quarter	Thomson One Banker	+
BO/VC fund perform.	Time-weighted IRRs of funds sponsored by EVCA members	Thomson One Banker	+
BO/VC fund perform., liquid.	Time-weighted IRRs of liquidated funds sponsored by EVCA members	Thomson One Banker	+

Table 18: Information Asymmetry, Market Timing and Agency Conflict Proxies

This table lists and describes the proxies used for aggregate level analysis. "Prediction" refers to the predicted relationship between the proxy and the number of deals under the respective hypothesis. In particular, "+" denotes a positive relation and "-" an inverse relationship.

5.3.2.2 *Information Asymmetry Proxies*

The dispersion of analysts' earnings forecasts of listed companies can be used as a measure of the level of information asymmetries (Krishnaswami and Subramaniam

1999). This dispersion can be obtained from the I/B/E/S database. By capturing the heterogeneity of beliefs held by informed and uninformed investors, the dispersion of analysts' earnings forecast was found by Ghysels and Juergens (2001) to be an appropriate measure of information asymmetries and has been applied by Lowry (2003) to analyze the drivers of IPO volume and Leary and Roberts (2010) who investigate corporate financing decisions in light of the pecking order theory. Caution is nevertheless necessary with this measure, as analysts' forecasts are commonly regarded to be subject to various biases (Daniel, Hirshleifer and Teoh 2002). Therefore, diverging beliefs on the part of analysts could be due not only to "noise" and private information, but also to behavioral and other kinds of biases. Other data quality concerns have been expressed more recently by Givoly, Hayn and Lehavy (2009). However, the dispersion should at least be robust with regard to the various systematic overestimation biases, such as overreactions to positive news, underreactions to negative news and optimism about long-term forecasts (Anderson, Ghysels and Juergens 2005, p. 889).

The dispersion of analysts' earnings forecasts is calculated on a quarterly basis for the EuroStoxx50 companies by computing the mean weighted standard deviation across all available analyst forecasts of earnings per share. The time series suffers from the severe drawback that, before 2002, analysts' coverage was very rudimentary and, above all, heterogeneous for the different quarters of the year. Coverage of earnings forecasts for the fourth quarter was naturally the highest, since most companies end their fiscal years in December. Other quarters received less intensive coverage. For example, there was no value for the dispersion of earnings forecast for the third quarters prior to 2003. The missing values have therefore been replaced by simple interpolations, as 11 interpolated values are considered to outweigh the loss of more than thirty observations in the time series. This approach has the limitation of omitting potential seasonal effects in the time series (Lütkepohl and Krätzig 2008, p. 4). To rule out the possibility of ignoring seasonal trends by interpolation, four time series were constructed, of which each contains only observations for a particular quarter. Then, paired and unpaired mean comparison tests were conducted (results not reported) to test whether systematic differences exist in the level of dispersion between the different quarters. For example, had the third quarter would been found to be higher or lower than any of the other quarters in most cases, interpolation would hide this pattern. However, at the 5% level, none of the four quarters exhibits dispersions of earnings forecasts that are systematically different from those of the other three quarters. Accordingly, interpolation appears to be a reasonable measure to replace the missing values.

The second information asymmetry variable is the average daily trading volume of EuroStoxx50 stocks. The reasoning for using this measure is that low-volume stocks are typically targeted by informed traders, whereas, in the case of actively traded stocks, investors with no private information typically outnumber informed investors (Easley, Kiefer, O'Hara and Paperman 1996; Easley, Hvidkjaer and O'Hara 2002). Similarly, the aggregate level of information asymmetries is captured using this measure for EuroStoxx50 firms.

The third proxy for the level of information asymmetries is the difference in the market-to-book ratio between dividend payers and non-dividend payers. Pioneering work by Modigliani and Miller (1958), Miller and Rock (1985) and Williams and John (1985) documents the signaling role of dividends, which reveal positive private information about the firm paying the dividend. Dividend payers are, thus, generally considered to face lower information asymmetries, a hypothesis that recently received empirical support from Zhao and Li (2008). Chang (2006) also includes a dividend payer dummy to capture information asymmetries. This well-known information asymmetry pattern is combined with the market-to-book ratio.[1] Taking the difference between dividend payers and non-dividend payers controls for changes in the market-wide market-to-book ratio, which is associated with market timing opportunities in this study.

Although this proxy is used to capture information asymmetries, it should be noted that a similar measure – the dividend premium – is frequently used to proxy the mood on the stock market (Baker and Wurgler 2004a, 2004b). The underlying idea is that investors are supposed to be subject to changing moods relating to "safety" in the context of income streams from dividends. Firms respond to these mood changes by paying dividends or not (Baker and Wurgler 2007, p. 137). Given the controversial

[1] The market-to-book ratio itself is frequently used as an information asymmetry proxy (Van Ness, Van Ness and Warr 2001). However, this study uses the market-to-book ratio as a market timing variable in accordance with Baker and Wurgler (2002), Jensen (2004), Schmidt, Nowak and Knigge (2004), Alti (2006), Rau and Stouraitis (2010) and others who take this variable to measure market timing opportunities or misvaluation.

academic debate about underlying theories on dividend policies,[1] the statistical results for this proxy must be treated with caution.

As can be seen in Table 18, predictions regarding the relationship with deal volume are not as straightforward as for the other variables, since there are two competing hypotheses. The adverse selection cost hypothesis predicts that brisk deal activity should overlap with periods of low information asymmetries and should thus exhibit a negative correlation to the dispersion of earnings forecasts as well as to the difference between the market-to-book ratio for dividend payers and non-dividend payers. It should also correlate positively to the deal volume. The value add hypothesis predicts the contrary relationships since, according to this view, deal activity is encouraged by significant information asymmetries.

5.3.2.3 **Market Timing Proxies**

The first proxy is the market-to-book ratio measured as the market value of assets, expressed in terms of market capitalization, relative to the book value of assets. This proxy has also been employed by Baker and Wurgler (2002), Jensen (2004), Schmidt, Nowak and Knigge (2004), Alti (2006) and Rau and Stouraitis (2010) to evaluate market timing opportunities or temporary misevaluations. Another proxy is IPO volume, measured as the gross proceeds of equity issues by European companies. The IPO volume is frequently used to measure market timing opportunities for equity issues (Lowry 2003, p. 14; Alti 2006; Baker and Wurgler 2007).

The third market timing variable is the spread of AAA-rated corporate bonds less CCC-rated corporate bonds. This proxy is adopted from Chen (2010), who shows that time-varying spreads provide opportunities to exploit the market timing of debt issuance. This view is also in line with Kaplan and Strömberg (2009), who postulate that private equity investors can exploit temporary mispricings in debt and equity markets. However, this measure also has alternative uses in financial literature. For example, credit spreads are frequently used as proxies for the overall level of debt-related financing costs (Evanoff and Wall 2001; Dutordoir and Van de Gucht 2007), which would correspond to the capital supply hypothesis put forward in this study.

1 For a comprehensive review of empirical studies on dividend policy, see Baker (2009).

The market timing hypothesis predicts a positive relationship between private equity investment activity and all three variables that serve as proxies for the availability of market timing opportunities.

5.3.2.4 *Agency Conflict Proxies*

The proxies for the agency conflict hypothesis are generated by filtering the Thomson One Banker private equity module for members of the EVCA. It is thus assumed that all private equity firms with considerable investment activities in Europe will be members of the leading private equity organization in the euro area.

Funds raised serve as a measure of whether private equity firm increase investment activity once funds experience high capital inflows (Gompers and Lerner 2000, p. 283; Ljungqvist et al. 2008). However, it should be noted that there is also a neoclassical interpretation of this proxy, as funds raised may be viewed as a capital supply proxy.

The number of first-time funds serves as a proxy for the market entry of new private equity firms. A positive relationship between this variable and the number of deals can be interpreted as new players entering the private equity market in boom times. This is consistent with the findings of Kaplan and Schoar (2005), who report that more GPs enter the private equity market following periods of high private equity returns. The agency conflict that arises from these market entrance pattern reflects the resultant competition between private firms for deals (Gompers and Lerner 2000, p. 283) and the deteriorating quality of deals as private equity firms overpay in bidding contests (Kaplan and Stein 1993, p. 348; Gompers and Lerner 1996, p. 464). The number of first-time funds thus serves as a proxy for the response of private equity firms to market conditions. A positive relation between the number of deals and funds raised would support the agency conflict view, as newcomers may not invest in the best interests of fund investors, but might instead pursue their own agendas by overinvesting.

Fund performance with a lead of one quarter is used to measure the overall performance of private equity funds prior to investment activities. The choice of this proxy is based on findings by Ljungqvist et al. (2008), who argues that, following periods of high returns, private equity firms become more conservative in their investment approach. This would be consistent with a decelerating pace of investment.

5.3.3 Time Series Characteristics of Proxies

As noted earlier, the most demanding challenges in statistical tests of relationships between econometric time series arise from the non-stationarity of the data. The central limit theorem used in OLS requires time series to be stationary and weakly dependent (Wooldridge 2006, p. 379). Violations of these prerequisites are likely to result in ostensible relationships between the variables analyzed or "spurious regressions" (Granger and Newbold 1974). As the dependent variables have been found to be highly persistent and to contain unit roots (see section 5.2), the independent variables must also be analyzed for their time series characteristics, in particular for stationarity. Dickey-Fuller (Dickey and Fuller 1979) and Phillips-Perron (Phillips and Perron 1988) tests for unit roots are therefore conducted. The results are presented in Table 19.

For these tests, the null hypothesis is that the time series has a unit root. If the test statistic does not exceed the critical value, the null hypothesis can be rejected and it can be concluded that the time series has no unit root or is I(0). The test results in Table 19 show that most economic shock variables and all capital supply variables are unit root processes as indicated by the insignificant test statistics. In contrast to this, the majority of the remaining variables cannot be described by unit root processes. Unit root variables are exceptionally prone to "spurious regressions" (Granger and Newbold 1974) when the instationary independent variables, e.g. the number of buyouts and venture capital investments, are regressed on them using OLS.

	Test statistic		Critical values		
	Dickey-Fuller	Phillips-Perron	1%	5%	10%
Economic shock variables					
GDP	0.000	-1.119	-3.541	-2.908	-2.589
Industrial production	-1.207	-1.460	-3.539	-2.907	-2.588
Business climate index	-1.895	-2.854	-3.539	-2.907	-2.588
Δ Operating income growth	-6.926 ***	-6.926 ***	-3.607	-2.941	-2.605
Δ Gross profit margin	-13.992 ***	-13.498 ***	-3.662	-2.964	-2.614
Probability of default	-2.516	-2.611	-3.682	-2.972	-2.618
Capital demand variables					
Fixed asset investments	0.000	1.404	-3.539	-2.907	-2.588
Δ Sales growth	-6.755 ***	-6.759 ***	-3.634	-2.952	-2.61
Δ Capital expenditure	-9.647 ***	-11.528 ***	-3.607	-2.941	-2.605
Δ Total assets	-8.281 ***	-8.500 ***	-3.648	-2.958	-2.612
Capital supply variables					
Domestic credit	2.383	1.249	-3.539	-2.907	-2.588
High yield index	-1.860	-2.014	-3.628	-2.950	-2.608
Debt issuance	5.024	5.580	-3.539	-2.907	-2.588
EURIBOR	-1.196	-1.588	-3.562	-2.920	-2.588
LIBOR	-1.897	-2.252	-3.539	-2.907	-2.595
Information asymmetry variables					
Δ Dispersion of earnings forecasts	.12.724 ***	-18.010 ***	-3.544	-2.909	-2.59
Trading volume	-4.773 ***	-4.496 ***	-3.539	-2.907	-2.588
Δ M2B non-dividend payers	-6.250 ***	-6.247 ***	-3.634	-2.952	-2.61
Market timing variables					
Market to book ratio	-7.490 ***	-7.341 ***	-3.641	-2.955	-2.611
IPO volume	-6.659 ***	-6.854 ***	-3.539	-2.907	-2.588
Spread AAA vs. CCC	-1.856	-2.004	-3.655	-2.961	-2.613
Agency variables					
BO capital raised	-3.049 **	-2.759 *	-3.545	-2.910	-2.590
Number of first time BO funds	-4.537 ***	-4.321 ***	-3.607	-2.941	-2.605
BO fund performance	-8.778 ***	-8.969 ***	-3.558	-2.917	-2.594
BO fund performance, liquidated	-6.623 ***	-6.602 ***	-3.577	-2.928	-2.599
VC capital raised	-4.474 ***	-4.367 ***	-3.538	-2.912	-2.591
Number of first time VC funds	-5.318 ***	-5.419 ***	-3.576	-2.928	-2.599
VC fund performance	-7.090 ***	-7.382 ***	-3.551	-2.913	-2.592
VC fund performance, liquidated	-7.539 ***	-7.540 ***	-3.560	-2.919	-2.594

***; **; * Significance at the 1%, 5%, and 10% levels in one-sided significance tests.

Table 19: Unit Root Statistics for Independent Variables

This table shows the results of Dickey-Fuller and Phillips-Perron tests for unit roots. Critical values vary depending on the length of the time series, e.g. the number of observations.

However, one case in which regressions of two or more unit root variables on each other are not spurious is if they are cointegrated (Wooldridge 2006, p. 623). The basic concept first introduced by Granger (1981, p. 128) and given an extensive formal treatment by Engle and Granger (1987) centers around the relationship of two I(1) series. Let $\{x_t\}$ and $\{y_t\}$ be two I(1) processes. If a number $\beta \neq 0$ exists for which $x_t - \beta y_t$ is I(0), then the two time series are said to be cointegrated. To put that another way: If a linear combination exists for two I(1) processes, that is I(0), then the series are cointegrated and OLS regressions are meaningful (Wooldridge 2006, p. 623). Short-term and long-term interest rates are one well-known example of cointegrated I(1) time series (Engle and Granger 1987, p. 274). If this were not so, the difference between both rates could become very large without any way of reverting to a regular mean, thereby opening up arbitrage possibilities. In fact, the spread of interest rates has a tendency to revert to its mean and deviations from this mean are only temporary (Wooldridge 2006, p. 638). This example illustrates that, if two I(1) processes are cointegrated, this underscores and characterizes the long-term economic relationship between these variables. As a general rule, if two I(1) time series are cointegrated, they will share the same stochastic trend (Stock and Watson 2007, p. 654). In other words, the time series are exposed to the same influencing factors by which they are bound to some relationship in the long run (Brooks 2008, p. 336).

Johansen tests of cointegration (Johansen 1991) are performed to determine the order of cointegration and shown in Table 20. These tests have the advantage of not requiring a prior estimate of β for the stationary linear combination. A sequential Johansen test starts with the null hypothesis that the number of cointegrating relationships is equal to zero. The alternative is that there should be at least one cointegrating relationship. The null hypothesis can be rejected at the 5% level if the trace statistic is higher than the critical value reported in the top row of Table 20. If it is not rejected, the test procedure is halted and the null hypothesis of no cointegration cannot be rejected. However, if the first null hypothesis is rejected, the next null hypothesis is that there is one cointegrating relationship. In this case, the alternative is that there are at least two cointegrating relationships. A higher order of cointegration simply means that there are more than one stationary linear combinations. In this analysis, the only point of interest is whether there is at least one cointegrating relationship. The test is therefore broken off after testing for one relationship.

Since cointegration tests cannot be performed if the time series have gaps, some of the time series had to be adjusted. Missing values were therefore replaced by simple interpolations. The alternative approach would have been to shorten the time series to all observations without gaps, which would have resulted in a loss of 50% of the observations of a time series in extreme cases. Although interpolation is a rough measure, the bias it introduces to the overall results is relatively small, since only nine interpolations were conducted out of about 1,800 observations in the 28 time series.

For the sake of completeness, the test was performed not only for the variables that are I(1), but also for the I(0) series. In these cases, the test investigates whether a stationary linear combination of one stationary and one non-stationary time series exists. It is trivial to find such a linar combinations, as any linear combination that puts a sufficiently high weighting on the I(0) process will result in a stationary process. Consistent with this consideration, such a linear combination exists for almost all I(0) independent variables. However, the series are by definition not cointegrated with the dependent variable, nor is the economic interpretation applicable.

	Order of integration	Lag length	BO Trace statistic max rank = 0	BO Trace statistic max rank = 1	VC Trace statistic max rank = 0	VC Trace statistic max rank = 1
Critical value at the 5% level			15.410	3.760	15.410	3.760
Economic shock variables						
GDP	I(1)	2	8.121		5.431	
Industrial production	I(1)	3	13.550 **	2.221	9.520	
Business climate index	I(1)	3	19.132 **	2.272	16.822 **	2.917
Δ Operating income growth	I(0)	4	50.072 **	7.157 **	48.302 **	4.983 **
Δ Gross profit margin	I(0)	2	25.192 **	2.988	23.558 **	2.409
Probability of default	I(1)	2	16.759 **	2.935	12.871	
Capital demand variables						
Fixed asset investments	I(1)	2	15.029 **	2.668	9.708	
Δ Sales growth	I(0)	1	24.524 **	4.614 **	22.887 **	4.103 **
Δ Capital expenditure	I(0)	3	38.153 **	6.461 **	36.896 **	4.926 **
Δ Total assets	I(0)	4	35.863 **	5.763 **	30.223 **	0.866
Capital supply variables						
Domestic credit	I(1)	4	8.180		6.038	
High yield index	I(1)	1	20.952 **	5.672 **	11.520	
Debt issuance	I(1)	1	30.024 **	3.143	32.423 **	4.098 **
EURIBOR	I(1)	2	16.062 **	2.097	9.619	
LIBOR	I(1)	1	6.457		7.483	
Information asymmetry variables						
Dispersion of earnings forecasts	I(0)	3	94.761 **	2.756	96.325 **	2.650
Trading volume	I(0)	2	32.265 **	2.487	21.505 **	2.386
Δ M2B non-dividend payers	I(0)	1	37.787 **	5.143 **	37.369 **	6.073 **
Market timing variables						
Market to book ratio	I(0)	4	16.337 **	2.775	9.693	
IPO volume	I(0)	2	20.475 **	2.124	17.967 **	2.340
Spread AAA vs. CCC	I(1)	2	25.578 **	7.897 **	7.880	
Agency variables						
BO capital raised	I(0)	2	16.544 **	2.684		
Number of first time BO funds	I(0)	0	25.740 **	2.418		
BO fund performance	I(0)	2	45.015 **	2.661		
BO fund performance, liquidated	I(0)	0	24.781 **	3.299		
VC capital raised	I(0)	1			30.796 **	3.825 **
Number of first time VC funds	I(0)	4			20.963 **	2.657
VC fund performance	I(0)	2			18.844 **	2.814
VC fund performance, liquidated	I(0)	0			28.592 **	2.596

** Higher than the critical value at the 5% level in one-sided significance tests.

Table 20: Cointegrating Relationships

This table shows the results of Johansen tests for cointegration. The order of integration is I(1), if the time series has been identified as a unit root process (see Table 19). "Lag length" denotes the number of lags identified using the varsoc command of STATA. The null hypothesis is that the maximum rank equals zero and one, respectively.

For the I(1) variables, the picture is mixed and differences emerge in the cointegrating relationships between the number of buyouts and venture capital investments. Specifically, the number of venture capital investments exhibits less cointegrating relationships with economic variables than buyouts.

Although they do not allow for any conclusions about causality, the results document a number of long-term relationships. In particular, buyout activity is, in the long run, bound to several economic shock variables, such as industrial production, the business climate index, the probability of default and the capital supply variable fixed-asset investments. Of the capital supply variables, the high-yield index, the volume of debt issuance and the spread between investment-grade and non-investment-grade bonds exhibits a long-term relationship with the number of buyouts. For the venture capital activity, however, only the business climate index (as an economic shock variable) and the volume of debt issuance (as a capital demand variable) show cointegrating relationships with the number of investments. These results might tentatively be interpreted as to indicate that buyout activity is more closely related to the overall business climate and financing conditions, while this link is weaker for venture capital investments.

The test results are of no significance for the I(0) variables, since cointegration requires both time series to have a unit root.

5.4 Univariate Analysis

Based on the findings discussed in the section above, independent variables can be divided into three different categories. As shown in Table 21, the first and –fortunately – largest set of variables are the stationary time series. These variables can be used in OLS and related types of regressions without causing spurious regressions. For the remaining I(1) variables, a distinction must be drawn between those that exhibit a cointegrating relationship with the dependent variables and those that do not share the same stochastic trend as the dependent variables and are thus not cointegrated.

I(0)	I(1)			
	BO		VC	
	Cointegrated	Not cointegrated	Cointegrated	Not cointegrated
Economic shock variables				
		GDP		GDP
	Industrial prod.			Industrial prod.
	Busin. climate ind.		Busin. climate ind.	
Δ Op. income growth				
Δ Gross prof. margin				
	Prob. of default			Prob. of default
Capital demand variables				
	Fixed asset invest.			Fixed asset invest.
Δ Sales growth				
Δ Capital expend.				
Δ Total assets				
Capital supply variables				
		Domestic credit		Domestic credit
	High yield index			High yield index
	Debt issuance		Debt issuance	
	EURIBOR			EURIBOR
		LIBOR		LIBOR
Information asymmetry variables				
Δ Disp. of earnings FC				
Trading volume				
Δ M2B non-dividend				
Market timing variables				
Market to book ratio				
IPO volume				
	Spread AAA/CCC			Spread AAA/CCC
Agency variables				
BO capital raised				
No. of first time BO funds				
BO performance				
BO performance, liquid.				
VC capital raised				
No. of first time VC funds				
VC performance				
VC performance, liquid.				

Table 21: Categorization of Dependent Variables

This table summarizes the results of Table 19 and Table 20 and classifies the dependent variables as I(0) series and I(1) processes. The latter group is then subdivided into groups of variables that are cointegrated or not cointegrated with the corresponding number of buyouts and venture capital investments.

The variables that are unit root processes but are not cointegrated with the dependent variables are prone to spurious regressions. Remarkably, the set of such "problematical" variables consists of only two variables for the total number of buyouts, but no less than eight variables for total venture capital activity. Nevertheless, OLS regressions are run with the number of buyouts as dependent variables followed by FGLS regressions. These regressions employ a transformation suggested by Prais and Winsten (1954), which also corrects for heteroskedasticity and autocorrelation (Verbeek 2008, p. 100).

5.4.1 OLS Regressions

In the case of trended time series, it often happens that a similar trend is found in the error terms of the residuals. This causes the model to suffer from heteroskedasticity (Vogelwang 2005, p. 183). Although heteroskedasticity does not in general provide reasons to reject an otherwise correct model (Mankiw 1990, p. 1648) it leads to invalid t and F statistics and thus to biased inferences (Wooldridge 2006, p. 265). Since many of the independent variables are trended, a Breusch-Pangan test for heteroskedasticity was conducted. This procedure tests the null hypothesis of homoskedasticity by regressing the squared residuals on the independent variable. If the χ^2 statistic of an F test suggests that the coefficient of this regression is not zero, the null hypothesis has to be rejected (Breusch and Pangan 1979). The regressions are first conducted with the original independent variables, i.e. without leads or lags. Then the regressions are rerun with transformed variables. These transformations consist of the inclusion of different leads or lags or changing differences into averages for selected variables.

5.4.1.1 *Buyout Transactions*

5.4.1.1.1 OLS Regressions with the Original Independent Variables

The OLS results shown in Table 22 document significant bivariate relationships between the number of buyouts and several of the independent variables. Of the *economic shock* variables, the business climate index seems to have the greatest impact in fueling transactions, as a change of just one point in this index is associated with 17 additional transactions per quarter. The coefficient of industrial production is of a similar magnitude, but is affected by heteroskedasticity as indicated by the significant χ^2 statistic. An increase in the probability of default appears to have a significant negative impact, which is consistent with the prediction that financial sponsors slow down investment activity if default rates rise. The coefficient of GDP and its significance may be biased as the variable is nonstationary, not cointegrated with the dependent variable and the regression is affected by heteroskedasticity.

		Coefficient	*t*-statistic	R^2	F	χ^2
Economic shock variables						
sr	GDP	0.75 ***	17.64	0.802	311.30 ***	20.45 ***
	Industrial production	16.10 ***	20.25	0.840	409.97 ***	11.45 ***
	Business climate index	17.04 ***	3.12	0.111	9.73 ***	3.18 *
	Δ Operating income growth	-0.88	-1.23	0.032	1.51 ***	0.47
	Δ Gross profit margin	-5.33	-0.10	0.000	0.01	0.02
	Probability of default	-0.38 ***	-4.23	0.338	17.87 ***	0.67
Capital demand variables						
	Fixed asset investments	0.39 ***	25.96	0.896	674.00 ***	16.76 ***
	Δ Sales growth	-1.82	-1.28	0.039	1.65	0.58
	Δ Capital expenditure	-36.28	-0.84	0.016	0.71	0.12
	Δ Total assets	-8.80	-0.59	0.008	0.34	0.10
Capital supply variables						
sr	Domestic credit	119.50 ***	9.55	0.539	91.21 ***	19.29 ***
	High yield index	3.57 ***	4.42	0.318	19.55 ***	0.90 **
	Debt issuance	0.04 ***	10.50	0.586	110.19 ***	34.99 ***
	EURIBOR	-48.44 ***	-4.86	0.264	23.58 ***	0.42
Information asymmetry variables						
	Dispersion of earnings forecasts	363.52 *	1.68	0.043	3.45 *	1.44
	Trading volume	18.00 ***	7.83	0.440	61.29 ***	1.27
	Δ M2B non-dividend payers	-6.73 ***	-2.77	0.158	7.69 ***	0.49
Market timing variables						
	Market to book ratio	12.42	0.85	0.017	0.73	0.01
	IPO volume	10.36 ***	4.46	0.203	19.87 ***	0.28
	Spread AAA vs. CCC	-4.46 ***	-6.20	0.503	38.41 ***	0.46
Agency variables						
	BO capital raised	7.35 ***	7.57	0.424	57.37 ***	1.13
	Number of first time BO funds	31.84 ***	2.76	0.091	7.60 ***	0.27
	BO fund performance	0.17	0.11	0.000	0.00	0.19
	BO fund performance, liquidated	-0.92	-0.97	0.018	0.95	0.25

***; **; * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 22: OLS Regressions with the Original Independent Variables – Buyouts

This table shows the results of OLS regressions with the number of buyouts as dependent variable. The prefix "sr" in the first row denotes that regression results might be spurious according to the analyses reported in Table 19, Table 20 and Table 21 and that inferences based on these statistics might be biased. χ^2 denotes the statistics of the Breusch-Pangan test for heteroskedasticity, based on the null hypothesis of homoskedasticity.

Fixed-asset investments is the only significant *capital demand* variable. However, the significance of this variable is likely to be inflated by heteroskedasticity, as suggested by the highly significant χ^2 statistic.

Support for the *capital supply* hypothesis is provided by the highly significant negative EURIBOR coefficient suggesting that investment activity surges if financing conditions become less expensive, and vice versa. The high-yield index and total debt issuance both exhibit positive coefficients as predicted, although their significance may be biased by heteroskedasticity.

Two out of three information asymmetry variables exhibit highly significant coefficients with the same sign, as predicted by the *adverse selection* hypothesis. Of the market timing variables, IPO volume and the spread between AAA and CCC rated bonds exhibit significant coefficients in line with the prediction of the *market timing* hypothesis. Of the *agency conflict* variables, raised capital and the number of buyout funds have a strong positive correlation with the level of investment activity. This is consistent with the prediction.

As documented in Table 21 and indicated by the "sr" prefix in Table 22, only two variables – namely GDP and domestic credit– are prone to spurious regressions. However, the coefficients and R^2 of GDP and domestic credit suggest that these variables might play an important role in modeling deal activity if these relationships can be proven to be meaningful. Nevertheless, after taking into account the limitations to inference arising from spurious regressions and heteroskedasticity, the results provide support for the *economic shock*, *capital supply*, *adverse selection, market timing* and *agency conflict* hypothesis since the majority of proxies document a probably unbiased significant relationship in line with prediction. However, no support is found for the *capital demand* hypothesis since the results are lacking significance or suffer from high heteroskedasticity.

5.4.1.1.2 OLS Regressions with Transformed Independent Variables

The regressions are rerun with up to four leads and lags for the independent variables. If adding different leads or lags results in higher significance, the results are amended as shown in Table 23. However, most of the results remain unchanged in qualitative terms. Since the majority of the differenced variables remain insignificant, means are used instead of the difference, making some variables significant for selected leads or lags. If the significance is unaffected by any variable transformation, the results from the previous regressions (Table 22) are carried forward.

This exercise has two goals. First, it serves as a robustness check to the prior regressions. In particular, it shows whether the results are robust to alternative transformations of the time series. Second, the proper length of lags or leads of the independent variable can be hardly determined a priori. For example, the theoretical framework and the operationalization predicts a positive relationship between industrial production and deal activity. In addition, one can find reasonable arguments, why industrial production should lead private equity activity, but it is impossible to tell whether this lead should be one, two or even more quarters. Thus, this analysis contains an inductive element within the otherwise strictly deductive research design.

		Coefficient	*t*-statistic	R^2	F	χ^2
	Economic shock variables					
sr	GDP $_{t}$	0.75 ***	17.64	0.802	311.30 ***	20.45 ***
	Industrial production $_{t-3}$	15.58 ***	15.30	0.753	234.19 ***	2.55
	Business climate index $_{t-1}$	14.87 ***	2.66	0.083	7.09 ***	0.91
	Δ Operating income growth $_{t-2}$	-1.38 *	-1.85	0.071	3.43 *	0.45
	Ø Gross profit margin $_{t-2}$	6.69 **	2.47	0.138	6.10 **	0.10
	Probability of default $_{t}$	-0.38 ***	-4.23	0.338	17.87 ***	0.67
	Capital demand variables					
	Fixed asset investments $_{t}$	0.39 ***	25.96	0.896	674.00 ***	16.76 ***
	Δ Sales growth $_{t-1}$	-2.89 **	-2.10	0.097	4.41 **	0.58
	Ø Capital expenditure $_{t-2}$	-8.27 *	-1.75	0.062	3.06	0.05
	Δ Total assets $_{t}$	-8.80	-0.59	0.008	0.34	0.10
	Capital supply variables					
sr	Domestic credit $_{t}$	119.50 ***	9.55	0.539	91.21 ***	19.29 ***
	High yield index $_{t}$	3.57 ***	4.42	0.32	19.55 ***	0.90 **
	Debt issuance $_{t}$	0.04 ***	10.50	0.586	110.19 ***	34.99 ***
	EURIBOR $_{t}$	-48.44 ***	-4.86	0.264	23.58 ***	0.42
	Information asymmetry variables					
	Dispersion of earnings forecasts $_{t-2}$	526.45 **	2.51	0.080	6.30 **	0.54
	Trading volume $_{t}$	18.00 ***	7.83	0.440	61.29 ***	1.27
	Δ M2B non-dividend payers $_{t-3}$	-6.73 ***	-2.77	0.158	7.69 ***	0.49
	Market timing variables					
	Market to book ratio $_{t-3}$	-25.66 *	-1.77	0.068	3.14 *	1.88
	IPO volume $_{t}$	10.36 ***	4.46	0.203	19.87 ***	0.28
	Spread AAA vs. CCC $_{t}$	-4.46 ***	-6.20	0.503	38.41 ***	0.46
	Agency variables					
	BO capital raised $_{t-2}$	7.96 ***	8.60	0.490	73.93 ***	3.46 *
	Number of first time BO funds $_{t+2}$	36.04 ***	3.13	0.112	9.81 ***	0.48
	BO fund performance $_{t}$	0.17	0.11	0.000	0.00	0.19
	BO fund performance, liquidated $_{t}$	-0.92	-0.97	0.018	0.95	0.25

***; **; * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 23: OLS Regressions with Transformed Independent Variables – Buyouts

This table shows the results of OLS regressions with the number of buyouts as dependent variable. Transformations of the independent variables are conducted by using different leads or lags of the original series (as indicated by the subscripts), or by transformation from differences to means if this results in an increase in the significance of the *t* and *F* statistics. The prefix "sr" in the first row denotes that regression results might be spurious according to the analyses reported in Table 19, Table 20 and Table 21 and that inferences based on these statistics might be biased. χ^2 denotes the statistics of the Breusch-Pangan test for heteroskedasticity, based on the null hypothesis of homoskedasticity.

Several variables become significant after a slight transformation of the time series. The inclusion of a lead of three quarters to the industrial production variable causes heteroskedasticity in the error terms to disappear. This means that industrial production three quarters prior to deal activity is the more robust driver than the original time series. The change in operating income growth becomes significant at the 10% level if the variable is used with a lead of three quarters. The gross profit margin remains insignificant until the variable is changed from the differenced time series to the simple mean of EuroStoxx50 stocks. When this happens, the coefficient switches its sign and turns positive. This might suggest that private equity investors prefer to complete deals during periods of high profitability but declining growth rates. However, given the insignificance of the untransformed variables, this explanation must be seen only as a tentative interpretation and needs further support from more robust test results.

Similar results are obtained for sales growth and capital expenditure, both of which exhibit significant negative coefficients after time series are used with a lead of one or two quarters respectively. However, times series with a lead can hardly be interpreted as capital demand variables. These proxies were constructed to gauge capital demand prior to a private equity transaction by measuring spending after it. Specifically, if firms increase capital expenditure and sales after a certain point in time, corresponding capital demand must have existed beforehand. However, as the lagged time series are insignificant (results not reported), only the fixed-asset investments variable is left to support the capital demand hypothesis with various leads and lags, but the result remains affected from high heteroskedasticity.

The capital supply variables remain untransformed as they are already highly significant. For the information asymmetry variable change in the dispersion of earnings forecasts the result remains insignificant for various leads and lags. The market timing variable market-to-book ratio becomes significant at the 10% level, if the time series is used with a lead of three quarters. However, the sign of the coefficient turns negative suggesting that low market valuations for listed companies trigger deal activity in contrast to the market timing hypothesis. For the capital raised variable, coefficients, t and F statistics increase further if the variable is used with two leads. This finding is consistent with the view that buyout firms accelerate investments after periods of high liquidity inflows into the industry. For the number of first-time funds, significance increases once the time series is lagged by two quarters, lending support to the hypothesis that new private equity firms enter the market after periods of high activity.

To summarize, the results remain qualitatively unchanged when compared to the preceding regressions. However significance levels have changed for some variables. Similar to the regressions with the original independent variables, the regressions with the transformed variables support the *economic shock*, *capital supply*, *adverse selection* and *agency conflict* hypothesis. However, the evidence for the *capital demand* hypothesis remains weak and the results for the *market timing* hypothesis are inconclusive, since the signs of the coefficients are contradictory with regard to the predictions.

5.4.1.2 ***Venture Capital Transactions***

5.4.1.2.1 OLS Regressions with the Original Independent Variables

Regressions with the number of venture capital transactions as independent variables lead to related results, however, the evidence is weaker for two reasons: First, given that the number of venture capital investments is on average about 50% higher than the number of buyouts, the coefficients of the independent variables are usually higher in absolute terms too, although their significance is often lower. This can be attributed to the greater volatility of venture capital activity, as any regression suffers from low model significance if the independent variables exhibit too little fluctuation, or if the independent variables are considerably more volatile than the dependent variables. Second, there are many variables that are prone to spurious regressions (marked "sr" in Table 24), since the variables are nonstationary and not cointegrated with the independent variable. Together with the overall lower significance than that of the buyout regressions this leads to very few variables that ultimately support the predictions.

		Coefficient	t-statistic	R^2	F	χ^2
Economic shock variables						
sr	GDP	1.03 ***	9.35	0.532	87.38 ***	17.78 ***
sr	Industrial production	22.23 ***	20.11	0.567	102.30 ***	26.56 ***
	Business climate index	24.40 **	2.61	0.081	6.83 **	3.50 *
	Δ Operating income growth	-1.87	-1.34	0.038	1.79	0.41
	Δ Gross profit margin	74.14	0.71	0.013	0.50	0.04
sr	Probability of default	-0.31	-1.59	0.068	2.54	0.27
Capital demand variables						
sr	Fixed asset investments	0.57 ***	13.01	0.685	169.25 ***	24.62 ***
	Δ Sales growth	-2.44	-0.87	0.018	0.75	0.04
	Δ Capital expenditure	3.73	0.43	0.004	0.18	1.15
	Δ Total assets	9.82	0.34	0.003	0.12	0.10
Capital supply variables						
sr	Domestic credit	141.50 ***	5.34	0.268	28.54 ***	4.64 **
sr	High yield index	3.25 *	1.76	0.069	3.09 *	0.10
	Debt issuance	0.05 ***	6.14	0.326	37.69 ***	9.09 ***
sr	EURIBOR	-80.96 ***	-4.53	0.249	20.51 ***	1.40
Information asymmetry variables						
	Dispersion of earnings forecasts	914.56 ***	2.86	0.097	8.20 ***	0.10
	Trading volume	23.30 ***	5.27	0.263	27.79 ***	0.87
	Δ M2B non-dividend payers	-11.20 **	-2.30	0.114	5.29 **	0.51
Market timing variables						
	Market to book ratio	36.90	1.37	0.042	1.88	0.28
	IPO volume	15.91 ***	3.99	0.170	15.94 ***	0.31
sr	Spread AAA vs. CCC	-3.47 *	-1.80	0.079	3.24 *	0.15
Agency variables						
	VC capital raised	67.50 ***	5.70	0.294	32.46 ***	0.15
	Number of first time VC funds	22.08 ***	3.20	0.116	10.23 ***	0.27
	VC fund performance	-8.74 ***	-2.83	0.102	7.98 ***	1.32
	VC fund performance, liquidated	-1.88	-0.65	0.007	0.43	0.47

***; **; * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 24: OLS Regressions with the Original Independent Variables – Venture Capital

This table shows the results of OLS regressions with the number of venture investments as dependent variable. Transformations of the independent variables are conducted by using different leads or lags of the original series (as indicated by the subscripts), or by transformation from differences to means if this results in an increase in the significance of the *t* and *F* statistics. The prefix "sr" in the first row denotes that regression results might be spurious according to the analyses reported in Table 19, Table 20 and Table 21 and that inferences based on these statistics might be biased. χ^2 denotes the statistics of the Breusch-Pangan test for heteroskedasticity, based on the null hypothesis of homoskedasticity.

Evidence for the *economic shock* hypothesis is provided only by the business climate index, since the other variables are either insignificant or drawing inferences is impossible due to the spurious regression problem. For similar reasons, no supporting conclusion can be drawn from the regressions with the *capital demand* variables. Of the *capital supply* proxies, debt issuance exhibits a significant and (most likely) non-spurious relationship with the number of venture capital investments, although the regression suffers from heteroskedasticity.

The results for the information asymmetry and agency proxies are somewhat more conclusive. Coefficients and the significance of the coefficients for the information asymmetry variables are similar to the results for the buyout subsample suggesting in accordance with the *adverse selection* hypothesis, that lower levels of information asymmetries complement substantial investment activity. Unlike buyout activity, the number of venture capital investments correlates negatively to fund performance, suggesting that venture capital firms invest heavily during times of superior fund performance. Interestingly, this relationship does not hold if performance is measured by liquidated funds only.

To summarize, the findings for the venture capital sample do not contradict the results for the buyout sample, e.g. supporting evidence for the the *economic shock*, *capital supply*, *adverse selection, market timing* and *agency conflict* hypothesis. However, the number of significant variables is lower and more proxies might be prone to spurious regressions. No convincing evidence is found for the *capital demand* hypothesis.

5.4.1.2.2 OLS Regressions with Transformed Independent Variables

The regression results presented in Table 25 document that with corresponding lead or lag selection, almost all variables exhibit significant relationships with the venture capital investment activity.

		Coefficient	t-statistic	R^2	F	χ^2
Economic shock variables						
sr	GDP $_t$	1.03 ***	9.35	0.532	87.38 ***	17.78 ***
sr	Industrial production $_t$	22.23 ***	20.11	0.567	102.30 ***	26.56 ***
	Business climate index $_t$	24.40 **	2.61	0.081	6.83 **	3.50 *
	Ø Operating income growth $_{t-2}$	0.00 **	2.30	0.103	5.29	1.15
	Δ Gross profit margin $_t$	74.14	0.71	0.013	0.50	0.04
sr	Probability of default $_t$	-0.31	-1.59	0.068	2.54	0.27
Capital demand variables						
sr	Fixed asset investments $_t$	0.57 ***	13.01	0.685	169.25 ***	24.62 ***
	Δ Sales growth $_{t+4}$	6.38 **	2.47	0.141	6.09 **	0.39
	Ø Capital expenditure $_{t+3}$	13.84 *	1.73	0.058	2.98 *	0.00
	Δ Total assets $_t$	9.82	0.34	0.003	0.12	0.10
Capital supply variables						
sr	Domestic credit $_t$	141.50 ***	5.34	0.268	28.54 ***	4.64 **
sr	High yield index $_{t+1}$	4.57 **	2.56	0.14	6.57 **	0.13
	Debt issuance $_t$	0.05 ***	6.14	0.326	37.69 ***	9.09 ***
sr	EURIBOR $_t$	-80.96 ***	-4.53	0.249	20.51 ***	1.40
Information asymmetry variables						
	Dispersion of earnings forecasts $_t$	914.56 ***	2.86	0.097	8.20 ***	0.10
	Trading volume $_t$	23.30 ***	5.27	0.263	27.79 ***	0.87
	Δ M2B non-dividend payers $_t$	-11.20 **	-2.30	0.114	5.29 **	0.51
Market timing variables						
	Market to book ratio $_{t+2}$	66.03 ***	2.93	0.173	8.57 ***	0.07
	IPO volume $_t$	15.91 ***	3.99	0.170	15.94 ***	0.31
sr	Spread AAA vs. CCC $_{t+1}$	-4.13 **	-2.20	0.110	4.85 **	0.12
Agency variables						
	BO capital raised $_{t+1}$	0.07 ***	5.62	0.288	31.58 ***	0.58
	Number of first time BO funds $_{t+1}$	25.64 ***	3.69	0.149	13.63 ***	0.05
	BO fund performance $_{t-1}$	-9.49 ***	-2.70	0.102	7.98 ***	1.32
	BO fund performance, liquidated $_t$	-1.88	-0.65	0.007	0.43	0.47

***; **; * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 25: OLS Regressions with Transformed Independent Variables – Venture Capital

This table shows the results of OLS regressions with the number of venture investments as dependent variable. Transformations of the independent variables are conducted by using different leads or lags of the original series (as indicated by the subscripts), or by transforming differences to means if this results in an increase in the significance of the t and F statistics. The prefix "sr" in the first row indicates that regression results may be spurious, and that inferences based on these statistics may be biased. χ^2 denotes the statistics of the Breusch-Pangan test for heteroskedasticity, based on the null hypothesis of homoskedasticity.

When compared to the results of the preceding paragraph, in addition to the supporting evidence found for the the *economic shock*, *capital supply*, *adverse selection* and *agency conflict* hypothesis there is also support for the other hypotheses. In particular, the fact that listed companies experience significant sales growth after and increase their capital expenditure three and four quarters after brisk venture investment activity suggests that venture capitalist satisfy the *capital demand* of target companies.

The market timing variable market-to-book ratio is significantly positive if it is used with a lag of two quarters. This would in fact tell a slightly different *market timing* story: Rising valuation levels after private equity waves would suggest that venture capitalists would be able to time the market in that they do not invest at market peaks but complete transactions before price levels reach temporary highs.

However, the results presented so far, had the disadvantage of violating some of the assumptions for OLS regressions. In order to overcome these deficits, the next sections tests for serial correlation and subsequently presents more robust results.

5.4.2 Testing for Serial Correlation

The analyses so far have taken into account the spurious regression problem and heteroskedasticy. Concerns have already been expressed that regressions of time series regressions frequently suffer from serial correlation of the error terms. The resulting underestimation of the standard errors will then affect the efficiency of the estimators as this will lead to inflated test statistics and thus to biased inference (Wooldridge 2006, p. 435).

The following tests address this issue by testing for serial correlation. First a Durbin-Watson test is conducted. Then, in order to overcome the deficits of the Durbin-Watson test in allowing for heteroskedasticity and testing for higher-order serial correlation the Breusch-Godfrey test is performed (Wooldridge 1991).

	No. of obser-vations	Durbin-Watson			Breusch-Godfrey	
		d-statistic	d_U	d_L	χ^2	
Economic shock variables						
GDP $_t$	79	0.445	1.611	1.662	46.833	***
Industrial production $_{t-3}$	79	0.487	1.611	1.662	44.876	***
Business climate index $_{t-1}$	80	0.114	1.611	1.662	68.882	***
Δ Operating income growth $_{t-2}$	47	0.465	1.503	1.585	26.707	***
Ø Gross profit margin $_{t-2}$	40	0.598	1.442	1.566	17.911	***
Probability of default $_t$	37	0.685	1.442	1.566	15.185	***
Capital demand variables						
Fixed asset investments $_t$	80	0.801	1.611	1.662	28.675	***
Δ Sales growth $_{t-1}$	43	0.523	1.442	1.544	23.280	***
Ø Capital expenditure $_{t-2}$	48	0.392	1.503	1.585	27.724	***
Δ Total assets $_t$	43	0.307	1.442	1.544	26.668	***
Capital supply variables						
Domestic credit $_t$	80	0.207	1.611	1.662	64.285	***
High yield index $_t$	44	0.596	1.442	1.544	20.317	***
Debt issuance $_t$	80	0.240	1.611	1.662	61.741	***
EURIBOR $_t$	64	0.277	1.567	1.629	47.175	***
Information asymmetry variables						
Dispersion of earnings forecasts $_{t-2}$	75	0.167	1.598	1.652	62.051	***
Trading volume $_t$	80	1.002	1.611	1.662	25.258	***
Δ M2B non-dividend payers $_{t-3}$	43	0.556	1.442	1.544	21.288	***
Market timing variables						
Market to book ratio $_{t-3}$	45	0.221	1.442	1.544	28.029	***
IPO volume $_t$	80	0.455	1.611	1.662	54.971	***
Spread AAA vs. CCC $_t$	40	0.884	1.442	1.566	12.053	***
Agency variables						
BO capital raised $_{t-2}$	79	0.533	1.611	1.662	43.939	***
Number of first time BO funds $_{t+2}$	80	0.311	1.611	1.662	60.024	***
BO fund performance $_t$	72	0.110	1.598	1.652	62.794	***
BO fund performance, liquidated $_t$	55	0.210	1.528	1.601	43.113	***

*** Significance at the 1% level in two-sided significance tests.

Table 26: Serial Correlation Statistics of OLS Regression – Buyouts

	No. of obser-vations	Durbin-Watson			Breusch-Godfrey	
		d-statistic	d_U	d_L	χ^2	
Economic shock variables						
GDP $_t$	79	0.325	1.611	1.662	55.138	***
Industrial production $_t$	80	0.362	1.611	1.662	53.631	***
Business climate index $_t$	80	0.168	1.611	1.662	65.230	***
Ø Operating income growth $_{t-2}$	48	0.427	1.503	1.585	27.550	***
Δ Gross profit margin $_t$	39	0.507	1.442	1.566	20.158	***
Probability of default $_t$	37	0.662	1.442	1.566	13.003	***
Capital demand variables						
Fixed asset investments $_t$	80	0.476	1.611	1.662	46.419	***
Δ Sales growth $_{t+4}$	39	0.505	1.442	1.544	20.315	***
Ø Capital expenditure $_{t+3}$	45	0.592	1.503	1.585	20.877	***
Δ Total assets $_t$	43	0.436	1.442	1.544	21.759	***
Capital supply variables						
Domestic credit $_t$	80	0.214	1.611	1.662	63.651	***
High yield index $_{t+1}$	43	0.634	1.442	1.544	18.010	***
Debt issuance $_t$	80	0.233	1.611	1.662	62.233	***
EURIBOR $_t$	64	0.345	1.567	1.629	43.443	***
Information asymmetry variables						
Dispersion of earnings forecasts $_t$	78	0.304	1.598	1.652	57.730	***
Trading volume $_t$	80	0.672	1.611	1.662	39.753	***
Δ M2B non-dividend payers $_t$	43	0.737	1.442	1.544	18.357	***
Market timing variables						
Market to book ratio $_{t+2}$	45	0.428	1.442	1.544	20.360	***
IPO volume $_t$	80	0.488	1.611	1.662	52.109	***
Spread AAA vs. CCC $_{t+1}$	38	0.633	1.442	1.566	16.677	***
Agency variables						
VC capital raised $_{t+1}$	80	0.522	1.611	1.662	45.805	***
Number of first time VC funds $_{t+1}$	80	0.357	1.611	1.662	55.502	***
VC fund performance $_{t-1}$	72	0.386	1.598	1.652	49.945	***
VC fund performance, liquidated $_t$	67	0.193	1.528	1.601	53.552	***

*** Significance at the 1% level in two-sided significance tests.

Table 27: Serial Correlation Statistics of OLS Regression – Venture Investments

The results in Table 26 and Table 27 can be quickly summarized as documenting high levels of serial correlation with virtual certainty for both buyouts and venture capital investments. The Durbin-Watson *d* statistics reported in Table 26 must be compared with two sets of critical values, usually referred to as d_U (for upper) and d_L (for lower)

(Wooldridge 2006, p. 415). The critical values for a test at the 5% level and one regressor (the lagged time series) were obtained from Savin and White (1977) for the respective sample sizes (Savin and White 1977, p. 1994). Since the *d* statistics fall considerably below the lower critical values of the Durbin-Watson statistic in all regressions, the null hypothesis of no serial correlation must be rejected at the 5% level. Although Table 26 and Table 27 report only the critical values at the 5% level, the *d* statistics also fall below the 1% critical values (see Savin and White 1977).

The Breusch-Godfrey test uses a Lagrange multiplier procedure to test the null hypothesis of no serial correlation (Wooldridge 1991), which clearly has to be rejected for all regressions given the χ^2 statistics reported in Table 26 and Table 27 .

5.4.3 FGLS Regressions

In order to obtain more robust results FGLS regressions are performed using Prais-Winston estimators (Prais and Winsten 1954) and calculating robust standard errors with the White-Huber estimator (MacKinnon and White 1985) for the regressions in which the previous tests have indicated heteroskedasticity.

The regressions are rerun for all variables with up to four leads and lags. The most significant statistic determines the lag that is presented in Table 28 and Table 29.

	Coefficient	*t*-statistic	R^2	F
Economic shock variables				
GDP $_{t-4}$	0.81 ***	10.08	0.535	84.61 ***
Industrial production $_{t-1}$	13.93 ***	8.16	0.383	59.15 ***
Business climate index $_t$	10.12 ***	2.64	0.050	5.42 ***
Δ Operating income growth $_{t-2}$	-0.09	-0.27	0.000	0.00
Ø Gross profit margin $_{t-2}$	2.89 ***	2.70	0.087	28.56 ***
Probability of default $_t$	-0.15	-1.65	0.274	53.09 ***
Capital demand variables				
Fixed asset investments $_{t+1}$	-0.37 ***	10.99	0.605	119.86 ***
Δ Sales growth $_{t+4}$	1.13 *	-1.75	0.200	9.26 ***
Ø Capital expenditure $_{t-2}$	0.85	0.35	0.000	0.00
Δ Total assets $_{t+2}$	-10.75 *	-1.87	0.286	15.61 ***
Capital supply variables				
Domestic credit $_{t-3}$	0.07 **	2.57	0.044	8.04
High yield index $_t$	2.15 **	2.05	0.093	4.32 **
Debt issuance $_t$	0.01	0.63	0.000	3.69 **
EURIBOR $_t$	20.95	1.60	0.013	0.83
Information asymmetry variables				
Δ Dispersion of earnings forecasts	-40.15	-1.33	0.000	3.53
Trading volume $_{t-1}$	2.28 **	2.32	0.045	3.63 *
Δ M2B non-dividend payers $_t$	-3.03 **	-2.54	0.104	4.78 **
Market timing variables				
Market to book ratio $_{t-2}$	16.55 **	2.30	0.109	5.27 **
IPO volume $_t$	0.52	0.72	0.000	2.06
Spread AAA vs. CCC $_t$	-3.03 ***	-2.95	0.245	12.30 ***
Agency variables				
BO capital raised $_{t-3}$	1.34 **	2.17	0.042	5.32 ***
Number of first time BO funds $_{t+2}$	2.10	-0.70	0.000	2.16
BO fund performance $_t$	0.23	1.00	0.000	2.92
BO fund performance, liquidated $_t$	-0.33	-1.03	0.000	0.00

***, **, * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 28: FGLS Regressions with Robust Standard Errors – Buyouts

This table presents FGLS regression results with the number of buyouts as dependent variable. FGLS regressions are performed using Prais-Winston estimators and calculating robust standard errors with the White-Huber estimator for the regressions in which the previous tests have indicated heteroskedasticity.

The FGLS results for the buyout sample do not differ fundamentally from the OLS regressions presented earlier in this study, as most of the independent variables exhibit coefficients of similar scale, but the significance is reduced for a number of variables. The latter point is not surprising, since the regression method has been chosen to correct potentially inflated test statistics.

The *economic shock* hypothesis is supported by the results, although the change in operating income and the probability of default have turned insignificant. For the other variables, the results are quite robust to the use of various leads. For example, GDP exhibits the greatest significance if it is used with a lead of four quarters implying that deal activity reacts to GDP with a lag of one year. The results for the *capital demand* variables are inconclusive. In particular, some of the coefficients exhibit signs that are contradictory to the prior results and to the supposed prediction or the coefficients even switch signs between different lags. Support is maintained for the *capital supply* hypothesis, although debt issuance and EURIBOR are insignificant in FGLS regressions. The coefficients of the other variables are significant and exhibit signs in line with the prediction. However, the R^2 are very small. While most of the coefficients exhibit a similar scale compared to the previous results for the domestic credit variable the absolute value of the coefficient is much smaller than previously estimated. Regarding the information asymmetries, the results are qualitatively unchanged in terms of significance and provide support for the *adverse selection* hypothesis. However, the R^2 of the trading volume variable is severely reduced suggesting that this variable has little explanatory power for the buyout activity. Support for the *market timing* hypothesis is provided by the significant coefficients of the market-to-book ratio and the spread between AAA and CCC rated bonds that suggest a negative relationship between deal activity and stock market valuations and a reverse impact of credit spreads.

The support for the *agency conflict* hypothesis is weak, since there is only one variable with a significant coefficient and the R^2 is rather small.

	Coefficient	t-statistic	R^2	F
Economic shock variables				
GDP $_{t-4}$	1.08 ***	3.67	0.135	19.40 ***
Industrial production $_{t}$	16.73 ***	3.39	0.092	11.38 ***
Business climate index $_{t}$	12.80 *	1.98	0.007	3.37 **
Ø Operating income growth $_{t-2}$	0.00 *	1.98	0.012	0.58
Ø Gross profit margin $_{t}$	5.56 **	2.79	0.220	10.74 ***
Probability of default $_{t}$	-0.15	-1.65	0.274	53.09 ***
Capital demand variables				
Fixed asset investments $_{t+1}$	0.51 ***	4.55	0.185	22.68 ***
Δ Sales growth $_{t+4}$	4.38 ***	3.33	0.349	19.85 ***
Ø Capital expenditure $_{t-2}$	0.85	0.35	0.000	0.00
Δ Total assets $_{t+2}$	-29.25 **	-2.05	0.225	11.33 ***
Capital supply variables				
Domestic credit $_{t-2}$	0.12 *	1.87	0.008	4.54 **
High yield index $_{t}$	2.15 **	2.05	0.093	4.32 **
Debt issuance $_{t-2}$	0.04 **	2.14	0.009	4.59 **
EURIBOR $_{t}$	10.07	0.36	0.000	0.83
Information asymmetry variables				
Δ Dispersion of earnings forecasts	20.16	0.25	0.000	0.00
Trading volume $_{t}$	-5.19 **	-2.46	0.061	5.02 **
Δ M2B non-dividend payers $_{t}$	-8.64 ***	-3.35	0.185	9.28 **
Market timing variables				
Market to book ratio $_{t+2}$	38.52 ***	2.22	0.173	8.56 ***
IPO volume $_{t}$	0.06	0.00	0.000	0.00
Spread AAA vs. CCC $_{t+1}$	-3.26	-1.28	0.189	8.40 ***
Agency variables				
VC capital raised $_{t+1}$	0.00	0.46	0.000	0.00
Number of first time VC funds $_{t+1}$	3.84	1.52	0.014	1.11
VC fund performance $_{t-1}$	-0.69	-0.64	0.000	0.00
VC fund performance, liquidated $_{t}$	-0.84	-0.88	0.000	0.00

***, **, * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 29: FGLS Regressions with Robust Standard Errors – Venture Investments

This table presents FGLS regression results with the number of venture investments as dependent variable. FGLS regressions are performed using Prais-Winston estimators and calculating robust standard errors with the White-Huber estimator for the regressions in which the previous tests have indicated heteroskedasticity.

For the venture capital sample, the FGLS regressions provide additional support for the *economic shock* hypothesis. Regarding the *capital demand* hypothesis, the evidence is ambiguous. On the one hand, the lagged fixed asset investments and the change in sales growth exhibit a significant positive relationship with deal activity in line with the prediction. On the other hand, the coefficient of capital expenditure is insignificant albeit positive and – even more worrying – the coefficient of the change in total assets lagged by two quarters is significantly negative. However, as for the buyout sample, the coefficient for this variable has turned out to be very sensitive to the choice of the lag length apparently switching the sign at random. This suggests that it might be better to put only little weight on this variable. Given the fact that the aggregated volume of fixed asset investments – probably the best proxy for the aggregate capital demand – exhibits a positive relationship with the deal volume it appears reasonable to value the results in favor of the *capital demand* hypothesis.

The results for the remaining hypotheses are inconclusive. In particular, the *capital supply* hypothesis is only supported by two out of four proxies and the sign of the coefficient for EURIBOR is negative in contrast to the prediction. Of the information asymmetry variables only two exhibit significant coefficients but with contradictory results regarding the *value add* and *adverse selection cost* hypothesis. Of the *market timing* variables only market-to-book ratio exhibits a significantly positive coefficient. However, the variable is lagged by two quarters, which would not be consistent with valuation levels driving the deal activity. Finally, the *agency conflict* variables seem to be irrelevant for the venture capital investment activity since none of them exhibits a significant coefficient.

5.4.4 Summary of Findings

The univariate results suggest that for the majority of the hypotheses supporting evidence has been found while conducting the analyses. However, the results for the respective hypotheses differ in terms of significance and in their robustness to different statistical approaches and transformations of the proxy variables.

	BO			VC		
	OLS		FGLS	OLS		FGLS
	Original time series	Transformed time series		Original time series	Transformed time series	
Neoclassical view						
Economic shock hypothesis	+	+	+	+	+	+
Capital demand hypothesis	o	o	o	o	+	+
Capital supply hypothesis	+	+	+	+	+	o
Information asymmetry view						
Adverse selection hypothesis	+	+	+	+	+	o
Value add hypothesis	o	o	o	o	o	o
Market timing hypothesis	+	+	+	o	+	o
Agency conflict hypothesis	+	+	o	+	+	o

+ Results with supporting evidence; o results without supporting evidence.

Table 30: Summary of Findings of the Univariate Driver Analysis at Aggregate Level

Table 30 summarizes the findings of the univariate regressions at aggregate level. The *economic shock* hypothesis is supported throughout the respective analyses for both buyouts and venture investments suggesting that private equity firms accelerate their investment behavior when economic prospects improve. *Capital supply* seems to play an important role, too as hypothesized. However, while the results suggest that venture investments are driven by the aggregate *capital demand*, no such evidence is found for buyouts. The results document that following periods of high venture capital investment activity the aggregate level of fixed investments increases and listed companies are expanding which is reflected in sales increases. The operationalization hereby assumes that this pattern indicates a corresponding capital demand at the time, the private equity deals are made and that the funds raised in such transactions are subsequently invested in fixed assets or expansion plans.

The *adverse selection* hypothesis is supported by the results for both subsamples. In particular, investment activity seems to slow down during times of high information asymmetries and to accelerate when information asymmetries decrease.

The results for the *market timing* hypothesis differ between the two subsamples. For buyout transactions, market timing seams to play a role in terms of IPO activity and in terms of credit market conditions that appear to foster deal activity if high yield debt becomes comparatively cheap relative to investment grade debt measured by the spread between AAA and CCC rated bonds. However, for venture capital investments these conditions seem to be less decisive.

Finally, the *agency conflict* hypothesis is supported by the results albeit not by the FGLS regressions. Nevertheless, as the agency conflict variables are I(0), OLS regressions should be not be spurious. The results suggest that private equity firms accelerate investment activity when they have raised exceptional amounts of fund liquidity. Moreover, the number of first-time funds increase following periods of high deal activity, which is in line with the suggestion that those new entrants increase the competition for deals.

5.5 Multivariate Analysis

5.5.1 Introduction

The aim of this section is to fit multivariate models based on the findings of univariate evidence. While univariate results may be able provide hints about which variables have to be considered, they do not allow to model the dependent variable, if theory suggests that the drivers jointly affect the dependent variable. In particular, univariate models are prone to misspecification errors if a multivariate relationship is suggested by theory.

Two popular approaches to this kind of task are stepwise and hierarchical regressions (Gliner and Morgan 2000, p. 297). In stepwise regressions, which variables are included in the model is decided on the basis of the statistical properties of the variables. The forward method starts with an empty equation and adds variables only if the model fit and significance is improved. The backward method starts with a full model and then subsequently drops insignificant variables until the model is reduced to only statistically significant variables (Meyers, Gamst and Guarino 2006, p. 174). This procedure has the serious drawback of selecting explanatory variables on purely statistical grounds, however. This weakens the external validity of the study, e.g. the generalizability of the results, as a model might easily be overfitted following this procedure (Lovell 1983, p. 6). The hierarchical approach predefines the order in which the variables are included in the model (Gliner and Morgan 2000, p. 297).

The approach described below contains a stepwise element without basing the "inclusion versus exclusion" decision entirely on a statistical basis. Moreover, the results are not interpreted as being ultimate theoretical models. The results are more conservatively interpreted, in particular as different operationalizations of the hypotheses already tested. Finally, since it turns out that the results for buyouts and venture capital investments are quite similar, the variable selection can hardly be the result of a random effect.

In a first step, a full model consisting of all variables found to be significant in the univariate results is fitted for each hypothesis. The models are amended as specified below and compared to each other. Unfortunately, the number of observations for all multivariate models is limited to the number of observations in the shortest time series. In order to obtain models that cover a longer time horizon, models were therefore tested that only contain time series that are available for at least 75 quarters. Finally, different models that emerge from different theoretical viewpoints were discussed.

The lag length for the variables is determined by the lag length identified in the univariate regressions. Where the lag length is different in OLS and FGLS, the appropriateness of the two regression methods determines which should be chosen. In particular, if not otherwise stated and reasoned, the lag length from the OLS results is applied, provided that the OLS results are considered to be unbiased. However, if FGLS estimators are to be preferred,[1] the lag length identified by FGLS is employed.

5.5.2 Fitting the Buyout Model

One way to test the competing hypotheses against each other is to construct multivariate models that each consist of only those variables that support a particular hypothesis, and then to compare significance, F statistics and R^2. Table 31 and Table 32 summarize the tests of such alternative models. To control for potential seasonality effects, dummy variables for the different quarters are included in the full models. However, none of the quarter dummies is significant in any of the models, suggesting that there is no particular quarter in which deal makers prefer to handle transactions.

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[1] This is particularily the case if the supposed relationship is likely to be spurious.

In the full *economic shock* model presented in row one, only the probability of default index is significant at the 5% level. Reducing the model to the time series that are available for almost twenty years on a quarterly basis results in significant coefficients for the long-term economic time series. However, the high-variance inflation factors reported in Table 65 in Appendix 10.3 raise severe concerns with regard to multicollinearity.

The leads identified by the FGLS regressions are used for the *capital demand* variables, since the OLS regression found only those variables with a lead to be significant. It therefore makes little sense to use these as capital demand proxies, as the logic of operationalization requires the proxies for the capital demand variable to be lagged relative to investment activity. Two out of three variables are significant and suggest a positive relationship between aggregate capital demand and the number of buyouts. Reducing the model to the significant variables results in an increase of R^2 from 29% to 40%. Multicollinearity seems not be an issue for this combination of variables, given the low VIF values.

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	986.73	-759.40 ***	-502.98 **	-553.70 ***	-359.49	145.652 *
	(1.26)	(-2.76)	(-2.07)	(-3.51)	(-4.14)	(1.88)
Economic shock variables						
GDP $_{t-4}$	0.26	0.51 ***				
	(0.83)	(3.55)				
Industrial production $_{t-1}$	-0.44	7.18 **				
	(-0.09)	(2.56)				
Business climate index $_{t-1}$	-11.58 *	-5.55 **				
	(-1.78)	(-2.51)				
Ø Gross profit margin $_{t-2}$	5.04					
	(1.33)					
Probability of default $_{t}$	-0.55 **					
	(-2.29)					
Capital demand variables						
Fixed asset investments $_{t+1}$			0.36 ***	0.38 ***		
			(3.90)	(5.56)		
Δ Sales growth $_{t+4}$			1.38 **	1.66 ***		
			(2.29)	(7.86)		
Ø Capital expenditure $_{t+2}$			-2.00			
			(-0.42)			
Capital supply variables						
Domestic credit $_{t}$					-0.08	
					(-0.69)	
High yield index $_{t}$					4.41 ***	4.12 ***
					(5.81)	(5.50)
Debt issuance $_{t}$					-0.05	
					(1.00)	
EURIBOR $_{t}$					56.62 ***	33.86 ***
					(3.47)	(4.16)
Control variables						
1st quarter dummy	11.69		-15.49		-16.74	
	(0.32)		(-0.39)		(-0.58)	
2nd quarter dummy	-6.09		14.43		-29.53	
	(-0.16)		(0.33)		(-0.99)	
3rd quarter dummy	-17.75		-20.98		-47.07	
	(-0.45)		(-0.47)		(-1.42)	
Number of observations	32	75	37	39	44	44
F-statistic	5.07 ***	220.77 ***	17.15 ***	39.05 ***	12.16 ***	23.700 ***
Adjusted R^2	0.406	0.868	0.287	0.408	0.545	0.442

***, **, * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 31: Neoclassical Models of Buyouts

This table presents multivariate Newey-West regression results with the number of buyouts as dependent variables. *T*-statistics are presented in parentheses.

Models 5 and 6 indicate that the high-yield index and EURIBOR seem to possess considerable explanatory power. However, in contrast to the prediction made by the *capital supply* hypothesis, the EURIBOR coefficient is positive.

Remarkably, some of the coefficients – e.g. industrial production, business climate index, domestic credit, debt issuance and EURIBOR – switch signs, which contradicts both the predictions and the univariate results. The contradictory signs delivered by the neoclassical variables are most likely attributable to the fact that these variables are closely correlated time series, and that combinations of these series lead to odd results. In a multivariate regression, the coefficients can be interpreted as the impact of the independent variable on the dependent variable, if controlled for all other variables (Anderson, Williams and Sweeney 2008). For two closely correlated variables that are combined in a single model, this has the following implication: The coefficient of the variable with the lower impact on the independent variable will naturally turn negative if controlled for the (stronger) impact of the other variable. For instance, in the univariate results, the coefficient for domestic credit is about three times as high as the coefficient for debt issuance. Consistent with this finding, if both variables are combined in model 7 of Table 31, then the coefficient of debt issuance becomes negative.

Fortunately, the variables associated with the other variables are less closely correlated as indicated by the VIF values in Table 66. Hence, their combination in one model is more promising. Model 2 in Table 32 shows that the two *information asymmetry* proxies are able to significantly explain 15% of the variance of deal activity. The positive coefficient of trading volume and the negative coefficient of the difference between the market-to-book ratio of dividend payers and non-dividend payers suggest that high levels of information asymmetries hamper buyout activity as predicted by the *adverse selection* hypothesis. The results for the *market timing* variables are inconclusive, since only the spread between AAA- and CCC-rated bonds is significant and the sign of the market-to-book ratio is contradictory. Nevertheless, the market timing model is able to account for more than 50% of variance. The *agency conflict* model is highly significant and explains about half of the variance in deal activity. The coefficients suggest that buyout firms speed up investment activity two quarters after they have raised above-average amounts of liquid funds, and that the number of first-time funds increases following periods of busy deal activity.

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	212.91 ***	240.53 ***	442.75 ***	418.73 ***	57.76 *	94.562 ***
	(4.87)	(6.82)	(6.87)	(7.51)	(1.67)	(4.42)
Information asymmetry variables						
Trading volume $_t$	11.29 ***	7.34 ***				
	(3.92)	(2.85)				
Δ M2B non-dividend $_{t-3}$	-3.95 ***	-3.05 **				
	(-2.97)	(-2.02)				
Market timing variables						
Market to book ratio $_{t-3}$			-16.73	-17.28		
			(-0.63)	(-1.08)		
IPO volume $_t$			1.70	1.86		
			(0.90)	(1.13)		
Spread AAA vs. CCC $_t$			-4.35 ***	-4.19 ***		
			(-6.13)	(-5.89)		
Agency variables						
BO capital raised $_{t-2}$					7.43 ***	7.327 ***
					(6.52)	(6.38)
Number of first time BO funds $_{t+2}$					30.64 ***	28.321 ***
					(4.12)	(3.77)
Control variables						
1st quarter dummy	-62.54		-18.21		4.11	
	(-1.59)		(-0.56)		(0.11)	
2nd quarter dummy	-37.17		-35.30		42.39	
	(-0.92)		(-1.06)		(1.09)	
3rd quarter dummy	25.19		-32.98		5.95	
	(0.58)		(-0.86)		(0.15)	
Number of observations	43	43	36	36	79	79
F-statistic	6.19 ***	6.36 ***	8.05 ***	16.08 ***	15.22 ***	33.480 ***
Adjusted R^2	0.168	0.150	0.573	0.507	0.496	0.505

***, **, * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 32: Information Asymmetry, Market Timing and Agency Conflict Models of Buyouts

This table presents multivariate Newey-West regression results with the number of buyouts as dependent variable. *T*-statistics are presented in parentheses.

Since many of the time series are only available for a part of the sample period, the previous regressions often had less than 40 observations and thus covered only the past decade. The following analysis therefore considers only explanatory variables that cover at least 75 quarters. A backward stepwise regression as shown in Table 33 results in a pure *neoclassical* model, which is able to account for 90% of the fluctuations presented in row six.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	630.43	617.88	616.91	330.26	338.15	343.57	1160.53 **
	(1.33)	(1.34)	(1.35)	(0.96)	(0.99)	(0.96)	(2.01)
Economic shock variables							
GDP $_{t-4}$	-1.13 **	-1.10 **	-1.10 **	-1.03 **	-1.09 **	-1.18 **	-1.73 **
	(-2.45)	(-2.47)	(-2.52)	(-2.46)	(0.01)	(-2.66)	(-3.08)
Industrial production $_{t-1}$	9.91 *	9.73 *	9.73 *	5.51 *	6.09 **	7.13 **	9.00
	(1.92)	(1.99)	(2.01)	(1.98)	(2.05)	(2.49)	(1.43)
Business climate index $_{t-1}$	-4.46	-4.49	-4.50				
	(-1.05)	(-1.08)	(-1.08)				
Capital demand variables							
Fixed asset investments $_{t}$	0.41 ***	0.41 ***	0.41 ***	0.45 ***	0.49 ***	0.50 ***	0.42 **
	(3.80)	(3.83)	(3.86)	(4.96)	(5.45)	(5.54)	(2.06)
Capital supply variables							
Domestic credit	-0.23 ***	-2.35 ***	-0.24 ***	-0.20 ***	-0.22 ***	-0.23 ***	-0.35 ***
	(0.00)	(-3.04)	(-3.07)	(-2.93)	(-3.27)	(-3.45)	(-3.39)
Debt issuance	0.12 ***	0.11 ***	0.11 ***	0.11 ***	0.11 ***	0.12 ***	0.19 ***
	(3.04)	(3.05)	(3.08)	(3.00)	(3.18)	(3.42)	(3.50)
Information asymmetry variables							
Trading volume $_{t-1}$	2.48	2.59	2.59	2.90	3.12		
	(0.23)	(1.32)	(1.36)	(1.50)	(1.57)		
Market timing variables							
IPO volume	1.75	1.72	1.72	1.53			
	(1.31)	(1.34)	(1.33)	(1.26)			
Agency variables							
BO capital raised	-0.14						
	(-0.16)						
No. of first time BO funds	1.04	0.13					
	(0.28)	(0.03)					
Number of observations	75	75	75	75	75	75	36
F-statistic	100.21	11.29	125.67	138.31	139.47	140.44	6.83
Adjusted R^2	0.903	0.905	0.906	0.906	0.905	0.902	0.454

***, **, * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 33: Long Time Series of Buyouts

This table presents multivariate Newey-West regression results with the number of buyouts as dependent variable. The combination of independent variables is determined with the help of backward selections using all time series that consist of at least 75 observations (quarters). The least significant variable is dropped from each row to the subsequent regression. *T*-statistics are presented in parentheses.

The coefficients presented in Table 33 are fairly robust throughout the different model modifications, and are also robust to shortening the sample period to the recent 36 quarters as documented by model seven. However, R^2 then decreases to less than 50% which might be explained by two alternative approaches: First, the loss in explanatory power could be simply due to the reduction of the sample size. Second, it could also imply that in the more recent period, other factors have become more important to explain deal activity.

Nevertheless, all models suffer from pronounced multicollinearity, as documented by the high variance inflation factors reported in Table 66 in Appendix 10.3. Colinearity is also reflected in the changes in coefficients when compared to the univariate results. As discussed earlier, for highly correlated variables, the coefficients in a multivariate model represent the relative impact of the variables when compared to the other variables; they do not represent their impact in isolation. Although it is not possible to meaningfully model the variables together and then interpret the coefficient, it can be concluded that neoclassical variables can explain a large part of the variance in buyout activity. However, the variables used in the models shown in Table 33 do not allow economic shocks, capital demand and capital supply to be modeled as distinctive factors.

In order to obtain a neoclassical model that is less impacted by multicollinearity, it has to be avoided to put some of the closely correlated long time series together in one model. The neoclassical variable with the highest R^2 in univariate OLS regressions – fixed-asset investment – is therefore chosen and combined with the remaining (rather uncorrelated) time series, as shown in model 1 in Table 34. Despite the high F and R^2 values and the fact that most variables are significant, the VIF values reported in Table 69 in Appendix 10.3 still document colinearity between the independent variables. The high-yield index, the variable with the highest VIF, is therefore dropped in model 2. The coefficients are in line with the predictions of the neoclassical hypotheses and almost 70% of the variance in buyout activity can be explained. However, the EURIBOR coefficient is insignificant.

Model three employs GPD as the economic shock variable and adds the uncorrelated variables sales growth and EURIBOR to the neoclassical model. It then includes one variable for each of the other hypotheses, in particular using the most significant variable in univariate OLS regressions. Only two coefficients are significant and the model suffers from multicollinearity. The variable with the highest VIF is the spread between AAA- and CCC- rated bonds. Replacing this variable by a different market timing proxy – IPO volume – leads to another multicolinear model, of which capital raised exhibits the highest VIF. Replacing funds raised by the number of first-time funds leads to a model that seems to be unaffected by multicollinearity. However, EURIBOR and the number of first-time funds are insignificant. Dropping the insignificant variables in model six does neither substantially change the *F* statistic nor R^2. Remarkably, the combined models explain less than 40% of the variance in buyout activity, which is less than in the market timing or agency conflict models in Table 32, let alone neoclassical model two in Table 34.

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-531.7 ***	-376.78 **	751.8	-418.8	363.4	-511.4
	(-3.66)	(-2.11)	(1.54)	(-0.98)	(-1.00)	(-1.71) *
Economic shock variables						
GDP $_{t-4}$			-0.3	0.4	0.4 *	0.4 **
			(-0.97)	(1.60)	(1.89)	(2.50)
Probability of default $_t$	0.08	-0.21 ***				
	(0.81)	(-5.33)				
Capital demand variables						
Fixed asset investments $_{t+1}$	0.2 **	0.32 ***				
	(2.09)	(3.80)				
Δ Sales growth $_{t+4}$	1.2 ***	1.45 ***	0.9	0.8 **	1.2 ***	0.9 ***
	(5.29)	(6.19)	(0.97)	(2.06)	(2.89)	(3.40)
Capital supply variables						
Domestic credit						
High yield index	3.99 ***					
	(3.95)					
EURIBOR	20.0 **	-2.66	29.3 *	-4.0	-2.2	
	(2.05)	(-0.28)	(1.90)	(-0.26)	(-0.17)	
Information asymmetry variables						
Trading volume $_{t-1}$			2.7	4.6	4.5 *	4.6 *
			(1.35)	(1.75)	(1.84)	(1.78)
Market timing variables						
IPO volume				5.9 **	5.8 **	5.9 **
				(2.40)	(2.36)	(2.52)
Spread AAA vs. CCC			-6.4 ***			
			(-4.36)			
Agency variables						
BO capital raised			0.4	1.0		
			(0.05)	(0.24)		
No. of first time BO funds					-10.7	
					(-1.10)	
Number of observations	36	36	34	34	34	34
F-statistic	97.86 ***	28.90 ***	13.28 ***	5.23 ***	7.70 ***	7.98 ***
Adjusted R^2	0.622	0.683	0.498	0.311	0.338	0.357

***, **, * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 34: Neoclassical and Combined Models – Buyouts

This table presents multivariate Newey-West regression results with the number of buyouts as dependent variables. *T*-statistics are presented in parentheses.

5.5.3 Fitting the Venture Capital Model

The neoclassical models of venture capital investments in Table 35 are not fundamentally different from the findings for the buyout activity. Since the dependent variables are virtually the same, except for the number of lags in some cases, multicollinearity is also an issue here for the economic shock and capital supply models. The variance explained by the models is generally lower than in the case of buyouts, as would be expected given the higher variance in the number of venture capital investments. One notable difference to the buyout models is the high coefficient of sales growth, indicating that EuroStoxx companies significantly increase sales four quarters after high venture capital activity – a finding that seems to be less meaningful for the timing of buyouts. This is consistent with venture capital investments clustering in the early stages of the business cycle.

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	1450.21	-1357.1 **	527.40	501.85	1334.28 **	618.836 ***
	(0.79)	(-2.07)	(1.20)	(1.22)	(2.29)	(3.37)
Economic shock variables						
GDP $_{t-4}$	-0.18	1.31 ***				
	(-0.86)	(2.95)				
Industrial production $_{t}$	-26.61 ***	-2.00				
	(-5.79)	(-0.21)				
Business climate index $_{t}$	25.24	-3.22				
	(1.51)	(-0.43)				
Δ Gross profit margin $_{t}$	6.99					
	(1.15)					
Probability of default $_{t}$	-0.50 **					
	(-0.70)					
Capital demand variables						
Fixed asset investments $_{t+1}$			0.00	0.00		
			(0.02)	(0.02)		
Δ Sales growth $_{t+4}$			5.90 ***	6.39 ***		
			(4.98)	(10.15)		
Capital supply variables						
Domestic credit $_{t-2}$					-0.66 **	-6.29 **
					(-2.38)	(-2.53)
High yield index $_{t}$					4.78 ***	4.46 ***
					(3.47)	(3.37)
Debt issuance $_{t}$					0.23 *	0.22 **
					(1.93)	(2.03)
EURIBOR $_{t}$					145.70 **	137.78 **
					(2.47)	(2.36)
Control variables						
1st quarter dummy	-72.64		-41.76			
	(-0.86)		(-0.44)		-80.92	
2nd quarter dummy	-88.19		-16.87		(-1.03)	
	(-1.11)		(-0.18)		-113.96	
3rd quarter dummy	-17.75		-43.69		(-1.49)	
	(-0.45)		(-0.47)		-110.27	
					(-1.50)	
	32	75	39	39	44	44
	23.07 ***	57.33 ***	34.21 ***	77.91 ***	6.61 ***	12.11 ***
	0.382	0.630	0.022	0.094	0.318	0.304

***, **, * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 35: Neoclassical Models of Venture Capital Investments

This table presents multivariate Newey-West regression results with the number of venture capital investments as dependent variable. *T*-statistics are presented in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	615.01 ***	502.41 ***	479.57 ***	431.50 ***	240.91 ***	195.67
	(4.58)	(6.69)	(4.61)	(6.64)	(3.00)	(4.54)
Information asymmetry variables						
Trading volume $_t$	-3.79	0.84				
	(-0.45)	(0.16)				
Δ M2B non-dividend payers $_t$	-7.18 *	-6.23 *				
	(-1.86)	(-1.98)				
Market timing variables						
Market to book ratio $_{t+2}$			79.11 ***	78.18 ***		
			(4.01)	(3.60)		
IPO volume $_t$			-5.72 *	-5.69 *		
			(-1.76)	(-1.75)		
Spread AAA vs. CCC $_{t+1}$			-4.087 **	-3.55 **		
			(-2.49)	(6.64)		
Agency variables						
VC capital raised $_{t+1/t-1}$					52.33 ***	38.31 ***
					(4.54)	(4.09)
Number of first time VC funds $_{t+1}$					6.03	14.88 ***
					(0.95)	(2.57)
VC fund performance $_{t-1}$					-5.08 *	-5.89 ***
					(-1.86)	(-2.56)
Control variables						
1st quarter dummy	-79.07		-6.57		4.11	
	(-0.85)		(-0.08)		(0.11)	
2nd quarter dummy	-26.35		-114.56		42.39	
	(-0.27)		(-1.51)		(1.09)	
3rd quarter dummy	-124.97		-63.96		5.95	
	(-1.16)		(-0.77)		(0.15)	
Number of observations	43	43	38	38	72	72
F-statistic	1.04	6.36 ***	4.96 **	7.29 **	17.13 ***	17.94 ***
Adjusted R^2	-0.039	-0.013	0.274	0.274	0.255	0.259

***, **, * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 36: Information Asymmetry, Market Timing and Agency Conflict Models of Venture Capital Investments

This table presents multivariate Newey-West regression results with the number of venture capital investments as dependent variable. *T*-statistics are presented in parentheses.

The low VIF values shown in Table 70 in Appendix 10.3 suggest that multicollinearity seems not to be an issue for the regressions presented in Table 36. In the information asymmetry model, none of the coefficients are significant at the 5% level. The adjusted R^2 is actually negative. This suggests that information asymmetries at the aggregate level are less influential for venture capital transactions. The market timing models, however, are highly significant, although the coefficients are contradictory.

This is also the case for the buyout model. The agency conflict model in row six suggests that venture capitalists seem to increase their investment activity following periods of exceptionally successful fundraising and that new players enter the market after they have observed high deal volumes. Surprising is, however, the negative relationship between fund returns and deal activity. This might be due to the fact that venture capital performance is highly volatile in Europe or can be regarded as comparatively "noisy" (see section 7).

Constructing a model out of the variables that are available for almost 20 years is quite similar to the procedure done for the buyout sample. Table 37 highlights that backward selection leads to a highly significant neoclassical model that is suffering from pronounced mulitcolinearity (see Table 70 in Appendix 10.3), which is, however, able to explain 80% of the variance of investment activity.

As for the buyout model it is the aim to construct a combined model that does not suffer from high multicollinearity. Sales growth and fixed asset investments are the first variables to be included in the model as these two variables are the ones with the greatest explanatory power in univariate regressions and exhibit only a minor correlation. Since the same correlations apply for the independent variables as argued in the preceding paragraph, the same variables are selected in the models presented in Table 37, but with their respective leads and lags determined in the above sections.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	248.21	274.80	418.93	119.79	117.02	-211.87	-423.76	-154.51
	(0.51)	(0.39)	(0.57)	(0.20)	(0.03)	(-0.39)	(-1.08)	(-0.12)
Economic shock variables								
GDP $_{t-4}$	-2.13 *	-2.13 ***	-2.07 **	-2.17 ***	-2.01 ***	-2.05 ***	-2.00 ***	-2.05 **
	(-2.60)	(-2.65)	(-2.69)	(-3.00)	(-3.15)	(-3.18)	(-3.16)	(-2.85)
Industrial production $_t$	27.44 **	26.83 **	26.63 **	19.67 **	19.08 **	23.36 ***	25.21 ***	36.01 *
	(2.40)	(2.39)	(2.38)	(2.31)	(2.26)	(2.74)	(3.21)	(1.82)
Business climate index $_t$	-7.17	-6.24	-8.09					
	(-6.30)	(-0.55)	(-0.72)					
Capital demand variables								
Fixed asset investments $_t$	1.10 ***	1.13 ***	1.09 ***	1.20 ***	1.17 ***	1.19 ***	1.19 ***	0.77 *
	(4.00)	(4.19)	(4.31)	(7.04)	(7.42)	(7.55)	(7.87)	(1.72)
Capital supply variables								
Domestic credit $_{t-2}$	-0.73 ***	-0.73 ***	-0.72 ***	-0.70 ***	-0.68 ***	-0.71 ***	-0.67 ***	-0.71 ***
	(-4.89)	(-4.93)	(-5.05)	(-4.99)	(-5.01)	(-5.60)	(-5.44)	(-3.41)
Debt issuance $_t$	0.23 ***	0.23 ***	0.23 ***	0.23 ***	0.21 ***	0.21 ***	0.18 ***	0.17 **
	(3.30)	(3.30)	(3.31)	(3.37)	(3.36)	(3.43)	(3.65)	(2.40)
Information asymmetry variables								
Trading volume $_t$	-4.44	-4.46	-4.79	-4.18				
	(-0.82)	(-0.83)	(1.01)	(-0.80)				
Market timing variables								
IPO volume $_t$	1.01							
	(0.27)							
Agency variables								
VC capital raised $_{t-1}$	-3.75	-3.74						
	(-0.16)	(-0.31)						
Number of first time VC	5.19	5.34	5.55	5.27	5.19			
	(0.97)	(0.99)	(1.01)	(1.00)	(0.33)			
VC fund performance $_{t-1}$	-2.08	-1.97	-1.85	-1.98	-2.06	-2.39		
	(-1.05)	(-1.03)	(-0.99)	(-1.10)	(-1.20)	(-1.46)		
Number of observations	68	68	68	68	68	68	75	36
F-statistic	41.72 ***	45.12 ***	51.71 ***	57.30 ***	66.32 ***	66.32 ***	92.92 ***	14.90 ***
Adjusted R^2	0.765	0.769	0.772	0.774	0.775	0.774	0.799	0.419

***, **, * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 37: Long Time Series of Venture Capital Investments

This table presents multivariate Newey-West regression results with the number of venture capital investments as dependent variable. The combination of independent variables is determined with the help of backward selections using all time series that consist of at least 75 observations (quarters). The least significant variable is dropped from each row to the subsequent regression . *T*-statistics are presented in parentheses.

Combining these variables in model one of Table 38 results in a model with highly significant coefficients and adjusted R^2 of 48%. However, high multicollineariy is also present as indicated by the high VIF values in Table 71 in Appendix 10.3. The VIF values suggest that the high yield index and the probality of default index seem to be the major sources of multicollinearity. Dropping the first variable results in model two in which coefficients are lacking significance and which is only able to explain less that 25% of variance in venture capital investment activity. Dropping the second variable instead, leads to an increase in explanatory power as suggested by the R^2 of 38% and to an increase of significance of the coefficients reported in model three. Notably, in contrast to the predictions of the neoclassical hypotheses the coefficient of fixed asset investments is negative and of EURIBOR positive. However, dropping for each of these variables the respective other variable for the respective hypothesis, e.g. sales growth and the high yield index, results in a switch of signs according to the predictions (results not shown) as does the construction of an interaction term of both variables (results not shown). This documents the bilateral interaction for both pairs of variables.

Model four adds three additional variables, one for each of the remaining hypotheses. However, only the information asymmetry variable is significant and only at the 10% level. Dropping the insignificant variables does results in a model that is able to explain 45% of the variance in deal activity.

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	281.0	684.64	863.2 **	837.9 **	882.9 **	451.6
	(0.74)	(1.44)	(2.60)	(2.46)	(2.69)	(1.32)
Economic shock variables						
Probability of default $_t$	0.43 *	-0.32 **				
	(1.92)	(-2.30)				
Capital demand variables						
Fixed asset investments $_{t+1}$	-0.41 **	-0.07	-0.53 ***	-0.44 ***	-0.45 **	-0.26
	(-2.39)	(-0.38)	(-3.33)	(-3.01)	(-2.52)	(-1.43)
Δ Sales growth $_{t+4}$	5.60 ***	6.38 ***	5.63 ***	4.91 ***	4.56 **	4.41 **
	(10.99)	(8.50)	(9.80)	(5.12)	(2.16)	(2.23)
Capital supply variables						
Domestic credit $_t$						
High yield index $_t$	10.39 ***		7.55 ***	6.98 ***	6.99 ***	6.73 ***
	(4.20)		(5.04)	(5.51)	(3.91)	(3.80)
EURIBOR $_t$	67.35 **	8.30	76.25 ***	60.39 **	70.18 ***	20.99
	(2.05)	(0.28)	(3.12)	(2.39)	(3.17)	(0.78)
Information asymmetry variables						
Trading volume $_t$				-9.62 *	-10.23 **	-6.58
				(-1.89)	(-2.36)	(0.14)
Market timing variables						
Market to book ratio $_{t+2}$						20.38
						(0.85)
IPO volume $_t$				1.58		
				(0.64)		
Agency variables						
VC capital raised $_{t-1}$				11.5		
				(1.29)		
No. of first time VC funds $_{t-1}$						14.76 *
						(2.03)
Number of observations	36	36	39	39	39	37
F-statistic	120.05 ***	62.94 ***	80.18 ***	60.19 ***	7.35 ***	28.13 ***
Adjusted R^2	0.480	0.246	0.382	0.444	0.455	0.524

***, **, * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 38: Neoclassical and Combined Models – Venture Capital

This table presents multivariate Newey-West regression results with the number of venture capital investment as dependent variables. *T*-statistics are presented in parentheses.

5.5.4 Summary of Findings

At an aggregate level and for both samples, it is impossible to determine whether economic shocks, capital demand and capital supply are distinctive factors. Nevertheless, the explanatory power of neoclassical models seem to oughtweight the other hypotheses.

	BO		VC	
	Individual model	Full model	Individual model	Full model
Neoclassical view				
Economic shock hypothesis	+	+	+	+
Capital demand hypothesis	+	+	+	+
Capital supply hypothesis	+	o	+	o
Information asymmetry view				
Adverse selection hypothesis	+	+	o	o
Value add hypothesis	o	o	o	o
Market timing hypothesis	o	+	o	o
Agency conflict hypothesis	+	o	+	o

+ Results with supporting evidence; o results without supporting evidence.

Table 39: Summary of Findings of the Univariate Driver Analysis at Aggregate Level

This table summarizes the findings of the multivariate analyses conducted at aggregate leve. Individual model refers to multivariate models including only variables for a particular hypothesis. Full model refers to models consisting of proxy variables for all competing hypothesis.

Table 39 summarizes the findings of the multivariate regressions on aggregate level. The results show that the explanatory power of neoclassical hypotheses are greatest and most robust. While there has been at least some evidence for most of the other hypotheses, this evidence has been weakened by either contradictory signs of the coefficients or a lack in significance.

5.6 Conclusion

Both univariate and multivariate results document that neoclassical hypotheses explain a lot of the variance of both, buyouts and venture capital transactions, at aggregate level. In particular, *economic shocks* seem to be a very decisive factor for both subsamples as univariate and multivariate evidence documents. For the *capital demand* and the *capital supply* hypothesis the results are also lagely in line with the predictions, however it seems that capital demand is more crucial for venture capital activity, which is in particular reflected by the high sales increases following periods of high investment activity.

While the univariate results pointed to an *adverse selection* cost view for both subsamples, this is only confirmed for buyouts and the evidence for venture capital seems a lot weaker. A similar picture is drawn for the *agency conflict* hypothesis as the support for this view on private equity investments has been more supported by the univariate results than by the multivariate results. However, for both hypotheses the weaker evidence could also result from the fact, that the hypotheses do explain a certain share of variance but their explanatory power is outweighed by the high explanatory power of the neoclassical variables.

Finally, *market timing* variables seem to have an impact on buyout activity, when IPO activity and the spread between investment grade and non-investment grade debt is considered. However, no supporting evidence for market timing is found for venture investments. The market-to-book ratio as a measure of market wide valuation levels has little explanatory power at aggregate level for both subsamples and sometimes lead to contradictory results suggesting that dealmakers can hardly take advantage of misevaluations at aggregate level.

Overall, the results are more significant for buyouts than for venture capital activity. Moreover, the time series pattern of the dependent and independent variables analyzed in sections 5.2 and 5.3.3 suggest that the results for the buyout sample will be less likely to be affected by biases induced by undesirable statistical properties.

6 Empirical Part II: Drivers at Industry Level

6.1 Introduction

The aim of this section is to investigate the drivers of private equity investment activity at industry level. This approach is motivated by the established view that waves of mergers are also driven to a large extent by industry dynamics (see Mitchell and Mulherin 1996, Harford 2005 and Bartholdy et al. 2009, for example). This part of the study focuses on drivers that are considered to be particularly sensitive to industry-specific developments. Accordingly, the industry-level analysis focuses on the economic shock and the capital demand side of the neoclassical perspective, information asymmetries and market timing as potential drivers. Capital supply and agency aspects, however, are considered to be less closely bound to sector dynamics and impossible to measure at industry level. For these reasons, they have been excluded from the industry-level analysis.

The empirical approach has been organized as follows: Section 6.2 decribes the classification of deals into 17 different industry sectors in accordance with the MoneyTree™ industry classification followed by the identification of buyout and venture capital waves for the 80-quarter sample period. In section 6.3 hypotheses are formulated based on the theoretical framework developed in section 3. For each of these hypotheses, alternative proxies are constructed that are hypothesized to exhibit a statistical relationship with the dependent variable, e.g. deal activity. These steps of data preparation and operationalization in section 6.4 are followed by two kinds of statistical tests reported in section 6.5. First, rank models are used to examine the explanatory power of the hypothesized drivers, i.e. whether drivers exhibit abnormal levels when private equity waves begin. Second, the predictive power of the drivers is tested using univariate and multivariate logit models. These kinds of tests allow to conclude whether private equity waves are more likely to occur if individual drivers exhibit particular levels. Section 6.6 analyzes the timing of buyout waves relative to venture capital. The results are finally summarized and discussed in section 6.7.

6.2 Identification of Waves

The data provided by Thomson One Banker includes industry classifications for the target company in each transaction. Different classification systems are provided such as SIC codes, NAIC codes and MoneyTree™[1] industry classifications. Although SIC codes seem to be widespread in industry-level financial analyses (see Mitchell and Mulherin (1996) or Bernstein et al. (2010), for example), the MoneyTree™ industry classification is used in this analysis, for two reasons. First, the SIC codes for a considerable number of deals are missing from the database. Specifically, 27% of target companies remain unclassified; and these unclassified firms would actually constitute the biggest industry in the sample. Using the MoneyTree™ industry classification, however, only 2% of transactions have to be assigned to the "Other" category. Second, using double-digit SIC codes results in 82 industries out of which 26 experienced less than 100 deals between 1990 and 2009. That appears to be too little to analyze the clustering of transactions over a sample period of 80 quarters. The MoneyTree™ classification splits the sample into 17 industry groups, the smallest of which contains 619 deals. While any industry segmentations have their limitations and entail arbitrary aspects (see Gompers et al. (2008) and Lowry (2003), for example), the 17 industries selected are believed by the author to bracket together companies that are subject to similar technological and regulatory shocks and business cycle dynamics.

Identifying private equity waves in specific industries follows a procedure applied by Harford (2005) and Bartholdy et al. (2009) in the investigation of merger waves. For each of the 17 industries, buyout and venture capital transactions were counted per quarter. To identify potential waves, the total number of deals over a two-year period was used as a measure of deal activity. The two-year criterion has been used by Mitchell and Mulherin (1996) and Harford (2005) and has the advantage of being relatively robust with regard to outliers. This is a useful feature for a measure of activity, as a single quarter with exceptionally high deal activity does not necessarily indicate a wave. However, if the same high volume persists over several quarters, then the two-year activity will be high as well and thus identify the period as a wave.

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[1] The quarterly MoneyTree™ report is a study of venture capital activity in the United States provided in collaboration between PricewaterhouseCoopers and the National Venture Capital Association and using data from Thomson Reuters.

In order to define "exceptionally high" activity, 1,000 simulations of the distributions of the actual number of transactions over the 20-year period were run for each of the 17 industries. For each simulation the maximum two-year concentration of transactions was recorded. Then, the 95-percentile of the 1,000 simulated maximum two-year concentrations is defined as threshold for a wave in a given industry. This number is used to determine abnormally high deal activity in the actual times series of the number of transactions for the industry concerned. Once the two-year concentration exceeds the threshold for at least two quarters, a wave is identified which starts one year before the two-year activity goes beyond the threshold. This ensures that identified waves are not lagged just because of the two-year activity threshold. If the gap between two consecutive waves is only one quarter, this low-activity quarter is manually adjusted into a high-activity quarter. Thus, the quarter that belongs to the high-activity period and the wave are not split into two wave periods. For each industry, this procedure is performed for the time series of the number of venture capital and buyout transactions and for the total number of transactions.

As shown in Table 40, most industries experience one or two waves of venture capital, buyout and total private equity activity. In total, 24 venture capital waves and 24 buyout waves were identified over the 20-year period. Although the total numbers of waves are equal, the number of venture capital and buyout waves on a single industry level differs in many industries, suggesting that the dynamics of both types of transaction follow a different pattern. Focusing on the combined activity of buyout and venture capital transactions, the number of waves identified with the above mentioned procedure is 22, which is less than the 24 waves in each of the two subsamples. The reason for this difference is that the aggregate activity can only be at an abnormally high level, if the deal activity is simultaneously high in both subsamples.

Industry	Number of waves VC	BO	Total
Biotechnology	1	1	1
Business Products and Services	2	2	2
Computers and Peripherals	1	2	2
Consumer Products and Services	2	1	2
Electronics/Instrumentation	1	1	1
Financial Services	2	2	1
Healthcare Services	1	2	1
Industrial/Energy	1	1	1
IT Services	1	1	1
Media and Entertainment	1	2	1
Medical Devices and Equipment	1	1	1
Networking and Equipment	3	1	2
Other	1	2	1
Retailing/Distribution	2	2	2
Semiconductors	1	1	1
Software	2	1	1
Telecommunications	1	1	1
Total	24	24	22

Table 40: Number of Identified Waves per Industry in Europe from 1990 to 2009

This table shows the number of waves per industry in Europe between 1990 and 2009. The waves were identified with the aid of an activity threshold that was derived from simulations of the actual number of transactions per industry. "Total" means the combined activity of VC and BO transactions.

Figure 18 highlights the identified venture capital and buyout waves. Although it is easy to see that overall deal activity is clustered around the turn of the century and 2003 to 2005, the waves vary substantially – both across industries and in terms of the type of transaction (buyout or venture capital) – with regard to their starting quarter and duration. In order to investigate potential drivers on an industry level, the section below outlines hypotheses and conducts statistical tests using proxies for potential drivers.

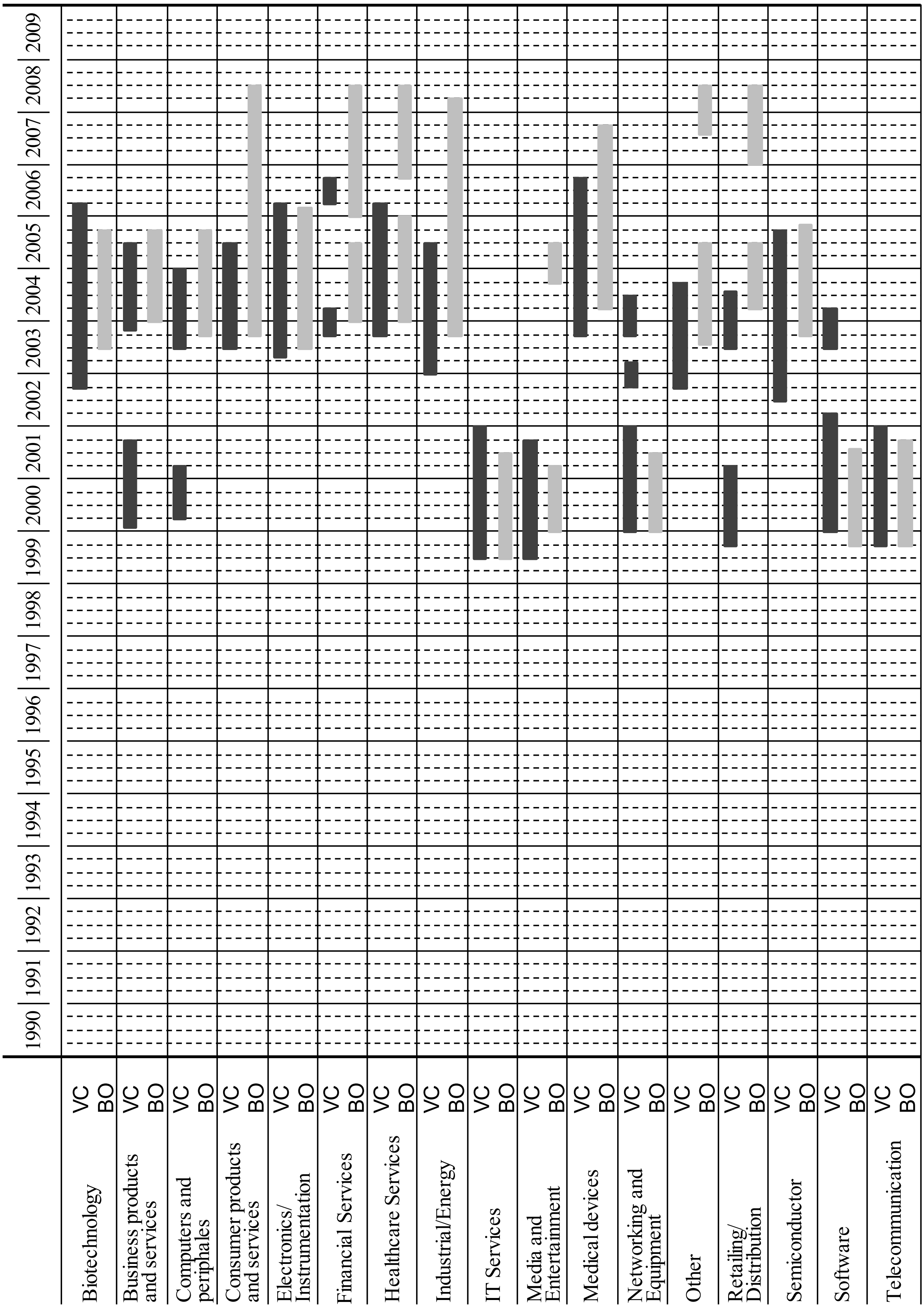

Figure 18: Venture Capital and Buyout Waves per Industry

The horizontal bars in this figure exhibit the duration of the identified waves per industry in Europe from 1990-2009

6.3 Hypotheses Development

Within the theoretical framework summarized in Figure 10, the analysis at industry level aims to shed light on neoclassical drivers, drivers that arise from changes in information asymmetries, and drivers that are associated with market timing. These three dimensions of the theoretical framework are the ones that may be most sensitive to specific industry developments. The economic effects of new technologies and regulations are often concentrated on certain industries and can stimulate growth or consolidation while also affecting operational and financial performance. Such developments are also supposed to have an impact on the level of information asymmetries in the industries concerned. However, as already outlined in the research model presented in Figure 15 in section 4.3.2, two hypotheses would not have theoretical grounds on industry level. In particular, the capital supply hypothesis relates to the willingness of debt and equity providers to finance private equity transactions. Those funds are usually not tied to particular industries which makes the industry level perspective redundant and impossible to operationalize. Similarly, the agency theoretical perspective refers to incentives of general partners to take advantage from overinvestment. These incentives exist regardless of the respective industries and there is no theoretical concept that explain why certain industries would temporarily provide more opportunities to realize those interests. For those reasons, the capital supply hypothesis and the agency conflict hypothesis are omitted in the industry level analysis. The other hypotheses are translated into an industry level context as follows:

The neoclassical view of private equity investments asserts that deal activity should be closely linked to the business cycle and economic shocks to certain industries. Based on economic fundamentals, this perspective is in line with the popular reasoning reflected in research into waves of mergers, (see Mitchell and Mulherin (1996), Shleifer and Vishny (2003), Harford (2005) and Yan (2006), for example). One central tenet of this view is that, for specific industries, temporary positive economic shocks stimulate demand for capital among the firms that operate in these industries. This is because more NPV-positive investment opportunities arise if economic conditions become more favorable and growth and profitability prospects improve. As private equity firms identify this promising outlook, they respond to the increasing demand for capital, resulting in a clustering of transactions in the respective industries. To separate the economic shock view from the capital demand view and to facilitate accurate measurement, two hypotheses have been formulated to capture the aforementioned reasoning:

N1: The more positive economic shocks occur in a particular industry, the greater the level of deal activity (economic shock hypothesis).

N2: The greater the demand for capital in a particular industry, the greater the level of deal activity (capital demand hypothesis).

The impact of information asymmetries on deal activity might be twofold, e.g. the adverse selection cost view and the value add view predict contrary relationships between the level of information asymmetries and deal activity: Traditional corporate finance theory states that information asymmetries increase the adverse selection cost of issuing equity (Myers and Majluf 1984). As a result, company management will normally prefer other types of financing (such as debt) or will postpone the issue of equity until information asymmetries have decreased. Although the adverse selection cost argument may hold for firms that have reached a certain stage of maturity in their corporate development, particularly venture capital investments follow a different corporate financing logic. Investments in startups and fast-growing companies are typically subject to immense information asymmetries (Amit et al. 1998), as they commit to new and unproven technologies and business models. Mitigating these substantial information asymmetries, however, is one of the main factors that enable venture capitalists to add value (Sahlmann 1990; Gompers and Lerner 1998; Cumming and Johan 2008). Amit et al. (1998) have shown theoretically and Gompers (1995) has provided empirical evidence that venture capitalists focus on investments precisely where information asymmetries with regard to uninformed or non-specialist investors are particularly large. They do so because these are the types of investments where they can add the greatest value und therefore earn the highest fees for their financing services (Gompers 1995; Amit et al. 1998, p. 441; Gompers and Lerner 2001, p. 155). Thus, two competing predictions must be tested:

IA1: The greater the information asymmetries in an industry, the lower the level of deal activity (adverse selection hypothesis).

IA2: The greater the information asymmetries in an industry, the greater the level of deal activity (value add hypothesis).

Advocates of market timing theories claim that high valuations during boom phases reflect target companies' ability to exploit temporary misvaluations in order to issue equity when they consider their companies to be overvalued (Kaplan and Strömberg 2009).

MT: The more favorable the industry-wide valuation level, the greater the level of deal activity (market timing hypothesis).

It should be noted that valuations levels cannot be interpreted exclusively in the context of the market timing theory, as high valuations are also consistent with alternative theories. The neoclassical view of industry-wide valuation levels is that valuations simply reflect an industry's general outlook. If publicly listed companies exhibit relatively high market valuations in relation to fundamentals such as earnings or the book value of assets, this indicates substantial growth opportunities which are derived from the availability of attractive investment opportunities (Brealey et al. 2008, p. 831). According to agency theoretical reasoning, the clustering of private equity transactions during high valuation periods is attributed to competition between private equity firms who overpay in bidding contests for the limited number of suitable targets (Jensen 1991, p. 26; Kaplan and Stein 1993, p. 348).

Despite the existing alternative interpretations of changing valuation levels over time, this study uses valuation levels in a context of market timing in line with Baker and Wurgler (2002), Harford (2005) and Kaplan and Strömberg (2009)

6.4 Test Specifications

The statistical tests used to investigate the formulated hypotheses above employ proxies, since none of the postulated drivers is directly observable. To measure the industry-wide properties of a potential driver or proxy, comparable European companies are selected to represent each of the industry groups, thereby constructing peer groups for the target companies.

6.4.1 Selection of Peer Companies for each Industry

Thomson One Banker's company analysis module is used to gather proxy data for the peer companies. Since industry classifications in the company analysis module are based on SIC codes only, MoneyTree™ industries must first be matched to SIC codes. Given that SIC codes are available for the majority of target companies, the most frequent SIC codes are used as industry specifications and as search criteria for each MoneyTree™ industry. In order to increase the chances of obtaining a detailed history of financial data going back up to 20 years, the search is further limited to companies with a market capitalization of more than EUR 1 billion. From the resultant "long list", an attempt is made to select companies that (according to their business description) are likely to be sensitive to the same factors as the industry description suggests. In some cases, it is not possible to find suitable listed European peer companies with a market capitalization of EUR 1 billion. For example, almost all the key manufacturers of computers and peripherals are based in either the USA, Japan or Taiwan. In such cases, the peer group search is extended to include overseas players and European companies in related industries. Staying with the example of the computer industry, two software companies, for instance, are thus included in the peer group. The matched SIC codes and 188 hand-picked peer companies are listed in Appendix 10.1.

6.4.2 Proxy Development

From the proxies developed for the aggregate level analysis, industry level specific proxies are constructed on the basis of listed industry peer groups. Therefore, the financial ratios described in Table 41 are computed for the identified peer companies by taking the equally weighted mean across all peer group members of a given industry for a given year. This leads to a time series over 20 years for each proxy and each industry. Thus, each proxy measures the state of a particular industry by aggregating financial information of publicly listed companies.

Several proxies employed for the aggregate level analysis cannot be obtained on industry level or are by nature macroeconomic data which only exist on aggregate level. Consequently, the proxies represent a subset of the variables introduced for the aggregate analysis.

Proxy	Description	Source	Prediction
Economic shock proxies			
Δ Operating income growth	Mean of absolute change in the year-to-year percentage growth of operating income of EuroStoxx50 companies	Thomson One Banker	+
Δ Gross profit margin	Mean of the absolute change in gross profit margin as a percentage of net sales of EuroStoxx50 companies	Thomson One Banker	+
Capital demand proxies			
Δ Sales growth	Mean of absolute change in the year-to-year percentage growth of net sales of EuroStoxx50 companies	Thomson One Banker	+
Δ Capital expenditure	Mean of the absolute change in capital expenditure as a percentage of net sales of EuroStoxx50 companies	Thomson One Banker	+
Δ Total assets	Mean of the absolute change in total assets in EUR amounts of EuroStoxx50 companies	Thomson One Banker	+
Information asymmetry proxies			
Disp. of earnings forecasts	Equal weighted disperion of earnings forecast of EuroStoxx50 companies, where the dispersion for a given company and a given quarter is the average of mean weighted standard deviation across all available analyst forecasts of earnings per share	I/B/E/S	-/+
Market timing proxies			
Market to book ratio	Market value of assets divided by the book value of assets as per end of the period	Thomson One Banker	+
Price earnings ratio	Stock price divided by the net income per share	Datastream	+

Table 41: Proxy Specifications

This table lists and describes the proxies used for the industry-level analysis. "Prediction" refers to the predicted relationship between the proxy and the number of deals pursuant to the respective hypothesis. In particular, "+" denotes a positive relationship and "—" an inverse relationship.

6.4.2.1 *Neoclassical Proxies*

6.4.2.1.1 Economic Shock Proxies

For the economic shock hypothesis (N1), two financial ratios are employed that serve as a measure of the economic condition and overall financial performance of a certain industry: operating income and gross profit margin. These variables are motivated by related research on merger waves (Mitchell and Mulherin 1996; Harford 2005) and IPO waves (Lowry 2003, p. 14) and are examined one year before a wave occurs. As economic shocks should have an impact on the profitability of a given sector, any positive development in these ratios at listed companies is interpreted as a positive economic shock to the respective industry

6.4.2.1.2 Capital Demand Proxies

Capital demand on industry level is measured as the development of three proxies is investigated one year after a wave starts. The proxies are capital expenditure, total assets and sales growth in accordance with the aggregate level analysis. These variables measure the use of financial funds one year after the wave start. Spending thus serves as a lagged proxy for capital demand one year before a wave began.

6.4.2.2 ***Information Asymmetry Proxy***

Information asymmetries are measured with the help of the dispersion of analysts forecasts for the respective industries as introduced in section 5.3.2.2.. The proxies for each industry are constructed by calculating the equal weighted dispersion of earnings forecasts of peer companies.[1] This dispersion for each peer company and for each quarter is calculated by computing the mean weighted standard deviation across all available analyst forecasts of earnings per share.

6.4.2.3 ***Market Timing Proxies***

As in the aggregate level analysis, the market-to-book ratio of peer companies is used to measure the valuation level of industries. This ratio proxies market timing by entrepreneurs and shareholders who issue equity or dispose of their shares if market prices for equity temporarily reach high levels. Unfortunately, the other proxies used on aggregate level are not available on industry level. In order to not only rely on one proxy, another proxy similar to the market-to-book ratio is employed: The price-

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[1] That way, the heterogeneity of beliefs regarding the earnings prospects of publicly listed peer companies in a particular industry serves as a measure of information asymmetries for the whole sector.

earnings ratio is used measured as the market value of a firm, which is denoted as the stock price divided by the earnings per share.[1]

6.4.3 Test Design

The statistical approach has been adopted from papers by Harford (2005) and Bartholdy et al. (2009) about merger waves. If the constructed proxies are correct measures of factors that are indeed driving deal activity, then the proxy variables will reach high levels when private equity waves occur. To measure whether this is the case, a quartile rank is assigned to each value in the 20-year time series of the proxy variables for each industry. Then, the corresponding rank of the proxy variable is recorded for every occurance of an industry wave. A separate sample is thus created for every proxy. Since there are 24 venture capital waves and 24 buyout waves, each proxy sample contains 24 observations. The procedure is repeated for each proxy, for the buyout waves and for the venture capital waves. These samples, consisting of the proxy ranks at the start of the wave, are then tested to determine whether their mean is significantly higher than 2.5. A mean rank of 2.5 or a rank which is indistinguishable from 2.5 would be equivalent to an ordinary level of the proxy. However, a rank of the proxy value significantly higher or lower than 2.5 indicates that proxy values are at abnormal levels when private equity waves start.

In order to facilitate the imagination of the procedure the following introduces an exemplified illustration of the approach. Table 42 illustrates the methodology for this kind of analysis using a simple example of the market-to-book ratio proxy. Let us imagine that, instead of the 17 industries defined, there were only two sectors, media & entertainment and financial services, each consisting of only five peer companies. The table presents the market-to-book ratios for each year and each peer company, and an equal weighted industry mean is calculated of the cross-section of peer companies. A quartile rank is then assigned to the mean of each time series. The longitudinal mean of the market-to-book ratio, shown in the last column, is 4.6 for media & entertainment companies and 2.0 for the financial services sample. The differential might reflect the fact that financial businesses are a lot more asset-intensive than

[1] For both proxies a high proxy value signifies a high valuation level of comparable companies in a given industry.

media and entertainment companies. As in the case of construction, the longitudinal mean of the ranks is 2.5. The highlighted columns mark the start of an industry wave.

Market-to-Book Ratio	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Mean
Media and Entertainment																					
Axel Springer AG	5.0	3.4	3.8	3.9	3.4	4.7	4.2	4.8	4.7	6.8	5.8	5.4	4.0	3.9	3.1	2.8	2.4	2.6	1.5	2.0	3.9
Pearson PLC	2.5	1.9	2.0	3.4	3.0	4.2	11.0	29.9	7.0	9.3	3.2	1.8	1.4	1.7	1.9	1.6	1.8	1.6	1.1	1.6	4.6
M6-Metropole TV	0.0	0.0	0.0	0.0	8.7	6.5	5.6	7.0	10.0	28.6	26.3	16.3	9.3	8.6	6.1	6.1	4.5	3.0	2.2	2.8	7.6
United Business Media	3.1	3.6	6.3	3.8	3.7	6.0	-12.2	-5.6	3.1	6.1	1.8	2.7	4.7	13.4	9.1	4.0	3.7	4.3	2.7	3.0	3.4
Telenor ASA	-	-	-	-	-	-	-	-	-	-	1.9	1.6	1.4	2.1	2.5	2.4	3.4	3.2	0.9	1.8	2.1
Industry Mean	2.7	2.2	3.0	2.7	4.7	5.4	2.1	9.0	6.2	12.7	7.8	5.6	4.1	5.9	4.5	3.4	3.1	2.9	1.7	2.2	4.6
Rank	1	1	2	2	3	3	1	4	4	4	4	3	3	4	3	2	2	2	1	1	2.5
Financial Services																					
AWD Holding AG	-	-	-	-	-	-	-	-	-	-	3.9	1.7	4.0	11.3	10.5	7.9	11.1	9.4	22.8	0.0	8.3
Danske Bank A/S	0.7	0.8	0.7	1.0	0.9	0.9	1.0	1.8	1.5	1.4	2.1	1.7	1.4	1.6	1.8	1.9	1.8	1.3	0.4	0.8	1.3
Euler Hermes	-	-	-	-	-	-	-	-	-	-	2.3	1.8	0.9	1.4	1.7	2.1	2.7	1.9	0.9	1.3	1.7
Rothschild	-	-	-	-	1.7	1.4	1.3	1.3	1.6	1.3	1.9	1.5	1.1	1.7	1.7	2.2	2.6	3.7	2.4	2.3	1.8
Natixis	-	-	-	-	-	-	-	-	-	1.0	1.2	1.2	1.0	1.1	1.2	1.2	1.5	0.9	0.2	0.5	1.0
Industry Mean	0.7	0.8	0.7	1.0	1.3	1.1	1.1	1.5	1.6	1.3	2.3	1.6	1.7	3.4	3.4	3.1	3.9	3.4	5.3	1.0	2.0
Rank	1	1	1	1	2	2	2	2	3	2	3	3	3	4	4	3	4	4	4	1	2.5

Industry	Wave start	Proxy value	Rank	*T*-statistic	*p*-value
Media and Entertainment	2000	7.8	4		
Media and Entertainment	2004	4.5	3		
Financial Services	2004	3.4	4		
Financial Services	2006	3.9	4		
Median		4.2	4		
Mean			3.8		
H_0: rank < 2.5				5.0	0.008

Table 42: Rank Model – Illustration of Methodology

For one company in the media & entertainment industry and three firms in the financial services sector, the data in the Thomson One Banker database does not cover the full sample period, since a number of firms went public during the time interval of observation. However, this deficiency is not too serious as the crucial values for the years in which waves started are included. Still, a potential bias could arise if the companies that entered the sample during the period under observation via IPO had above-average market-to-book ratios. That would increase the industry mean and thus inflate the ranks towards the end of the sample period, when most waves occur. However, as illustrated by Table 61 and Table 62 in Appendix 10.2, the ranks are robust enough to exclude those companies that exhibit an average market-to-book ratio that is above the industry mean (e.g. AWD Holding) and to exclude all firms with missing values, e.g. companies that were not part of the sample for the full observation period. The ranks of the mean book-to-market ratios for the year in which a wave start are then combined to form a sample of four observations, presented at the bottom of Table 42. The median of the ranks is 4, as three out of four proxy values are in the top quartile. The mean rank is 3.8, which is significantly higher than the 2.5 figure at the 1% level.

The analysis exemplified above is conducted using the full sample for the buyout and venture capital waves, for each proxy and for each industry. It takes account of the full peer groups, consisting of 7 to 31 peers per industry with a mean of 12 peer companies per industry.

In a first step, the rank model illustrated in Table 42 is investigated in order to test the explanatory power of the proxy variables. This analysis tests whether the proxy values in an industry were at abnormal levels each time an industry wave occurred. In a second step, logit regressions are performed as a robustness check to the aforementioned analysis. The results of the logit models can be further interpreted as tests of the predictive power of the postulated drivers (DeMaris 1992, p. 54), since the logit regressions test whether waves are more likely to occur if the proxy variables are at extreme levels.

6.5 Results

6.5.1 Explanatory Power of the Postulated Drivers

Table 43 shows the mean proxy value for all industry wave occurrences and the median and mean ranks of all proxy observations for each industry wave. If the mean rank is significantly higher than 2.5, this indicates that the proxy variable exhibits an abnormally high level when an industry wave occurs. Therefore, a one-sided t-test is performed with the null hypothesis that the mean rank is less than 2.5. The corresponding *p* value is presented in the appropriate column. For selected variables that exhibit a mean smaller than 2.5, a one-sided test is conducted with the null hypothesis that the mean rank is less than 2.5.

	Variable Median	Rank		p-value	
		Median	Mean	H_0: rank < 2.5	H_0: rank > 2.5
Economic shock variables					
Δ Operating income growth$_{t-1}$	0.9	3.0	2.619	0.3770	
Δ Gross profit margin$_{t-1}$	0.2	2.0	2.143 †	0.9183	0.0818
Capital demand variables					
Δ Capital expenditure$_{t+1}$	-0.2	3.0	2.905 *	0.0523	
Δ Total assets$_{t+1}$	517.7	4.0	3.333 ***	0.0009	
Δ Sales growth$_{t+1}$	3.0	3.0	2.857 *	0.0855	
Market timing variables					
Market-to-book-ratio$_t$	2.9	4.0	3.381 ***	0.0000	
Price-earnings-ratio$_t$	3.6	4.0	3.286 ***	0.0000	
Information asymmetry variable					
Δ Dispersion of earnings forecasts $_t$	-3.8	2.0	1.941 ††	0.9801	0.0199

***; **; * Significantly higher than 2.5 at the 1%, 5%, and 10% levels in one-sided significance tests
†††; ††; † Significantly lower than 2.5 at the 1%, 5%, and 10% levels in one-sided significance tests

Table 43: Explanatory Power Tests – Buyout Industry Waves

This table shows the results of an analysis of the condition of an industry when a wave starts. The sample includes 21 buyout waves. The proxy data comprise the annual financial data for preselected listed peer companies in each industry (see Appendix 10.1). Except for the information asymmetry variable, which was extracted from the I/B/E/S database, all proxy values were taken from the Thomson One Banker company analysis module.

Two variables are tested for the economic shock hypothesis: Δ Operating income growth one year prior to the start of a wave, which is the absolute change in year-on-year percentage growth in operating income in a given year; and Δ Gross profit margin one year prior to the start of a wave, which is the absolute change in the gross profit margin as a percentage of net sales. Both variables are expressed as percentages. The proxies for the capital demand hypothesis comprise Δ Capital expenditure (expressed as the absolute change in capital expenditure in percentage of net sales), Δ Total assets (expressed as the absolute change in total assets in EUR) and Δ Sales growth (defined as the absolute change in year-on-year percentage growth in net sales). All capital demand variables reflect a time lag of one period. To test the market timing hypothesis, the market-to-book ratio in the year in which a wave starts is used. This is the market value of assets divided by the book value of assets, together with the price-earnings ratio, which denotes the stock price, divided by net income per share. For the information asymmetry hypothesis, Δ Dispersion of earnings forecast for the period in which a wave starts is used as the proxy, measured as the absolute change in the dispersion of earnings forecast for a given industry. To calculate industry dispersion, the mean weighted standard deviation of all available analysts' forecasts of annual earnings per share for a given peer company and a given year are calculated and then aggregated to form an industry average.

The variable mean is the mean of the proxy values in the year in which the wave starts across all 21 industry waves. The median and mean ranks refer to the median and mean of the quartile ranks that were assigned to proxy values at the start of a wave. *P* values are provided for one-sides tests based on the null hypothesis that the mean rank is less than 2.5 or higher than 2.5.

In the buyout sample, the *economic shock* variables show mixed results. Operating income growth increases by 0.9% on average across all industries one year prior to the start of a wave. The median of the corresponding ranks is 3, indicating that this acceleration in operating profitability is abnormally high. However, the mean rank is only 2.619, i.e. not significantly higher than 2.5. For the change in the gross profit margin, the mean rank is significantly lower than 2.5, suggesting that industry-wide margins are actually in decline when buyout waves start. This indication is consistent with the assumption that buyout investors search for mature businesses with stable cash flows, but with enough inefficiencies for private equity firms to add value (Matthews et al. 2009). The test results also align with Oxman and Yildirim (2006), who argue that buyout targets are predominantly prosperous firms, albeit in a stage of slowing growth and declining profitability. Moderate growth prospects are typically accompanied by lower operating cash needs for expansion and R&D, allowing for the typically high cash requirements to service the leverage of buyouts (Achleitner, Betzer and Gider 2010).

Of all the *capital demand* variables, total assets – with a median rank of 4 – exhibits the highest quartile rank. It is also the most significant variable. The significant change in total assets can be interpreted in two ways. First, the rise in total assets is due to an increase in assets caused by increasing investments in fixed and current assets that are financed by the liquidity raised in the buyout transaction to satisfy capital demand. Second, the rise in total assets may simply reflect the fact that the balance sheet has simply been inflated by large amounts of debt, with the large amounts of cash flushed in by debt transactions driving up assets. In the latter case, the increase in assets would merely reflect an increase in cash. However, it is reasonable to conclude that private equity firms would not allow their target companies to build financial slack. By contrast, one of the key rationales for private equity financing – and one of the most important sources of value creation in buyouts – is the disciplining effect of high leverage that prevents corporate mangers from wasting cash (Jensen 1986; Loos 2006; Achleitner, Braun, Engel, Figge and Tappeiner 2010). Thus, if target companies were awash with cash after buyouts, this would indicate that capital demand exists for future operating investments, and that one period after the transaction is probably too short a time frame to see these planned investments materialize.

One year after a buyout wave, capital expenditure and sales growth are in the third quartile. This suggests that, after a buyout wave, comparable companies in a particular industry tend to increase their capital expenditures and expand their business. This is then reflected in superior sales growth. However, the mean of both variables – about 2.9 – is significant only at the 10% level, suggesting that these factors may be of only secondary importance. It seems questionable whether the variable median for capital expenditure is negative in reality, although it is in the third quartile. This variable is measured as the absolute change in capital expenditure as a percentage of net sales. For a company, that has left the startup and early expansion phase, this figure has to become negative over time. If the opposite was true and capital expenditure were to rise continuously as a percentage of sales, this would mean that capital expenditure is growing faster than sales. Such an overinvestment policy would be a poor strategy, since capital expenditures could not be amortized by profits generated from sales and would simply consume cash without ever turning into profits. While such investment behavior may be necessary in certain situations and for a limited time, such as for (moderately) growing companies, capital expenditure as a percentage of sales would necessarily decline for mature companies in particular. This is especially true for the peer companies, which consist of listed companies with a market capitalization of more than EUR 1 billion.

Overall, the results for the *capital demand* hypothesis suggest that, after buyout waves, firms in the same industry as the target companies experience an increase in assets, ramp up capital expenditure and expand their sales. Provided these growth opportunities have been anticipated by target companies and private equity firms, transactions are driven by increasing capital demand as growth is financed in times when industry prospects are promising.

The information asymmetry variable – the change in the dispersion of earnings forecasts – is in the second quartile and is negative. This implies decreasing information asymmetries as merger activity increases, as predicted by the *adverse selection cost* hypothesis. The mean rank is significantly lower than 2.5 at the 5% level and supports the view that declining information asymmetries are beneficial for transactions in that they reduce adverse selection costs.

The two market timing variables – the market-to-book ratio and the price-earnings ratio – are in the top quartile and are significant at the 1% level. This indicates that, when a wave of buyouts starts in a certain industry, the valuations of listed companies in that industry are extraordinarily high in line with the *market timing* hypothesis. This pattern is consistent with the findings of Kaplan and Stein (1993), Axelson et al. (2007), Chew and Kaplan (2007, 2009) and Kaplan and Strömberg (2009), all of whom document high valuation levels in private equity boom periods.

The findings for the venture capital sample exhibit some parallels, but there are also significantly different patterns. The results of the rank model are presented in Table 44.

	Variable Median	Rank		p-value	
		Median	Mean	H_0: rank < 2.5	H_0: rank > 2.5
Economic shock variables					
Δ Operating income growth$_{t-1}$	1.9	3.0	2.783 *	0.0941	
Δ Gross profit margin$_{t-1}$	0.8	3.0	2.870 **	0.0472	
Capital demand variables					
Δ Capital expenditure$_{t+1}$	-0.7	2.0	2.652	0.2326	
Δ Total assets$_{t+1}$	324.2	3.0	2.652	0.2425	
Δ Sales growth$_{t+1}$	1.6	3.0	2.652	0.3094	
Market timing variables					
Market-to-book-ratio$_t$	3.6	3.0	2.870 **	0.0335	
Price-earnings-ratio$_t$	2.5	4.0	3.696 ***	0.0000	
Information asymmetry variables					
Δ Dispersion of earnings forecasts $_t$	4.6	3.0	2.875 *	0.0615	0.9385

***; **; * Significantly higher than 2.5 at the 1%, 5%, and 10% levels in one-sided significance tests

Table 44: Explanatory Power Tests – Venture Capital Industry Waves

This table shows the results of an analysis of the condition of an industry when a waves starts. The sample includes 23 venture capital waves. The proxy data comprise the annual financial data for preselected listed peer companies in each industry (see Appendix 10.1). Except for the information asymmetry variable, which was extracted from the I/B/E/S database, all proxy values were taken from the Thomson One Banker company analysis module.

Two variables are tested for the economic shock hypothesis: Δ Operating income growth one year prior to the start of a wave, which is the absolute change in year-on-year percentage growth in operating income in a given year; and Δ Gross profit margin one year prior to the start of a wave, which is the absolute change in the gross profit margin as a percentage of net sales. Both variables are expressed as percentages. The proxies for the capital demand hypothesis comprise Δ Capital expenditure (expressed as the absolute change in capital expenditure in percentage of net sales), Δ Total assets (expressed as the absolute change in total assets in EUR) and Δ Sales growth (defined as the absolute change in year-on-year percentage growth in net sales). All capital demand variables reflect a time lag of one period. To test the market timing hypothesis, the market-to-book ratio in the year in which a wave starts is used. This is the market value of assets divided by the book value of assets, together with the price-earnings ratio, which denotes the stock price, divided by net income per share. For the information asymmetry hypothesis, Δ Dispersion of earnings forecast for the period in which a wave starts is used as the proxy, measured as the absolute change in the dispersion of earnings forecast for a given industry. To calculate industry dispersion, the mean weighted standard deviation of all available analysts' forecasts of annual earnings per share for a given peer company and a given year are calculated and then aggregated to form an industry average.

The variable mean is the mean of the proxy values in the year in which the wave starts across all 21 industry waves. The median and mean ranks refer to the median and mean of the quartile ranks that were assigned to proxy values at the start of a wave. *P* values are provided for one-sides tests based on the null hypothesis that the mean rank is less than 2.5 or higher than 2.5.

As predicted by the *economic shock* hypothesis, operating income growth and the gross profit margin are positive and exhibit a median rank of 3 for the venture capital sample. The mean rank exceeds 2.5, which is significant at the 10% level for operating income growth and significant at the 5% level for gross profit margin. This supports the view that venture capital waves occur predominantly after positive economic shocks which positively affects the operating profitability of companies in certain industries. To put that another way: If operating income growth accelerates and gross profit margins increase in an industry, the chances are that venture capital activity will increase too. This prediction is consistent with an approach that is widespread among venture capitalists, namely to use staged financing to maintain the right to abandon unprofitable ventures (Sahlmann 1990, p. 507) and increase the commitment of entrepreneurs (Neher 1999). Each financing stage typically requires the accomplishment of significant company development (Sahlmann 1990, p. 475). Often, the contracts between venture capitalists and entrepreneurs include financing rounds that are contingent on the financial performance of the venture capital-backed company (Kaplan and Strömberg 2003, p. 282; Cuny and Talmor 2005). The necessary conditions for the subsequent financing rounds may include growth and profitability thresholds. These findings are also consistent with Gompers' observation that successful ventures enjoy more financing rounds than those that fail (Gompers 1995). Gompers and Lerner (2001) and Gompers (2004) point out that venture capitalists gather information during each financing stage about the prospective profitability of a project. Based on these facts, they decide whether to go ahead with the next financing round or cancel the project. The prospects, however, will look much brighter if the industry in question is currently experiencing profitable growth, a factor which is modeled by the proxies. Thus, industry-wide growth and rising profitability likewise increase the probability that venture capital-backed firms will meet the financial targets they need to receive the next financing round. This in turn further increases venture capital activity.

The *capital demand* variables have little explanatory power as none of them is significant. One likely explanation is that venture capital-backed companies do not primarily invest in fixed assets, but instead use VC funds to finance R&D activities. Similarly, the lagged sales growth variable may fail to capture expansion investments, as it may take longer than just one period for the invested funds to turn into additional sales.

The change in the dispersion of earnings forecast is positive, with a median of 3 and the mean significantly higher than 2.5 at the 10% level. This suggests, as predicted by the *value add* hypothesis, that increasing information asymmetries foster venture capital investments, a hypothesis that is consistent with findings of Amit et. (1998) and Gompers and Lerner (2004), who note that venture capitalists target early-stage firms and high-technology companies. By nature, these companies are exposed to considerable uncertainty and significant information asymmetries. These information asymmetries however provide value creation potential for venture capitalists, since they can add value by monitoring and contracting (Kaplan and Lerner 2010). Increasing investment activity in times of high information asymmetries is also consistent with evidence provided by Gompers (1995) and Gompers and Lerner (2004), who find that venture capitalists increase the frequency of financing stages in cases where information asymmetries are particularly pronounced.

The results for the *market timing* variables suggest that the price levels of listed companies in a specific industry are of importance to venture capital activity. Given the median rank of 3 for the market-to-book ratio and 4 for the price-earnings ratio, both of which are significantly higher than 2.5, venture capital deal activity seems to be almost as sensitive to an increase in valuations as buyout transactions.

6.5.2 Predictive Power of the Postulated Drivers

6.5.2.1 *Univariate Results*

Univariate logistic regressions are performed with the dependent variable equal to one if an industry wave starts in a given year and zero otherwise. Logit models have the advantage of not being prone to "spurious regressions" (Granger and Newbold 1974), since the estimation technique does not rely on OLS, but uses a maximum likelihood estimation (MLE) procedure (DeMaris 1992). The dependent variables are the same proxies that were used for the tests of explanatory power, as reported in Table 43 and Table 44. The regression coefficients and corresponding p values are presented in Table 45.

In order to test the fit of assumed binary relationships, Pearson goodness-of-fit tests are performed. The test statistic compares the actual number of wave starts with the number expected pursuant to the model (based on the null hypothesis that the model fits the observed data). Finally, the probability of a wave predicted by the model is calculated for every industry year. The correlation between the predicted probabilities of waves and the waves actually observed is reported in the last column of Table 45 and provides another measure of how well the model is able to predict the observed waves.

	Number of observations	Coefficient	χ^2	Correlation of prediction with waves
Economic shock variables				
Δ Operating income growth $_{t-1}$	304	0.651 *	0.640	0.113
		(0.067)	(0.726)	
Δ Gross profit margin $_{t-1}$	320	-0.329 *	2.570	0.101
		(0.080)	(0.462)	
Capital demand variables				
Δ Capital expenditure $_{t+1}$	320	0.102	0.310	0.029
		(0.614)	(0.856)	
Δ Total assets $_{t+1}$	320	0.769 ***	6.760 **	0.194
		(0.002)	(0.034)	
Δ Sales growth $_{t+1}$	320	-0.113	6.540 *	0.036
		(0.539)	(0.088)	
Market timing variables				
Market-to-book-ratio $_t$	320	0.498 **	0.070	0.130
		(0.024)	(0.964)	
Price-earnings-ratio $_t$	320	-0.180	0.390	0.042
		(0.438)	(0.822)	
Information asymmetry variables				
Δ Dispersion of earnings forecasts $_t$	247	-0.308	0.230	0.086
		(0.202)	(0.891)	

***; **; * Significance at the 1%, 5%, and 10% levels in two-sided significance tests

Table 45: Logit Models – Buyout Industry Waves

This table reports the results of univariate logit models. The sample consists of 320 industry years from 1990 to 2009. The dependent variable is equal to one if a wave starts in a given industry year. The independent variables are the same proxies as used in the rank model, as shown in Table 43 and Table 44. A number of observations less than 320 signifies that data for the independent variable is missing. Coefficients are the ordered log odds (logit) regression coefficients. χ^2 denotes the test statistic of a Pearson's chi-squared goodness-of-fit test. *p* values are presented in parentheses. Correlation of prediction with waves denotes the correlation between the predicted probabilities of the model and the actual waves.

Table 45 shows the results of the buyout sample and confirms a number of proxies that have been found significant in the analysis of the explanatory power (section 6.5.1. of this study). The proxies of the *economic shock* hypothesis exhibit coefficients that are only significant at the 10% level but are in line with the predictions of the explanatory power analysis. Operating income has a positive coefficient, which means that a rise in operating income increases the probability of a wave in the following year, while the opposite is true for the gross profit margin. In line with the findings of the explanatory power analysis, the signs of the coefficients should be inverted. A possible explanation could be that buyout activity is encouraged if public companies in the same industry that have experienced increasing operating results show initial signs of declining profitability, manifested in deteriorating gross profit margins. Such a development is imaginable in mature industries in which firms experience margin pressure due to slowing market growth and/or increasing competition. For a while, industry members may still be able to compensate the loss of contribution margins by performance improvement measures or accounting policies. In such a situation, firms of that industry may experience shrinking gross profits but stable or even rising operating incomes. This explanation is consistent with the typical investment profile of buyout investors: mature companies with a proven business model and stable cash flows, but also with the potential to improve profitability (Rosenbaum and Pearl 2009, p. 170). Note that the *p* values of the χ^2 statistics far exceed the significance thresholds, indicating that the postulated binary relationship fits well.

Of the proxies for the *capital demand* hypothesis, only the increase in total assets is significant. However the χ^2 statistic is also significant at the 5% level. Thus the null hypothesis of no lack of fit for the logit model must be rejected. However, the statistics of a likelihood ratio test (not presented herein) do show that the model is significant, which reduces goodness-of-fit concerns. The positive coefficient of the market-to-book ratio is significant, while the other market timing variable – the price-earnings ratio – is not. Consistent with the findings regarding the explanatory power in the previous section (section 6.5.1), the coefficient of the information asymmetry variable is negative, as predicted by the *adverse selection cost* hypothesis, albeit not significant. It follows that increases in information asymmetries, measured in terms of the dispersion of earnings forecast, do not lead to increasing buyout activity for a given industry. Overall, the results suggest that the market-to-book ratio is the most robust predictor of a buyout wave, thus providing further support for the *market timing* hypothesis.

	Number of observations	Coefficient	χ^2	Correlation of prediction with waves
Economic shock variables				
Δ Operating income growth $_{t-1}$	304	1.018 ***	0.120	0.130
		(0.008)	(0.940)	
Δ Gross profit margin $_{t-1}$	320	0.296	0.910	
		(0.124)	(0.823)	
Capital demand variables				
Δ Capital expenditure $_{t+1}$	320	0.287	6.090 **	0.070
		(0.151)	(0.048)	
Δ Total assets $_{t+1}$	320	0.799 ***	2.590	0.189
		(0.001)	(0.274)	
Δ Sales growth $_{t+1}$	320	-0.113	1.880	0.037
		(0.539)	(0.598)	
Market timing variables				
Market-to-book-ratio $_t$	320	0.368 *	2.220	0.101
		(0.071)	(0.330)	
Price-earnings-ratio $_t$	320	0.331	2.940	0.072
		(0.212)	(0.230)	
Information asymmetry variables				
Δ Dispersion of earnings forecasts $_t$	247	0.368 *	0.190	0.110
		(0.100)	(0.909)	

***; **; * Significance at the 1%, 5%, and 10% levels in two-sided significance tests

Table 46: Logit Models – Venture Capital Industry Waves

This table reports the results of univariate logit models. The sample consists of 320 industry years from 1990 to 2009. The dependent variable is equal to one if a wave starts in a given industry year. The independent variables are the same proxies as used in the rank model, as shown in Table 43 and Table 44. A number of observations less than 320 signifies that data for the independent variable is missing. Coefficients are the ordered log odds (logit) regression coefficients. χ^2 denotes the test statistic of a Pearson's chi-squared goodness-of-fit test. *p* values are presented in parentheses. Correlation of prediction with waves denotes the correlation between the predicted probabilities of the model and the actual waves.

Table 46 presents the results for venture capital transactions. Of the *economic shock* variables, only operating income is significant. In line with results of the buyout sample, total assets is the only *capital demand* proxy which is significant. However, in contrast to the buyout sample, the χ^2 statistic for the total asset variable and the correspondingly high *p* values suggest that, for this proxy, the model fits reasonably well. Consistent with the findings for the buyout sample, out of the *market timing* variables only market-to-book ratio is positive and significant, however only at the 10% level. Finally, the change in the dispersion of earnings forecasts is significant at the 10% level and the binary relationship is supported by the insignificant χ^2 statistic.

While not completely opposite, the results for the venture capital transactions feature some remarkable differences. With regard to the *economic shock* variables, the change in operating income prior to private equity waves seems to be more significant in statistical and economic terms in the case of venture capital. A coefficient of 0.651 implies that a change of one unit[1] in this variable would increase the probability of a buyout wave in the next period by a factor of 1.9. For venture capital waves, however, this factor is as high as 2.8. Moreover, declining gross profit margins seem to encourage buyout activity, whereas such a relationship seems to be irrelevant for venture capital transactions. Consistent with the findings of the explanatory power analysis, these results suggests that economic shocks that lead to profitability increases are more likely to stimulate venture capital activity than buyouts. A possible explanation could be that firms in their early stages are more closely bound to the business cycle than the established companies that are typical buyout targets. Small growth companies financed by venture capital are also an important driving force for innovation (Gompers 2004, p. 274) and thus have the potential to be the source of technological shocks that spill over to entire industries.

Of the *capital demand* proxies, total assets is the only variable with a significant coefficient of comparable magnitude for both samples. The *market timing* view is supported by the market-to-book ratio which appears to be a significant driver for both samples as well, although its economic weighting is higher for buyouts. While the coefficient of 0.498 for buyouts implies that the probability of a wave increases by a factor of 1.7 for each unit increase in the industry market-to-book ratio, the coefficient for venture capital investments is just 0.368, corresponding to a probability increase by a factor of 1.4. Changes in the level of information asymmetries, measured in terms of the change in the dispersion of earnings forecasts, are significant only for the venture capital sample, with a coefficient equal to the impact of changes in the market-to-book ratio. Consistent with the findings of the explanatory power analysis, the coefficient is positive, implying that increases in information asymmetries raise the likelihood of a venture capital wave as predicted by the *value add* hypothesis. One of the key roles of venture capitalists is, after all, to mitigate information asymmetries (Gompers and Lerner 1998; Cumming and Johan 2008). Consequently, venture capital

[1] A change of the independent variable by one unit corresponds to a move from one quartile rank of an industry time series to next higher one.

firms can add more value in situations where information asymmetries are extraordinarily high. This might therefore explain the high level of venture capital activity.

Correlation of prediction with waves is the correlation between the waves actually observed and the probabilities predicted by the model. For most of the significant independent variables, this correlation exceeds 10%. The highest values approach 20%, whereas the correlations for insignificant variables are less than 10%. Generally speaking, while most variables exhibit some correlation with the waves actually observed, none of them, taken in isolation, could serve as a predictor of waves.

Overall, the results of the univariate predictive power tests are more compelling in the venture capital sample. In particular, for each of the postulated driver sets, one proxy exhibits predictive power at the 5% level. For buyouts, however, this holds true only for the market-to-book ratio and (if one neglects concerns regarding the model fit) for total assets. This suggests that venture capital activity responds more sensitively to industry developments,[1] perhaps because small enterprises are by nature more flexible and adaptive to changes in their environment. Another reason for the more immediate responsiveness of deal activity could be that venture capital transactions are less complex and involve smaller values than buyout transactions, and can thus be closed more quickly than buyouts that are typically larger and have more sophisticated deal structures.

To summarize: The univariate results of logit models suggest four conclusions. First, venture capital waves are more predictable than buyout waves. Second, venture capital waves occur after periods of rising profitability in an industry, whereas the initial signs of declining profitability begin to arise when waves of buyouts start. Third, the market-to-book ratio seems to be most robust predictor of both kinds of waves. Fourth and finally, venture capital waves are most likely to arise when information asymmetries are significant, whereas this is not the case for buyout investments.

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[1] Note that the independent variables are identical for both samples, as the proxy values for one industry are taken from the same industry peer group.

6.5.2.2 *Multivariate Results*

To test the joint predictive power of the variables in a one model, multivariate logit regressions are run. The results are presented in Table 47.

Panel A: BO transactions							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	-4.254 **	-2.217 ***	-4.424 ***	-3.409 ***	-4.513 ***	-5.528 ***	-6.207 ***
	(0.033)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
Economic shock variables							
Δ Operating income growth $_{t-1}$	0.422 **	-0.335			-0.159		
	(0.091)	(0.116)			(0.400)		
Δ Gross profit margin $_{t-1}$	-0.416	-0.154				-0.617	
	(0.122)	(0.465)				(0.007) ***	
Capital demand variables							
Δ Capital expenditure $_{t+1}$	-0.006		-0.034				
	(0.984)		(0.874)				
Δ Total assets $_{t+1}$	0.519 **		0.813 ***		0.787 ***	0.920 ***	0.759 ***
	(0.100)		(0.001)		(0.002)	(0.001)	(0.003)
Δ Sales growth $_{t+1}$	-0.028		-0.215				
	(0.912)		(0.278)				
Market timing variables							
Market-to-book-ratio $_t$	0.445			0.508 **		0.569 **	0.489 **
	(0.162)			(0.022)		(0.015)	(0.032)
Price-earnings-ratio $_t$	0.068			-0.208			
	(0.819)			(0.379)			
Information asymmetry variables							
Δ Dispersion of earnings forecasts $_t$	-0.308						
	(0.249)						
Pearson χ^2	300.740 ***	40.160	81.530 **	9.490	17.680	86.300 **	18.770
	(0.003)	(0.977)	(0.049)	(0.735)	(0.409)	(0.020)	(0.130)
Likelihood-ratio χ^2	14.720 *	0.360	13.040 ***	6.300 **	12.720 ***	1.040	24.870 ***
	(0.099)	(0.023) **	(0.005)	(0.041)	(0.002)	(0.792)	(0.000)
Correlation of prediction with waves	0.308	0.010	0.190	0.135	0.201	0.273	0.188

Table 47: Logit Models – Multivariate Results

This table reports results of multivariate logit models. The sample consists of 320 industry years from 1990 to 2009. The dependent variable is equal to one if a waves starts in an industry year. The independent variables are the same as used in the rank model as shown in Table 45Coefficients are the ordered log-odds (logit) regression coefficients. $\chi2$ –statistics are provided for Pearson's chi-squared goodness of fit tests and Likelihood-ratio tests. *p*-values are presented in parentheses. Correlation between prediction and waves denotes the correlation between the predicted probabilities of the model and the actual waves.

Panel B: VC transactions								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	-7.904 ***	-1.965 ***	-5.395 ***	-4.595 ***	-5.517 ***	-6.763 ***	-5.792 ***	-6.224 ***
	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Economic shock variables								
Δ Operating income growth $_{t-1}$	0.676 ***	-0.148			0.659 ***	0.624 **		0.622 **
	(0.009)	(0.460)			(0.008)	(0.013)		(0.013)
Δ Gross profit margin $_{t-1}$	-0.012	0.238						
	(0.961)	(0.205)						
Capital demand variables								
Δ Capital expenditure $_{t+1}$	0.248		0.178					
	(0.325)		(0.392)					
Δ Total assets $_{t+1}$	0.212		0.764			0.244	0.788 ***	
	(0.431)		(0.002) ***			(0.338)	(0.001)	
Δ Sales growth $_{t+1}$	0.076		0.059					
	(0.736)		(0.758)					
Market timing variables								
Market-to-book-ratio $_t$	0.228			0.361 *		0.202	0.351 *	
	(0.379)			(0.076)		(0.427)	(0.095)	
Price-earnings-ratio $_t$	0.229			0.321				
	(0.467)			(0.229)				
Information asymmetry variables								
Δ Dispersion of earnings forecasts $_t$	0.446 *				0.659 *	0.479 **		0.482 **
	(0.073)				(0.068)	(0.046)		(0.044)
Δ Total assets $_{t+1}$ * Market-to-book-ratio $_t$								0.085 *
								(0.087)
Pearson χ^2	200.250	40.700	74.350	10.500	8.930	115.010	40.700	86.480
	(0.956)	(0.997)	(0.135)	(0.653)	(0.916)	(0.982)	(0.997)	(0.970)
Likelihood-ratio χ^2	16.310 *	6.080 **	14.550 **	5.020 ***	11.230 ***	13.750 ***	16.640 ***	14.140 ***
	(0.061)	(0.108)	(0.088)	(0.081)	(0.004)	(0.008)	(0.000)	(0.002)
Correlation of prediction with waves	0.263	0.150	0.188	0.116	0.216	0.220	0.150	0.220

Table 47 (continued)

First, all variables are included in the full model as shown in row one of Panel A and B of Table 47. Then, nested models are presented in the other rows. In rows two to four, all proxies are tested for each of the hypotheses in a joint model, e.g. an economic shock model, a capital demand model and a valuation model. The information asymmetry model is omitted as it consists only of the dispersion of earnings forecast, which has already been tested as an univariate model. Stepwise regressions are then performed to fit the model (Wooldridge 2006, p. 678). Model five includes the variables that have been found to be significant at least at the 10% level in the full model. In model six, variables from the univariate regression are included if they are significant at the 10% level. Model seven represents the intersection of the variables used in model five for the buyout and venture capital samples. A Pearson χ^2 goodness-of-fit test and a likelihood ratio test is performed for each model.

In the full model for buyout waves presented in row one of panel A, only operating income growth and total assets are significant at the 5% level. Although the correlation of prediction with waves is 0.308, the significant Pearson χ^2 statistic and the majority of insignificant variables suggest problems with the model fit. For venture capital waves, operating income growth too is significant in the full model. The second significant variable (only at the 10% level) is the dispersion of earnings forecasts with the remaining variables being insignificant. Nevertheless, the χ^2 statistics suggest that the model fits quite well.

The *economic shock* model is insignificant for both subsamples. For the *capital demand* and *market timing* models, the findings of the univariate regressions are consistent with the univariate results. Model five reduces the full model to the significant variables. Although the significance of this nested model increases for the buyout sample, as does the model fit, only total assets remains significant. For the venture sample, the significance of operating profit and the dispersion of earnings forecast is even increased in model five compared to the full model and the model diagnostics suggest an adequate model fit. In model six of the buyout sample, the combination of significant variables from the univariate regressions, all three variables are highly significant. However, severe problems with the model fit are indicated by the χ^2 statistics. For the venture sample, model six, consisting of all significant variables in univariate regressions, once again emphasizes the relevance of operating income and the dispersion of earnings forecasts, while total assets and market-to-book ratio become insignificant.

Model seven takes the intersection of variables that were included in model six for the buyout and venture capital samples, i.e. total assets and the market-to-book ratio. For the buyout sample, this combination is significant with respect to the coefficient and the model as a whole. For venture capital investments, total assets and the market-to-book ratio are significant, too, although this is true for the market-to-book ratio only at the 10% level.

It seems puzzling that, in model six, total assets and the market-to-book ratio are insignificant in combination with other variables, although they do exhibit significance in model seven, where they are included without other variables. Accordingly, an interaction term of market-to-book ratio and total assets is added to the operating income growth and the dispersion of earnings forecasts variable in model eight. While the coefficients for operating income and the dispersion of earnings forecasts and the corresponding *p* values remain almost unchanged, the interaction term becomes significant at the 10% level. The χ^2 statistics suggest a proper model fit; and the correlation of prediction with waves rises to 0.22. However, the small coefficient indicates that the impact is negligible in economic terms.

To summarize the multivariate results for buyouts, total assets is the variable that seems to have the greatest impact, as indicated by the high coefficients. It is also the variable that is most robust in respect of alternative models. The market-to-book ratio plays an important role too, but is less significant and smaller in magnitude. Economic shock variables and information asymmetry variables have no predictive power for buyout waves. For the venture capital sample, the results tend in the opposite direction. The tests suggest that economic shocks, measured by the change in operating income and increases in information asymmetries, increase the likelihood of a private equity wave. Total assets and the market-to-book ratio are not significant in all models. Moreover, when combined with the other significant variables by an interaction term, the impact is small in economic terms, suggesting that capital demand and market timing variables are of only secondary importance for the prediction of venture capital waves.

The results of the logit models have to be evaluated with regard to two aspects: The first aspect is that the analysis was conducted as a robustness check to the rank model which tests the explanatory power of the driver. With this regard the analysis generally supports the findings of the explanatory power analysis in that the coefficients have the same signs. However, not all factors remain significant. In particular, for buyouts the logit models provide support for the *capital demand* and *market timing* hypothesis as well as for the *adverse selection* cost hypothesis. The *economic shock* hypothesis has to be rejected for buyout waves at industry level, as the results indicate a negative relation between selected profitability measures and deal activity. For venture capital investments, the results suggest that all hypothesized drivers are to some extent determinants of venture capital deal activity. In particular the coefficients provide some support for all hypothesis, e.g. the economic shock, capital demand, market timing and value add hypothesis. However, the significance is sensitive with regard to the combination of variables.

The second aspect for the evaluation of results is the predictive power of the drivers. As factual predictors should precede the waves they predict, the lagged capital demand proxies can not predict waves a priori, since they measure spending *after* transaction waves. Of the remaining proxies, market-to-book ratio has the greatest explanatory power for both buyout and venture capital waves at industry level. For venture capital investment waves, increasing information asymmetries point to an upcoming wave as well as improving operating profits in specific industries is an early indicator of increasing venture capital investment activity in these sectors.

However, as the correlation between the predicted waves and the actual occurrences is only between 10% to 30% in all multivariate models (see Table 47) the models seem to have only limited predictive power. Nevertheless, one has to keep in mind that industry waves have been characterized as a very rare event. In particular, waves were defined as deal activity that exceeds the 95-percentile from an emperical distribution resulting from 1,000 simulations of the actual number of deals over the sample period. One could therefore hardly expect proxies fluctuating across quartiles should be able to predict such rare events.

6.6 Timing of Buyout Waves relative to Venture Capital Waves

It has been postulated in section 3.1.3 that venture capital waves should lead buyout waves. This prediction was derived from stock market evidence provided by Spremann and Scheurle (2009) and Scheurle and Spremann (2010) that investors seem to prefer small growth stocks at the beginning of the business cycle and big value stocks toward the end of the business cycle. In order to test whether a similar pattern holds also true for the private equity market, the quarters in which the venture capital waves start are compared with the quarters in which the buyout waves start. Mean comparison tests are then conducted to identify a potential statistical difference.

Venture capital and buyout waves in an industry are matched to each other if the time gap between the two waves is less than two years. In other words, a buyout wave will be matched to a venture capital wave only if the buyout wave starts not later than two years after the end of the venture capital wave and ends not earlier than two years before the venture capital wave started. This ensures that only pairs of waves are considered that are likely to have occurred during one business cycle, which is usually assumed to last for three to four years. For example, as can be seen in, Table 47 and Table 48, this results in a match between the venture capital wave from Q3 2003 to Q2 2004 and the buyout wave from Q2 2004 to 2Q2005 for the retail and distribution industry. However, the venture capital wave from Q4 1999 to Q1 2001 and the buyout wave from Q1 2007 to Q2 2008 remain unmatched, as they are more thant two years apart. This procedure produces 18 pairs of waves, as shown in Table 48. With the exception of financial services companies who experienced two paired waves, all other industries witnessed exactly one paired wave. Venture capital waves lead buyout waves by up to five quarters. In two cases, they are even lagged by one quarter. The mean lead is one and a half quarters.

To test whether the lead given by venture capital activity is statistically significant, paired tests of mean differences are performed. However, as sample sizes of less than 30 require normality distribution of the differences to be tested beforehand, a Shapiro-Wilk test is conducted. The test statistic is not significant. Thus, the null hypothesis that the differences are normally distributed cannot be rejected, which allows to conclude that the results of mean difference tests will be unbiased.

Panel A: Start of VC versus BO Waves			
Industry	Start of the wave		Lead VC vs. BO
	VC	BO	
Biotechnology	4Q2002	3Q2003	3
Business Products and Services	4Q2003	1Q2004	1
Computers and Peripherals	2Q2003	4Q2003	2
Consumer Products and Services	2Q2003	4Q2003	2
Electronics/Instrumentation	2Q2003	3Q2003	1
Financial Services	4Q2003	1Q2004	1
Financial Services	2Q2006	1Q2006	-1
Healthcare Services	4Q2003	1Q2004	1
Industrial/Energy	1Q2003	4Q2003	3
IT Services	3Q1999	3Q1999	0
Media and Entertainment	3Q1999	1Q2000	2
Medical Devices and Equipment	4Q2003	2Q2004	2
Networking and Equipment	1Q2000	1Q2000	0
Other	4Q2002	3Q2003	3
Retailing/Distribution	3Q2003	2Q2004	3
Semiconductors	3Q2002	4Q2003	5
Software	1Q2000	4Q1999	-1
Telecommunications	4Q1999	4Q1999	0
Mean	2Q2002	4Q2002	1,5

Panel B: Paired Tests for Mean Difference		
H_0	Shapiro-Wilk-statistic	T-statistic
Differences are normally distributes	0.9605	
Mean difference equals 0		4,0249 ***
Mean difference < 0.5		2,6833 ***
Mean difference < 1		1,3416 *
Mean difference < 1.5		0,0000

***; **; * Significance at the 1%, 5%, and 10% levels in significance tests.

Table 48: Starting Quarters of Paired Venture Capital and Buyout Waves

Panel A shows the starting quarters for the paired venture capital and buyout waves. "Lead VC vs. BO" indicates the number of quarters by which the venture capital wave leads the paired buyout wave. Panel B exhibits the *t* statistics for two sample *t* tests for a difference in mean, based on the null hypothesis that the mean difference is equal 0, 0.5 or 1.

A two-sided paired *t* test of the starting quarters in the venture capital sample and the buyout sample is highly significant, suggesting that venture capital and buyout waves rarely commence simultaneously. One-sided paired *t* tests are then conducted based on the null hypothesis that the lead is smaller than 0.5, 1, and 1.5 respectively. As shown in Table 48, a lead of at least half a quarter is significant at the 1% level. A lead of up to one quarter is still significant at the 10% level, and a lead of 1.5 quarters is insignificant. This means that venture capital activity leads by one quarter ahead of buyout activity.

6.7 Conclusion

Table 49 summarizes the findings of the analyses reported in the sections above.

	BO			VC		
	Rank model	Logit model		Rank model	Logit model	
		Univariate	Multivar.		Univariate	Multivar.
Economic shock variables						
Δ Operating income growth $_{t-1}$		*		*	***	**
Δ Gross profit margin $_{t}$	†	†		**		
Capital demand variables						
Δ Capital expenditure $_{t+1}$	*					
Δ Total assets $_{t+1}$	***	***	***		***	*
Δ Sales growth $_{t+1}$	*					
Valuation variables						
Market-to-book-ratio $_{t}$	***	**	**	**	**	*
Price-earnings-ratio $_{t}$	***			***		
Information asymmetry variables						
Δ Dispersion of earnings forecasts $_{t}$	††			*	**	**

***; **; * Positive relationship at the 1%, 5%, and 10% levels; ††; † negative relationship at the 5%, and 10% levels

Table 49: Summarized Results of Industry-Level Analysis

The results discussed above imply four major findings: First, private equity transactions – both buyouts and venture investments – cluster in industries that are at temporarily high valuation levels. In particular, the market-to-book ratio seems to be the proxy variable with the highest explanatory and predictive power of industry waves. It is also the variable which is most robust to alternative test settings and thus provides support for the *market timing hypothesis* in line with the argument of Chew and Kaplan (2007, 2009) and Kaplan and Strömberg (2009). However, this result is in contrast to the aggregate level findings the where the market-to-book ratio has not to been found to be a major driver of aggregate deal activity in multivariate model. Thus, it seems that bidding contests that lead to temporary overvaluations are restricted to certain industries and foster deal activity in a particular sector. However, while the overvaluation and deal activity may spill over to related industries, the results of this study suggest that market timing opportunities do not persist on the market as a whole, but that market timing opportunities are temporarily and restricted to particular sectors of the market.

Second, the results for the *economic shock hypothesis* are contrary for the buyout and venture capital sample. While venture capitalists seem to focus on industries that experience positive economic shocks that manifest themselves in increasing operating profits, this seems to be irrelevant in buyout transactions. Alternatively stated: buyout firms seem to target particularly industries with declining profits. The evidence found for the venture capital sample suggests that early stage companies are more exposed to industry specific business cycles and is consistent with venture capitalists adjusting their staged financing policy to the achievement of financial targets by their investee companies. The results for the buyout sample suggest that buyout firms prefer to invest in mature industries, or in industries that are at a later stage of the business cycle (Oxman and Yildirim 2006; Matthews et al. 2009). This finding is also consistent with recent evidence provided by (Bernstein et al. 2010), who finds that buyouts are not abnormally clustered in highly cyclical industries. In line with this argument, venture capital activity leads buyout activity and thus reacts more promptly to economic shocks than buyouts.

Third, information asymmetries seem to play a different role for venture capital and buyout transactions. The results suggest that the investment behavior of venture capitalists can be better explained by the *value add hypothesis* since they seem to target industries with high levels of information asymmetries. For buyout investments however, the result point more into the direction of the *adverse selection cost hypothesis*, which would imply the avoidance of high information asymmetries and the preference for investments in more transparent and probably more predictable industries, which are usually mature industries. This finding seems to contradict the findings for the venture capital sample at aggregate level. However, for venture investments this apparent discrepancy might be interpreted as follows: The results suggest that for both buyouts and venture investments a growing level of the market wide information asymmetries generally increases the adverse selection costs which slows down investment activity. This might imply that venture capitalists do not in general favor market conditions with high information asymmetries, but at a given temporary level of market wide information asymmetries they would focus on particular industries which are subject to exceptional information asymmetries, where they can add value in mitigating those.

Forth, the *capital demand hypothesis* seems to be more important for buyouts than for venture capital investments. However, these findings are based on the relationship found between deal volume and the change in total assets of the peer companies one year after a wave start. As this proxy is probably the least accurate measure of capital demand the evidence for the hypothesis can only be regarded as weak support.

7 Empirical Part III: Performance Implications

7.1 Introduction

This final empirical part of the study sheds light on the question of whether periods of considerable deal activity are associated with superior or substandard performance. The investigation of the relationship between deal activity and returns has two main objectives. First, it serves as a robustness check for the driver analysis. As outlined in Figure 10, each of the competing theoretical viewpoints predicts a positive or negative activity-return relationship. Consequently, the relationship found in the data supports particular theories or assigns a certain weight to them. Second, the outcome provides valuable information for investors, as it implicitly indicates whether private equity fund investments should be avoided or recommended during boom periods.

This chapter is organized as follows: Section 7.2 reviews empirical studies of private equity performance. This is followed by a discussion of alternative performance measures and related findings in section 7.3. Section 7.4 describes the data and outlines the test design. The results are presented and discussed in section 7.5. A summary of the findings and conclusions is provided in section 7.6.

7.2 Related Literature

The increasing scope of private equity in Europe and elsewhere has spawned a considerable body of literature tackling various questions on the performance of this asset class. By way of an introduction to the topic, the sections that follow summarize three aspects of private equity returns that have caught the attention of academics: First, the performance of this asset class relative to stock markets has attracted the interest of academics and practitioners alike. Second, the heterogeneity and persistence of fund returns refers to the stylized fact that private equity performance demonstrates a significant dispersion across funds, while performance remains very persistent regarding GPs. The third issue, performance relative to private equity activity, touches on the research question addressed by this part of the dissertation.

7.2.1 Private Equity Performance Relative to Public Markets

Kaplan and Schoar (2005) find that buyout funds slightly underperform the S&P500. For venture capital funds, however, the result depends on whether returns are equal or value-weighted. A comparable result is reported by Gottschalg and Phalippou (2009), who find that private equity outperforms the S&P500, gross of fees, but underperforms on the net-of-fees measure. For European private equity funds, Kaserer and Diller (2004, p. 53) report that private equity underperforms stock markets on an equal-weighted basis, but outperform them if value-weighted return measures are used. Using a sophisticated return metric and a more recent buyout data set that cover thirty years of fund cash flows, including the financial crisis and its aftermath, Gottschalg (2010) reconfirms the findings of prior work: Private equity as an asset outperforms public markets only marginally or insignificantly after controlling for risk. However, the top quartile outperforms public markets by roughly 5%, net of fees (Gottschalg 2010b). Consistent with these results, which were obtained from analyzing fund data provided by Thomson Venture Economics, Phalippou (2010a, 2010b) reports that alphas of listed private equity funds are close to zero. Cochrane (2005) reports substantial alphas for a venture capital sample. However, these alphas do not differ much from those of publicly traded small firms, which suggests that the abnormal returns are related more to a size effect than to particularities of the asset class. These and other research results suggest that, even when controlled for the higher risk of private equity, the performance of this asset class is more or less similar to public markets, but does not adequately compensate for higher liquidity risk.[1]

7.2.2 Heterogeneity and Persistence of Private Equity Performance

In addition to the overall disappointing performance of private equity funds it has also been found that there is a considerable dispersion of returns across funds (Gottschalg and Phalippou 2009; Gottschalg 2010a, p. 287). This had led researchers to investigate the drivers of fund performance or indicators to predict future performance. First examined by Kaplan and Schoar (2005), academia seems to broadly agree on the fact that private equity fund managers exhibit persistence in fund returns and thus past

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[1] However, the performance varies across countries. For example, UK private equity funds consistently outperform the FTSE (BVCA 2006).

performance is a good predictor of future fund returns. This pattern has been repeatedly supported by studies undertaken by Axelson, Strömberg and Weisbach (2007), Phalippou and Gottschalg (2009), Axelson, Jenkinson, Strömberg and Weisbach (2010), Chung, Sensoy, Stern and Weisbach (2010) and Hochberg, Ljungqvist and Vissing-Jørgensen (2010). This effect has been attributed to the hypothesis that better GPs may be able to have superior access to better targets or can get better conditions in purchase price negotiations since target companies value the management skills that active private equity investors contribute to the management of the investee companies in addition to purely providing financing (Kaplan and Schoar 2005). However, the performance persistence does not only hold for winners but also for losers, since follow-on funds of low performing fund managers are also more likely to underperform, if money for them can be raised at all (Chung et al. 2010; Gottschalg 2010a, p. 287; Phalippou 2010a).

The persistence in private equity returns documents that private equity can provide superior returns but only for investors who invest in top performing funds (Gottschalg 2010b). This pattern is also reflected in the ability to raise future funds. While the top-performer are most likely to raise even larger funds in the future, the worst performing funds are less likely to collect equity for follow-on funds at all (Gompers and Lerner 1998; Kaplan and Strömberg 2009, p. 137).

7.2.3 Cyclicity in Private Equity Returns

Practitioners and industry observers frequently argue that periods of excessive investment activities are associated with a subsequent rise of default rates and correspondingly low returns (Curran 1990; Jensen 2007; Chew and Kaplan 2007; Chew and Kaplan 2009). However, apart from descriptive evidence there is little academic work on the relation between investment activity and subsequent returns.

The current status of research with regard to the dynamics of private equity returns and the performance fluctuations in time can to a large extent be ascribed to the findings of Steven N. Kaplan. The pioneering work of Kaplan and Schoar (2005) is the first one that examines the relation of private equity cycles on performance. An important finding which is indirectly related to the performance pattern is that following periods of high capital inflows into private equity, a growing number of new private equity firms enter the market. They also argue that funds raised during boom times are less likely to raise future funds which might indicate that they perform poorly. Finally, the study reveals that buyout and venture capital funds that were raised during periods of high capital commitments to private equity significantly underperform funds that were established in times of only modest fund raising. In a more recent study, Kaplan and Strömberg (2009) reconfirm the negative relation between fund raising and subsequent vintage year returns. Consistent with Kaplan and Schoar (2005) and Kaplan and Strömberg (2009), Lerner et al. (2007) find that LPs experience significantly lower return, if they invest during times of high capital inflows into private equity. This suggest that investors tend to herding when the market is "hot" (Lerner et al. 2007, p. 748).

Gompers et al. (2008) find for the venture capital industry that the performance implications of investment activity are inverse for fund managers with a high industry expertise and those who are less experienced. Experienced venture capitalists seem to adjust their investment activity to public market signals of promising investment opportunities which is consistent with high returns for investments made in high activity markets. Comparatively inexperienced fund managers appear not to adopt investment pace to general market conditions and thus their performance is rather unrelated to investment activity.

Cochrane (2006) argues that expected returns vary across time and with the business cycle. It should be noted that cyclicity in returns is not special to this assets class. Expected stock market returns do fluctuate over the business cycle and the exposure to macroeconomic risks may be captured by risk factors commonly used in asset pricing models (Cochrane 2006, p. 244).

7.3 Measuring Private Equity Returns

There are various ways to measure private equity performance. Time-weighted returns are sometimes reported in praxis but rarely used in scientific work. This return metric is based on periodic returns and weights all periods equal in taking the geometric mean hereby neglecting the time-value of different cash flows over the lifetime of a fund (Fraser-Sampson 2010, p. 47).

Many researchers who investigate the performance of private equity funds, calculate and report IRRs based on fund cash flow data (see for example Jones and Rhodes-Kropf 2003; Ljungqvist and Richardson 2003a, pp. 22–24; Lerner et al. 2007; Gottschalg and Phalippou 2009). Essentially, the internal rate of return is the discount rate that would result in an NPV of zero for a stream of cash flows (Damodaran 2010, p. 234):

$$\sum_{t=0}^{T} \frac{CF_t}{(1+IRR)^t} = 0 \tag{10}$$

with:

CF_t = Net Cash Flow in period t and

T = Investment Horizon.

Another popular approach is to measure fund performance by constructing public market equivalents (PME) (see for example Kaplan and Schoar 2005 or Diller and Kaserer 2009). This method suggested by Long and Nickels (1996) assumes that for each capital draw down a simultaneous investment in a benchmark index is made. Likewise, all cash distributions are instantly reinvested in the public benchmark. If the PME exceeds one, the fund has outperformed the benchmark, while a PME of less than one implies underperformance relative to the benchmark.

Recent research has increasingly focused on risk-adjusted return metrics. Driessen, Lin and Phalippou (2007) develop a methodology based on a Generalized Method of Moments (GMM) to evaluate performance and risk of private equity. Applying a GMM approach to a factor pricing model, they find that venture capital funds load positively on SMB and negatively on HML while buyout funds load negatively on SMB and positively on HML suggesting that the risk exposure of buyouts equals those of big value stocks while venture capital investments seem to be most similar to small growth stocks.

For venture capital, pioneering work by Cochrane (2005) and recent studies by Driessen et al. (2007), Driessen, Lin and Phalippou (2008) and Franzoni, Nowak and

Phalippou (2010) estimate betas between two and three. However, the span of reported alphas ranges from less than zero to more than 30%. Buyouts seem to be less exposed to market risk with a beta around one and alphas close to zero.

Since performance data on single investment level are not available, performance measures based on factor pricing models cannot be applied to the data. For the purpose of this study, IRRs seem to be a reasonable measure for three reasons. First, it allows to compare the order of magnitude to other work on European performance, for example Diller and Kaserer (2009) and Bottazzi (2010). Second, if private equity firms invest heavily at market peaks as hypothesized in this study, PMEs would camouflage this effect, since the PMEs would be simultaneously invested with such a poor timing strategy. Third, the use of excess IRRs in this study incorporates a similar reasoning as the PME without foregoing the information given by the IRRs.

7.4 Data and Test Specification

The Thomson Reuters' Private Equity Performance database is used for the performance analysis, formerly known as Thomson Venture Economics (Bernard 2009). Although the data base may be the most comprehensive data set of private equity performance data covering 1,310 European funds formed 1979-2008, in partnership with EVCA, the data may be subject to three major biases with regard to the research question. First, GPs may be tempted to overstate performance in order to facilitate future fund raising. For example Cumming and Walz (2010) report that private equity firms frequently disclose overstated book values of unexited portfolio companies. Thomson Reuters states that it prevents such biases by using only 50 percent GP reported performance data, while the remainder stems from LPs. Second, there is a fundamental difference between the data sets used for the driver analysis (number of transactions) and those used for performance evaluation (fund performance data). Third, the number of deals refers to all private equity transactions with a European target company, regardless of the origin of the investing private equity firm. However, the fund data used in the performance evaluation refers to European funds.

7.4.1 Descriptive Statistics

7.4.1.1 *Market Entry Characteristics*

Figure 19 illustrates the evolution of European fund vintages over time. The number of fund vintages per year keeps a record of how many new funds were closed in a year, thus reflecting the fund raising activity in the industry. The number of first-time fund vintages may provide evidence on whether new private equity firms preferably enter the market under certain market conditions, as postulated earlier.

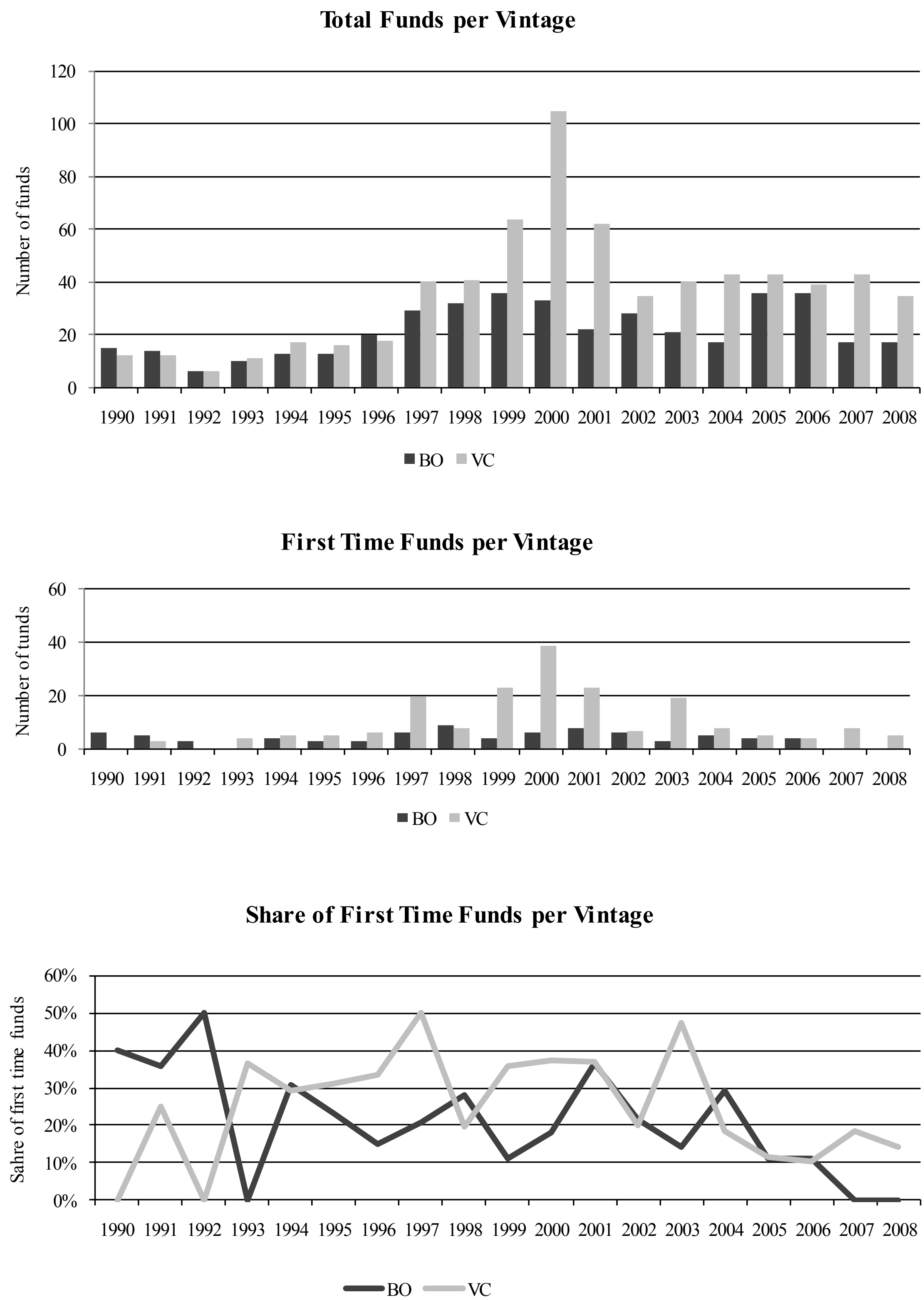

Figure 19: Number of Funds per Vintage

Like investment activity, the number of closings too seems to follow a wave pattern. And as with the number of private equity deals (see Figure 11, p. 65), two distinct waves can be identified: one around 2000 and one in the mid-2000s. However, this wave pattern is less apparent for first-time funds. As can be seen from the graph in the middle of Figure 19, the number of first-time funds seems to bear only a tenuous correlation to the total number of fund vintages, except for venture capital funds of the year 2000 which marks a peak for both the total number of fund vintages and the number of first-time venture fund.

The graph at the bottom of Figure 19 again illustrates that the share of first-time funds is fairly volatile with no apparent pattern. Nevertheless, the overall share of first-time funds seems to decline toward the end of the sample period. This might be due to the financial crisis, which made it impossible to close first-time funds. An alternative explanation would be that the European private equity market has reached a certain stage of maturity in that the market is increasingly controlled by established players.

To add statistical credence to these descriptive impressions, Table 50 shows the correlation matrices for the buyout and venture capital time series illustrated in Figure 19 and relates them to annual deal activity. Spearman rank coefficients are calculated, as these are more robust with respect to outliers than ordinary correlation coefficients (Barrow 2009, p. 247). Since all time series have a unit root, any correlation may be spurious. Consistent with the findings of the driver analysis in chapters 4 through 5 (which focused on quarterly deal activity), annual deal activity is highly autocorrelated. However, the correlation coefficients between the number of buyout vintages and deal activity or lagged deal activity are lower than 0.5, suggesting only a minor positive relationship. This is in contrast to the findings of chapter 4, where the total number of investing firms[1] and the number of deals exhibited a strong correlation (correlation coefficient 0.94; see Table 6, p. 76). There are two possible explanations for these differing findings. First, they might suggest that increasing deal activity in Europe is not primarily driven by new European funds, but that non-European private equity firms respond to changing market conditions by entering the European market in boom periods. Recall that new entrants in chapter 4 were defined as any first-time

[1] The number on investing firms does not necessarily equal the number of vintage funds, since established private equity firms usually run a number of investment funds.

fund conducting an investment in a European target regardles of the origin of the fund, while this section defines new entrants as first-time funds incorporated in Europe. Second, the difference could be due to differences in the underlying data sources. Although the transaction data used in chapters 4 through 5 and the performance data used in this chapter were both derived from Thomson One Banker, Thomson Reuters gathers the data in separate surveys and from different primary sources. While the transaction data primarily stem from GPs, the performance data are provided by both LPs and GPs in collaboration with the EVCA (Bernard 2009). This could result in different sample selection biases and, of course, different results.

	BOY_t	BOY_{t-1}	No. of BO funds $_t$	No. first-time BO funds $_t$	Share of first-time BO funds $_t$
BOY_t	1.000				
BOY_{t-1}	0.906 ***	1.000			
No. of BO funds $_t$	0.543 **	0.633 ***	1.000		
No. first-time BO funds $_t$	-0.096	-0.007	0.439 *	1.000	
Share of first-time BO funds $_t$	-0.053 **	-0.528 **	-0.355	0.571 **	1.000
	VCY_t	VCY_{t-1}	No. of VC funds $_t$	No. first-time VC funds $_t$	Share of first-time VC funds $_t$
VCY_t	1.000				
VCY_{t-1}	0.881 ***	1.000			
No. of VC funds $_t$	0.825 ***	0.738 ***	1.000		
No. first-time VC funds $_t$	0.681 ***	0.541 **	0.856 ***	1.000	
Share of first-time VC funds $_t$	0.200	0.029	0.315	0.684 ***	1.000

***; **; * Significance of the correlation coefficient at the 1%, 5%, and 10% levels.

Table 50: Correlation between Deal Activity, Number of Funds and New Entrants

This table shows Spearman rank coefficients for annual deal activity and the number of funds per vintage. BOY_t and VCY_t denote the number of deals in a given year. BOY_{t-1} and VCY_{t-1} are the lagged variables. No. of BO/VC funds $_t$ is the number of funds per vintage. No. of first-time BO/VC funds $_t$ indicates how many first-time funds were closed in a given year. The share of first-time BO/VC funds $_t$ denotes their share of the total number of fund vintages.

Table 50 also reveals that the number and share of first-time funds bear little correlation to deal activity or even exhibit a negative relationship. This would be consistent with a view in which deal activity is driven more by established European buyout companies and only to a lesser extent by newcomers.

The results for the venture capital sample paint a slightly different picture. The total number of fund vintages exhibits a stronger correlation than in the buyout sample and the correlation coefficients of the first-time funds are significantly positive, although they are only non-trivial for unlagged deal activity. This suggests that European venture capital firms indeed seem to react to increasing deal activity by closing more funds and also launching more first-time funds during boom phases. Overall, the results of the venture capital sample are more consistent with the hypothesis that new players enter the market in boom phases than for the buyout sample. This appears plausible, since the complexity of buyouts and the larger deal volumes would make market entries more difficult.

7.4.1.2 *Vintage Year Performance*

Vintage IRRs are calculated using combined quarterly fund cash flows for all European buyout and venture capital funds in the Thomson Reuters' Private Equity Performance database and their subsamples of first-time funds. For each vintage, the cash flows for all funds are pooled and the terminal net asset value is regarded as virtual final cash flow. To simplify the IRR calculation, all cash flows are treated as if they had cumulatively taken effect on the last day of a given quarter.

The IRR calculation is conducted by iteratively solving equation (10) for IRR. This requires a starting point to be estimated for the iteration. The sum of all cash flows per vintage is taken as the criterion to arrive at this starting point. If the sum of cash flows exceeds zero during the sample period, the starting point is 10%. However, if the sum of cash flows is (still) negative, iteration starts at -10%. Following this procedure, the IRR estimate converges in all cases and is robust with regard to the use of different starting points with absolute values of less than 100%.[1] Nevertheless, the right sign for the starting point is crucial, as iterations will otherwise fail to converge in some cases.

Figure 20 shows vintage-year IRRs for European buyout and venture capital funds and reveals several important performance patterns. First, buyout funds established in the mid-1990s and early 2000s performed exceptionally well. Second, these vintages were also accompanied by a low number of buyout fund vintages. Conversely, the worst-performing vintages (e.g. 1998/1999 and 2005/2006) were vintages in which the number of newly established funds peaked. This pattern is less clear for the venture capital sample, except for the internet bubble around 2000, which set a record in terms of the number of both vintage funds and poor performance. Third, venture capital substantially underperformed buyouts in almost all vintages consistent with the findings of Diller and Kaserer (2009) and Bottazzi (2010). Fourth, vintages after 2005 exhibit negative IRRs almost without exception. This reflects the typical j-curve effect over a fund lifetime, but may also be impacted by the effects of the financial crisis.

[1] The estimate even remains unchanged for absolute starting point values that are equal to or greater than 100%, provided the iteration converges. However, many of the IRR calculations fail to converge if starting points of less than -100% or greater than 100% are used.

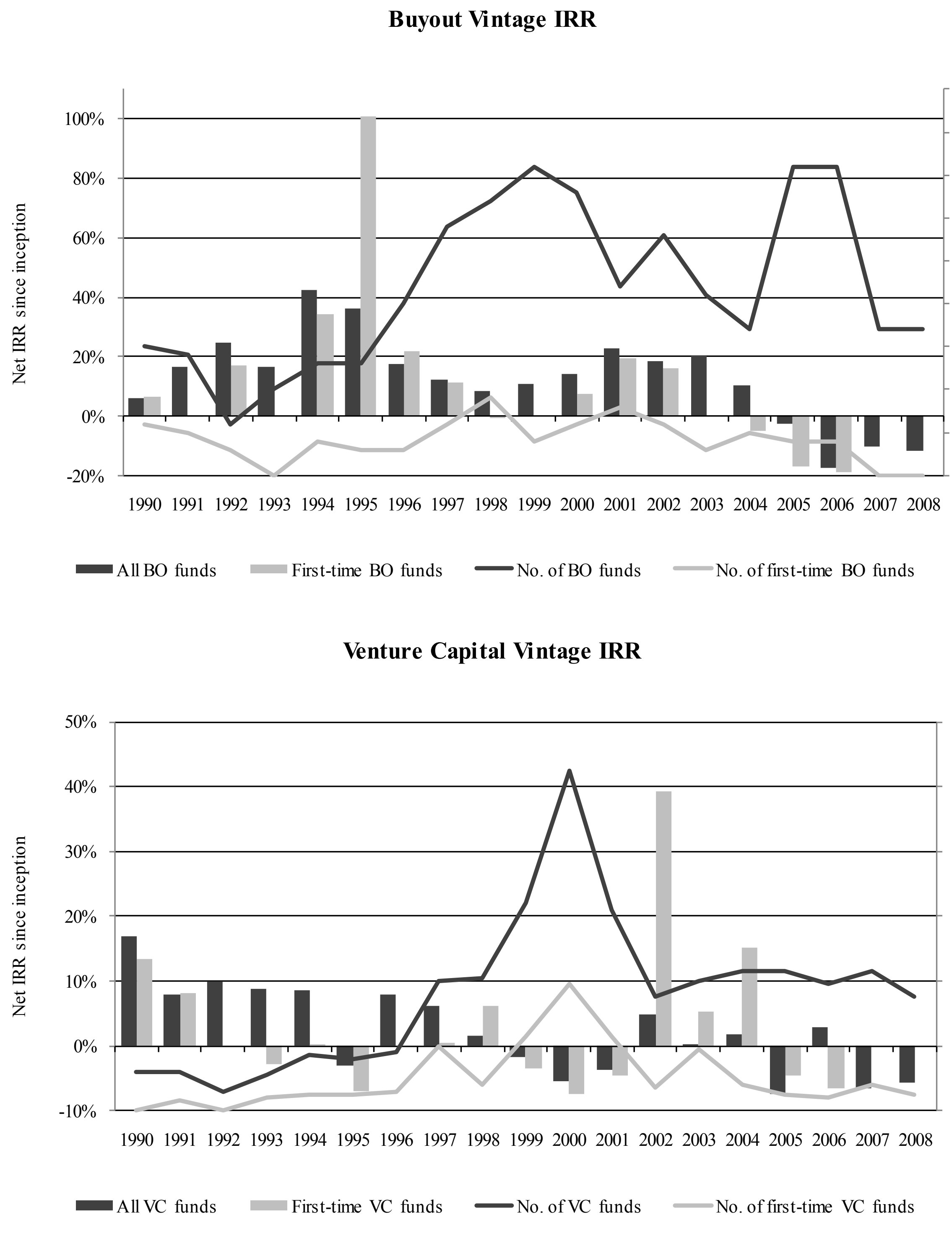

Figure 20: Vintage Year IRRs

The IRRs presented in Figure 20 are generally in line with the IRRs documented by Bottazzi (2010) who reports vintage IRRs of European buyout and venture capital funds for five-year vintage horizons, i.e. net IRRs since inception of funds closed during five year intervals. However, the IRRs of vintages 2005 – 2008 are remarkably lower than the results provided by Bottazzi (2010). The reason for the difference is most likely due to the different dates on which the data were obtained from the Thomson Reuters data base. Bottazzi (2010) uses vintage data up to 2007. Although she does not state the date of data retrieval, this would probably have been in 2008. The author of this study, however, has retrieved data in 2010 covering the reporting period from 1 January 1990 to 31 December 2009 including vintages until 2008. Since valuation levels of European firms have declined throughout 2008 the net asset values of unliquidated funds will be lower for data used in this study than for data that have been obtained in 2008. Consequently, the IRRs of this study are lower that Bottazzi's (2010) results.

Lending statistical credence to the visual evidence of a negative relationship between the number of vintage funds and vintage performance, Table 51 reports correlation coefficients between IRRs and the number of funds per vintage.

	Spearman rank correlation coeffient between IRR and No. of funds
All BO funds	-0.473 **
First-time BO funds	-0.183
All VC funds	-0.748 ***
First-time VCfunds	-0.080

***, ** Significance at the 1% and 5% levels

Table 51: Correlation between IRR and Number of Funds per Vintage

This table shows Spearman rank correlation coefficients between vintage IRRs and the number of funds per vintage. The sample period is 1990 to 2008. IRR is calculated as the IRR on pooled quarterly cash flows for all funds of a given vintage, regarding the terminal NAV as a virtual final cash flow.

As illustrated by Figure 20, vintage IRRs and the number of funds per vintage are negatively correlated. The coefficient for buyouts is less than 0.5 but still significant. For the sample of venture capital funds, the number of funds per vintage, the highly significant correlation coefficient of 0.75 indicates a strong negative relationship with the vintage IRR. For first-time funds (both buyouts and venture capital), this relationship is much weaker and statistically insignificant.

The negative correlation of IRRs and the number of funds per vintage is consistent with the findings of several studies that find evidence for a "money chasing deals" effect (Gompers and Lerner 2000; Ljungqvist and Richardson 2003a; Ljungqvist and Richardson 2003b; Diller and Kaserer 2009). The stronger correlation in the venture sample as compared to buyouts is consistent with the argument of Diller and Kaserer (2009), who contend that a "money chasing deal" effect should be stronger for venture capital, since the broader spectrum of potential investments allows venture capitalists to adjust their investment speed faster to the availability of fund capital than buyouts.

Excess IRRs are calculated as the difference between vintage IRRs from inception to the end of 2009 and the IRR of the EuroStoxx50 index over the same period. Figure 21 shows the excess IRRs per vintage for buyout and venture capital funds. The excess IRR for venture capital funds is noticeably lower than the relative performance of buyout funds. This is consistent with performance reported by Diller and Kaserer (2009).

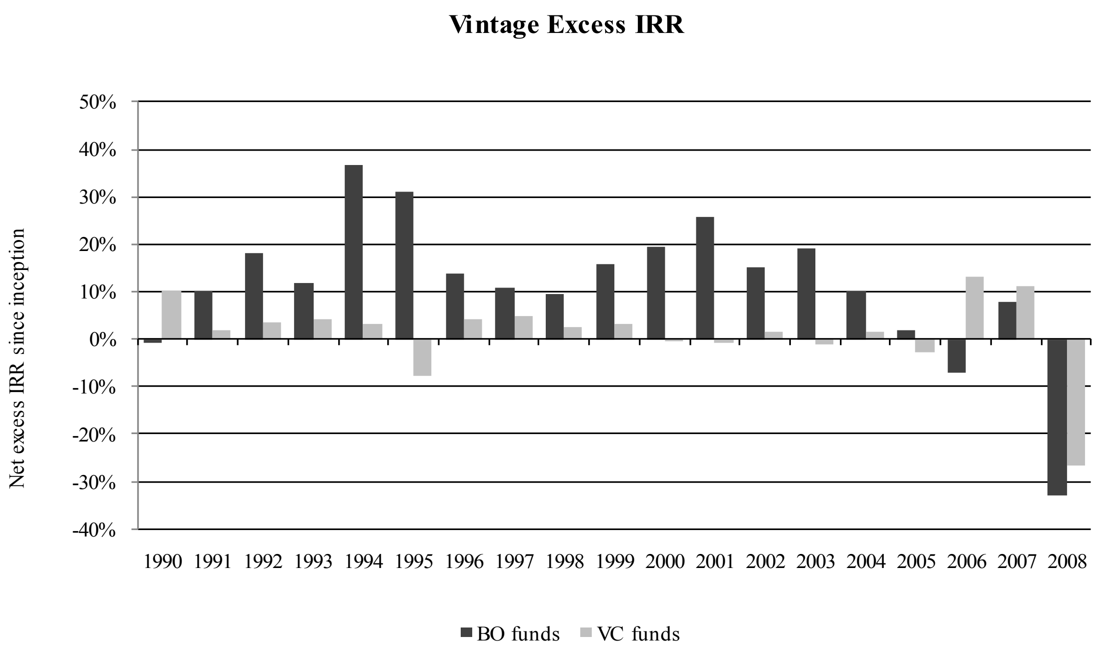

Figure 21: Excess Vintage IRRs of Buyout and Venture Capital Funds

7.4.2 Test Design

To investigate the impact of private equity deal activity on performance, the empirical tests focus on vintage IRRs, excess vintage IRRs and their development relative to deal activity. To better control for the "competition for deals" effect, vintage performance is also examined in relation to the number of funds per vintage.

7.4.2.1 *Hypothesized Predictions*

The competing driver theories illustrated in Figure 10 are believed to imply specific activity-return relationships, which are summarized in Table 52. Since neoclassical theories attribute fluctuations in deal activity to changes in economic fundamentals and the resultant variations in the prospects of potential target companies, private equity firms should respond to an improving economic climate by pressing ahead with the establishment of new funds and accelerating investment activity. Accordingly, investments made in periods of busy deal activity when numerous new funds are launched should outperform those made in sluggish private equity years.

	Neoclassical theory	Information asymmetries		Agency theory	Market timing theory
		Adverse selection	Value add		
Fund closing activity	+	-	+	-	-
Investment activity	+	-	+	-	-

+ Reinforcing impact, – Reverse impact

Table 52: Predicted Impact of Fund Closings and Investment Activity on Vintage IRRs from a Theoretical Perspective

The implications of the changing levels of information asymmetries are contrary for the signaling and value add perspective. The adverse selection view implies that, in periods of high information asymmetries, companies seeking private equity financing must accept comparatively high purchase price discounts that compensate investors for greater uncertainty. While these adverse selection costs lower the attractiveness of private equity transactions from the point of view of entrepreneurs and shareholders of potential target companies, it nevertheless implies that subsequent performance will be superior. The opposite is true for the value add perspective of information asymmetries. This view implies that high information asymmetries provide better opportunities for private equity firms to add value to portfolio companies. These firms will therefore speed up investment activity in times of pronounced information asymmetries and, ceteris paribus, these investments will outperform those effected in periods of low information asymmetries and low deal activity.

The agency theoretical view asserts that private equity firms have an incentive to overinvest and that certain periods provide particularly beneficial situations for such overinvestments, e.g. periods when large amounts of capital are flowing into the private equity industry. Consequently, investments made in times of brisk deal activity and many new fund closings will underperform investments made while the private equity activity is low.

Finally, the market timing view assumes that target companies are able to exploit temporary windows of opportunity and issue or dispose of shares when capital markets in general or particular sectors are overvalued and private equity firms compete against each other in bidding processes. Consequently, substantial investment activity and large numbers of fund closings will be associated with a comparatively poor subsequent performance.

7.4.2.2 *Test Specification*

The basic idea of the following tests is to measure private equity performance relative to investment activity and competition among private equity firms at the point in time when investments are made. However, this would make it necessary to have access to investment and performance data at the level of individual deals. Unfortunately, this information is not available from Thomson Reuters. A comprehensive data set including more than 5,000 single investments is contained in the CEPRES database. However, this database is subject to other biases, as discussed in section 4. Furthermore, switching the data set would violate data consistency within the different empirical parts of this dissertation. For these reasons, the cash flow data at fund level provided in the Thomson Reuters' Private Equity Performance database has been used and vintage IRRs and vintage excess IRRs have been calculated.

To control for serial correlation and heteroskedasticity in the error terms and in order to check the robustness of results with regard to different methodologies, three alternative regression approaches are employed: OLS regressions with robust standard errors, FGLS regressions with robust standard errors and weighted least squares (WLS) regressions with vintage IRRs and excess vintage IRRs as dependent variables. The standard errors used for the OLS and FGLS regressions are estimated using the White-Huber estimator (MacKinnon and White 1985). FGLS models are implemented using a transformation suggested by Prais and Winsten (1954), which also corrects for heteroskedasticity and autocorrelation (Verbeek 2008, p. 100). Finally, WLS regressions are run using weighting that is proportional to the annual number of deals.

The explanatory variables include the number of funds per vintage and the number of first-time funds per vintage. Their purpose is to capture potential competition among private equity firms and the entrance of new players to the market, as well as the number of investments per year and the lagged number of investments per year as measures of investment activity.

The operationalization procedure described above entails a certain oversimplification. Regressing vintage IRRs on investment activity in a vintage year indirectly assumes that investments are conducted in the first year after inception. However, usually it takes about four years for fund capital to be fully invested. Nevertheless, the approach is still considered to be appropriate, for two reasons. First, private equity deal activity is highly persistent (see section 5.2 for detailed analyses of the time series characteristics). Thus, if a nontrivial relationship exists between investment activity and performance, this relationship is most likely to be found even if the actual investment timing is not perfectly matched to the vintage. Second, taking account of lagged investment activity too should also capture much of the actual investment behavior of the funds for each vintage. To ensure that this is the case, it has been analyzed on a quarterly level how long it takes until 80% of capital has been drawn down for all mature vintages. The duration is 3.0 years for the buyout sample and 3.5 years for the venture capital sample. Consequently, the vintage year and the subsequent year should capture the lion's share of investment activity for a given fund vintage.

7.5 Results

7.5.1 Buyout Vintage Performance

Table 53 reports regression results with the vintage IRRs of buyout funds as dependent variable. The univariate OLS regressions presented in models 1 through 4 suggest that vintage performance correlates negatively to the number of funds per vintage, and that the impact is considerable in economic terms, as each additional fund implies an IRR reduction of 0.68 percentage points. By contrast, the coefficient is positive but not significant for the number of first-time funds. The number of deals and number of lagged deals seem to have a negative impact. Although the coefficients are small in absolute terms, they imply that, for each additional deal per year, performance declines by 1.4 or 1.5 base points respectively. To put that another way: An extra 100 deals per year will be associated with a drop of 1.4 or 1.5 percentage points respectively in the vintage IRR. A year-on-year change of 100 deals is actually not much, given a standard deviation of more than 600 deals on a yearly basis. Thus, based on OLS regressions, vintage IRRs can be regarded as highly sensitive to deal activity in the vintage year and the subsequent year.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: OLS regressions with robust standard errors						
Intercept	27.192 ***	6.782	23.458 ***	23.379 ***	23.572 ***	23.938 ***
	(3.340)	(0.910)	(5.250)	(5.670)	(3.380)	(3.610)
No. of BO funds $_t$	-0.680 **				-0.605 *	-0.587 *
	(-2.210)				(-2.090)	(-2.020)
No. of first-time BO funds $_t$		1.338			2.181 *	2.120 *
		(1.070)			(1.790)	(1.780)
BOY $_t$			-0.014 ***		0.003	
			(-3.010)		(0.310)	
BOY $_{t+1}$				-0.015 ***	-0.013	-0.010 **
				(-3.350)	(-1.440)	(-2.700)
Number of observations	19	19	19	19	19	19
F-statistic	4.90 ***	1.15	9.05 ***	11.25 ***	3.28 **	23.70 ***
R^2	0.184	0.048	0.349	0.412	0.526	0.442
Panel B: FGLS regressions with robust standard errors						
Intercept	18.038 ***	5.469	7.643	18.998 **	22.506 **	22.782 ***
	(2.030)	(0.750)	(0.760)	(2.570)	(2.470)	(3.020)
No. of BO funds $_t$	-0.573 ***				-0.533 *	-0.535 *
	(-3.630)				(-1.060)	(-2.110)
No. of first-time BO funds $_t$		0.662			1.397	1.383
		(0.750)			(1.290)	(1.290)
BOY $_t$			0.000		0.000	
			(0.010)		(0.008)	
BOY $_{t+1}$				-0.012 *	-0.009	-0.009
				(-1.820)	(-1.400)	(-1.560)
Number of observations	19	19	19	19	19	19
F-statistic	7.75 ***	0.51	0.44	3.30 *	2.00	2.52 *
R^2	0.191	0.024	0.001	0.163	0.332	0.333
Panel C: WLS regressions						
Intercept	29.242 ***	14.692 **	24.975 ***	24.868 ***	23.434 ***	23.079 ***
	(4.150)	(2.300)	(4.276)	(4.185)	(2.950)	(2.960)
No. of BO funds $_t$	-0.786 *				-0.429	-0.421
	(-1.690)				(-0.620)	(-0.620)
No. of first-time BO funds $_t$		1.325			1.911	1.896
		(1.691)			(0.970)	(0.970)
BOY $_t$			-0.014		0.001	
			(-2.430)		(0.080)	
BOY $_{t+1}$				-0.016 *	-0.014	-0.013
				(-2.550)	(-0.690)	(-1.480)
Number of observations	19	19	19	19	19	19
χ^2	2.85 *	0.61	5.92 **	6.52 **	7.49 **	7.48 *

***; **; * Significance at the 1%, 5%, and 10% levels in two-sided tests.

Table 53: Regression Results; Dependent Variable: Vintage IRRs for BO Funds

This table shows OLS, FGLS and WLS regressions with the vintage IRRs for buyout funds as dependent variable. BOY $_t$ indicates the number of deals for a given year. BOY $_{t-1}$ is the lagged variable. No. of BO funds$_t$ is the number of funds per vintage. No. of first-time BO indicates how many first-time funds were closed in a given year. Robust standard errors for OLS regressions are calculated using White's heteroskedasticity-consistent estimator. FGLS regressions are conducted using Prais-Winston transformations.

Combining all variables in the full model 5 leads to a loss of significance and to multicollinearity. Calculation of VIF values reveals that the number of buyouts is closely correlated to its lagged variable. Dropping the variable with highest VIF value, e.g. annual deal activity, causes the other variables to gain in significance and resolves the issue of multicollinearity in the model.

Although some of the coefficients are significant only at the 10% level, the OLS results with robust standard errors suggest that vintage performance correlates negatively to both deal closing and investment activity. Thus, the *agency conflict*, *market timing* and *signaling* view of information asymmetries are supported, unlike the *neoclassical* theory and the *value add* hypothesis.

Interestingly, the coefficient of the number of first-time funds is insignificant in the univariate model and significantly positive in the multivariate model, in contrast to the coefficient of the total number of vintage funds. Figure 20 hints at a potential explanation for this seeming inconsistency. The light gray line depicts the number of first-time funds, revealing that it bears little correlation to the total number of funds, as also suggested by the rather low correlation coefficient in Table 50. This implies that the closing of first-time funds follows a pattern which is different to overall closing activity. A possible explanation would be that private equity firms prefer to launch first-time funds when the economic outlook is favorable, whereas follow-up funds are driven by a cyclicity that is fostered by the extrapolation of past successes.

However, Panels B and C show that the significance of these results is not robust in respect of other regression methods. Although the signs of the coefficients remain largely unchanged, the significance is weaker for almost all models, suggesting that the interpretation given above should be treated with caution.

The regressions are repeated with excess IRRs as dependent variables. The results are presented in Table 54.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: OLS regressions with robust standard errors						
Intercept	33.612 **	1.613	10.396	5.761	24.613	22.051
	(2.400)	(0.560)	(1.050)	(0.610)	(1.720)	(1.690)
No. of BO funds $_t$	-1.317 **				-2.566 ***	-2.690 ***
	(-2.220)				(-4.100)	(-4.430)
No. of first-time BO funds $_t$		-1.860			6.149 **	6.576 **
		(-0.150)			(2.750)	(2.880)
BOY $_t$			-0.007		-0.019	
			(-0.810)		(-0.760)	
BOY $_{t+1}$				-0.00	0.035	0.020 *
				(-0.110)	(1.510)	(1.990)
Number of observations	19	19	19	19	19	19
F-statistic	4.91 **	0.31	0.65	0.01	6.37 ***	7.77 ***
R^2	0.191	0.002	0.024	0.001	0.488	0.456
Panel B: FGLS regressions with robust standard errors						
Intercept	33.776 **	-8.636	11.564	4.044	24.401	20.945
	(2.170)	(-0.610)	(0.860)	(0.300)	(1.590)	(1.570)
No. of BO funds $_t$	-1.302 *				-2.425 ***	-2.559 ***
	(-2.100)				(-3.940)	(-4.210)
No. of first-time BO funds $_t$		3.802			5.737 **	6.294 **
		(1.330)			(2.530)	(2.900)
BOY $_t$			-0.007		-0.019	
			(-0.640)		(-0.880)	
BOY $_{t+1}$				0.003 *	0.035	0.019 *
				(0.190)	(1.710)	(0.085)
Number of observations	19	19	19	19	19	19
F-statistic	2.43	0.98	0.37	0.23	5.55	5.66 ***
R^2	0.162	0.100	0.021	0.007	0.464	0.433
Panel C: WLS regressions						
Intercept	22.425 ***	-0.501	14.951 ***	13.306 ***	13.988 *	13.287 *
	(3.180)	(-0.080)	(3.500)	(3.180)	(1.790)	(1.710)
No. of BO funds $_t$	-0.760 *				-2.195 ***	-2.350 ***
	(-1.630)				(-3.180)	(-3.440)
No. of first-time BO funds $_t$		4.075 **			7.161 ***	7.449 ***
		(2.410)			(3.640)	(3.810)
BOY $_t$			-0.006		-0.028	
			(-1.010)		(-1.500)	
BOY $_{t+1}$				-0.00 **	0.045 **	0.018 **
				(-0.380)	(2.220)	(2.040)
Number of observations	19	19	19	19	19	19
χ^2	2.66	5.81 **	1.02	0.14 **	20.05 ***	17.80 ***

***; **; * Significance at the 1%, 5%, and 10% levels in two-sided tests.

Table 54: Regression Results; Dependent Variable: Vintage Excess IRRs for BO Funds

This table shows OLS, FGLS and WLS regressions with the vintage excess IRRs for buyout funds as dependent variable. BOY $_t$ indicates the number of deals for a given year. BOY $_{t-1}$ is the lagged variable. No. of BO funds$_t$ is the number of funds per vintage. No. of first-time BO indicates how many first-time funds were closed in a given year. Robust standard errors for OLS regressions are calculated using White's heteroskedasticity-consistent estimator. FGLS regressions are conducted using Prais-Winston transformations.

The results for the excess IRRs are, to some extent, similar to those for the IRRs with regard to the signs of the coefficients. However, significance is stronger in the multivariate model and also robust in respect of different regression approaches.

The number of buyout funds seems to negatively impact excess performance. This effect seems to be even stronger in absolute terms than for the results in Table 53. However, with the exception of WLS regressions, the other variables exhibit little significance in univariate models. In univariate WLS regressions, the coefficient of the number of first-time funds is positive and the coefficient for lagged deal activity is negative. Both findings are in line with the prior results for excess IRRs.

Combining all variables to form a multivariate model creates the problem of multicollinearity. Dropping the variable with the highest VIF value eliminates multicollinearity and results in a significant model. In contrast to the findings for the raw vintage IRRs, the coefficient for investment activity is positive. The fact that the coefficient for lagged deal activity is negative for the raw vintage IRRs and positive for the excess vintage IRRs suggests that private equity firms invest heavily when the market as a whole peaks, and that funds subsequently experience the resultant poorer returns. Performance does not appear to be worse than in public markets, however. The positive coefficients in the regressions with the excess IRRs as dependent variables even suggest that busy investment activity is associated with higher relative performance. Coefficients between 0.018 and 0.020 imply that an additional 100 deals per year would be accompanied by higher absolute excess returns that are up to two percentage points higher. However, this means that negative excess returns too would also be increased by substantial investment activity.

Overall, the results provide statistical evidence that the vintage performance of buyout funds correlates negatively to overall closing and investment activity. However, excess IRRs actually have a positive correlation to the number of annual investments. This suggests that buyout fund managers invest heavily when the market peaks and experience disappointing subsequent performance in line with overall market development. Relative performance is nevertheless better than that of public markets for vintages with heavy aggregate investment activity.

7.5.2 Venture Capital Vintage Performance

Table 55 shows the regression results for the venture capital sample with vintage IRRs as dependent variable.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: OLS regressions with robust standard errors						
Intercept	9.066 ***	5.452 **	7.530 ***	6.479 ***	10.192 ***	8.388 ***
	(3.900)	(2.440)	(4.020)	(3.390)	(4.370)	(4.000)
No. of VC funds $_t$	-0.188 ***				-0.227 *	
	(-3.670)				(-2.420)	
No. of first-time VC funds $_t$		-0.310 ***			0.244	-0.240 **
		(-2.980)			(1.060)	(-2.890)
VCY $_t$			-0.004 ***		-0.001	
			(-4.000)		(-0.530)	
VCY $_{t+1}$				-0.004 ***	-0.001	-0.003 **
				(-3.190)	(-0.540)	(-2.800)
Number of observations	19	19	19	19	19	44
F-statistic	13.49 ***	8.90 ***	16.03 ***	10.21 ***	5.49 **	23.70 ***
R^2	0.439	0.213	0.455	0.345	0.550	0.442
Panel B: FGLS regressions with robust standard errors						
Intercept	9.041 ***	5.232 *	7.539 ***	6.449 **	10.395 ***	8.392 ***
	(-3.690)	(1.820)	(3.860)	(3.190)	(5.890)	(3.940)
No. of VC funds $_t$	-0.187 ***				-0.296 ***	
	(-3.520)				(-3.120)	
No. of first-time VC funds $_t$		-0.282			0.402	-0.240 **
		(-2.690)			(1.700)	(-2.890)
VCY $_t$			-0.004		-0.001	
			(-3.900)		(-0.390)	
VCY $_{t+1}$				-0.004 *	-0.001	-0.003 **
				(-3.010)	(-0.320)	(-2.760)
Number of observations	19	19	19	19	19	19
F-statistic	7.05 ***	3.98	8.42 ***	5.55 **	8.44 ***	6.61 *
R^2	0.423	0.184	0.442	0.326	0.666	0.463
Panel C: WLS regressions						
Intercept	12.120 **	10.308 **	10.044 **	9.739 **	10.333	10.615 **
	(1.990)	(2.230)	(2.270)	(2.260)	(1.240)	(2.260)
No. of VC funds $_t$	-0.286				0.046	
	(-0.790)				(0.040)	
No. of first-time VC funds $_t$		-0.718			-0.571	-0.510
		(-0.750)			(-0.260)	(-0.470)
VCY $_t$			-0.006		0.000	
			(-0.760)		(-0.020)	
VCY $_{t+1}$				-0.005	-0.003	-0.003
				(-0.710)	(-0.150)	(-0.400)
Number of observations	19	19	19	19	19	19
χ^2	0.63 *	0.45	0.58 **	0.50 **	7.49 *	0.72

***; **; * Significance at the 1%, 5%, and 10% levels in two-sided tests.

Table 55: Regression Results; Dependent Variable: Vintage IRRs for VC Funds

This table shows OLS, FGLS and WLS regressions with vintage excess IRRs for venture capital funds as dependent variables. VCY $_t$ indicates the number of deals in a given year. VCY $_{t-1}$ is the lagged variable. No. of VC funds $_t$ is the number of funds per vintage. No. of first-time VC funds indicates how many first-time funds were closed in a given year. Robust standard errors for OLS regressions are calculated using White's heteroskedasticity-consistent estimator. FGLS regressions are conducted using Prais-Winston transformations.

The univariate regressions presented in Table 55 exhibit highly significant negative coefficients for all independent variables. The full model reported in row 5 suffers from high multicollinearity, as evidenced by the high unreported VIF values. Unlike in the buyout sample, not only investment activity and lagged investment activity are highly correlated, but so too are the total number of funds per vintage and the number of first-time funds (see Table 50, p. 214). Of the two correlated pairs of variables, the ones with the highest VIF values are therefore dropped. In the multivariate models in row 6 of panels A to C, the impact of investment and deal closing activity on vintage performance is negative and the model is able to explain almost half of the variance in vintage IRRs. However, the significance is severely reduced when WLS regressions are used.

The regressions are rerun with the excess vintage IRRs as dependent variables. However, as Table 56 shows, the coefficients are far from being significant and the low *F* statistics raise doubts about whether a linear relationship is the right approach to analyze excess returns for venture capital funds.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: OLS regressions with robust standard errors						
Intercept	1.119	0.854	-5.547	-10.165	-2.600	-4.409
	(0.110)	(0.100)	(-0.620)	(-1.160)	(-0.240)	(-0.460)
No. of VC funds $_t$	-0.175				-0.246	
	(-0.800)				(-0.370)	
No. of first-time VC funds $_t$		-0.596			-0.090	-0.722
		(-1.020)			(-0.060)	(-1.140)
VCY $_t$			0.000		-0.003	
			(0.070)		(-0.280)	
VCY $_{t+1}$				0.004	0.010	0.006
				(0.800)	(0.740)	(0.950)
Number of observations	19	19	19	19	19	19
F-statistic	0.64	1.05	0.01	0.64	0.36	0.84
R^2	0.026	0.054	0.000	0.034	0.121	0.110
Panel B: FGLS regressions with robust standard errors						
Intercept	2.254	3.245	-4.200	-9.768	-3.145	-3.080
	(0.190)	(0.320)	(-0.400)	(-1.000)	(-0.240)	(-0.270)
No. of VC funds $_t$	-0.190				-0.028	
	(-0.720)				(-0.040)	
No. of first-time VC funds $_t$		-0.740			-0.625	-0.796
		(-1.010)			(-0.420)	(-1.090)
VCY $_t$			0.000		-0.002	
			(-0.050)		(-0.210)	
VCY $_{t+1}$				0.004	0.007	0.006
				(0.780)	(0.620)	(0.920)
Number of observations	19	19	19	19	19	19
F-statistic	0.50	0.68	0.24	0.50	0.50	0.77
R^2	0.022	0.066	0.000	0.028	0.111	0.109
Panel C: WLS regressions						
Intercept	5.100	6.722	2.013	0.990	-5.048	5.784
	(0.840)	(1.450)	(0.450)	(0.230)	(-0.610)	(1.230)
No. of VC funds $_t$	-0.314				1.755	
	(-0.870)				(1.580)	
No. of first-time VC funds $_t$		-2.152 **			-5.706	-2.784 ***
		(-2.250)			(-2.590)	(-2.560)
VCY $_t$			-0.003		0.001	
			(-0.470)		(0.060)	
VCY $_{t+1}$				0.000	-0.007	0.009
				(0.010)	(-0.350)	(1.230)
Number of observations	19	19	19	19	19	19
χ^2	0.76	5.96 **	0.22	0.00	9.07 *	6.56 **

***; **; * Significance at the 1%, 5%, and 10% levels in two-sided tests.

Table 56: Regression Results; Dependent Variable: Vintage Excess IRRs for VC Funds

This table shows OLS, FGLS and WLS regressions with the vintage IRRs for venture capital funds as dependent variables. VCY $_t$ indicates the number of deals for a given year. VCY $_{t-1}$ is the lagged variable. No. of VC funds$_t$ is the number of funds per vintage. No. of first-time VC indicates how many first-time funds were closed in a given year. Robust standard errors for OLS regressions are calculated using White's heteroskedasticity-consistent estimator. FGLS regressions are conducted using Prais-Winston transformations.

Robust regressions are conducted to rule out the possibility that outliers might affect the results for the venture capital sample. This procedure is a special case of weighted least squares regression (Hamilton 2009) and starts by running OLS regressions. Using Cook's D (Cook 1977), the most influential observations are then identified and dropped. This is followed by the iterative weighting of observations based on their absolute residuals, in which observations with large residuals are down-weighted. The robust regressions are conducted with vintage IRRs and excess vintage IRRs as dependent variables.

	(1)	(4)	(2)	(3)	(5)	(6)
Panel A: Dependent variable: vintage IRR of VC funds						
Intercept	11.922 ***	5.790 **	7.793 ***	6.472 ***	10.721 ***	9.941 ***
	(8.500)	(2.620)	(3.680)	(3.080)	(3.900)	(9.760)
No. of VC funds $_t$	-0.235 ***				-0.236	
	(-6.080)				(-1.330)	
No. of first-time VC funds $_t$		-0.316 **			0.273	-0.341 ***
		(-2.010)			(0.730)	(-5.420)
VCY $_t$			-0.004 ***		-0.001	
			(-3.240)		(-0.350)	
VCY $_{t-1}$				-0.004 ***	-0.001	-0.002 ***
				(-2.690)	(-0.220)	(-3.320)
Number of observations	18	19	19	19	19	19
F-statistic	37.00 ***	4.05 *	10.48 ***	7.24 ***	3.31 **	24.89 ***
Panel B: Dependent variable: vintage excess IRR of VC funds						
Intercept	-1.197	-0.780	-7.380	-12.303	5.794	-6.727
	(-0.100)	(-0.080)	(-0.720)	(-1.240)	(0.370)	(-0.580)
No. of VC funds $_t$	-0.145				-1.355	
	(-6.080)				(-1.350)	
No. of first-time VC funds $_t$		-0.526			1.409	-0.622
		(-0.790)			(0.740)	(-0.860)
VCY $_t$			0.001		-0.015	
			(0.100)		(-0.820)	
VCY $_{t-1}$				-0.004	0.029	0.006
				(0.700)	(1.730)	(0.880)
Number of observations	19	19	19	19	18	19
F-statistic	0.26	0.63	0.01	0.49	1.16	0.63

***; **; * Significance at the 1%, 5%, and 10% levels in two-sided tests.

Table 57: Regression Results; Dependent Variables: Vintage IRR and Excess Vintage IRRs for Venture Capital Funds

This table shows OLS, FGLS and WLS regressions with vintage IRRs for venture capital funds as dependent variables. VCY $_t$ indicates the number of deals in a given year. VCY $_{t-1}$ is the lagged variable. No. of VC funds $_t$ is the number of funds per vintage. No. of first-time VC funds indicates how many first-time funds were closed in a given year. Robust standard errors for OLS regressions are calculated using White's heteroskedasticity-consistent estimator. FGLS regressions are conducted using Prais-Winston transformations.

As shown in Table 57, after controlling for outliers, the four explanatory variables exhibit significant negative relationships with the vintage IRRs of venture capital funds. This suggests that both investment activity and fund closing activity have a negative impact on vintage performance. However, after controlling for stock market performance by taking the excess IRRs as dependent variables, the relationship between the dependent and explanatory variables becomes insignificant. This suggests that venture capitalists predominantly close funds and conduct investments during periods when stock market returns hit their peaks. As a result, subsequent performance is below average, in line with overall capital market performance, which deteriorates during stock market downturns.

On the other hand, excess IRRs seem to be too noisy to establish a relationship between relative performance and investment and closing behavior. This suggestion appears evident in Figure 21. Whereas excess IRRs for buyouts seem to follow a wave pattern with peaks in 1994 and 2001, excess IRRs for venture capital do not seem to follow such cycles. This may be the reason for the lack of correlation to investment and fund closing waves.

7.5.3 Summary of Findings

The results for the buyout sample provide evidence that the vintage performance of buyout funds correlates negatively to the overall closing activity. This is consistent with research by Kaplan and Schoar (2005), Kaplan and Strömberg (2009), Lerner et al. (2007) and Gottschalg and Phalippou (2009), all of whom identify a negative relationship between increasing numbers of fund launches and subsequent returns. Moreover, vintage performance seems to correlate negatively to aggregate investment activity, although this relationship is positive if excess IRRs are used. This suggests that fund managers invest heavily around the times when markets peak, resulting in comparatively low subsequent performance. However, holding constant the number of fund closings, excess performance is higher following periods of busy deal activity, suggesting that private equity fund managers are able to slightly outperform public markets.

For the venture capital sample the results are highly sensitive to the regression approach and the return metric chosen. However, the results suggest that the performance of venture capital funds is negatively related to deal activity and fund closing activity with the latter being highly driven by first-time funds. However, no significant relationship is found when excess IRRs are used. Nevertheless, given the overall poor performance of venture capital, the finding for the raw IRRs might sufficiently indicate that periods of high activity in the venture capital market do not indicate superior performance.

7.6 Conclusion

Performance patterns for both samples exhibit a significant negative correlation between IRR and both deal activity and closing activity. This suggests that private equity firms tend to crowd into the market when performance of public market peaks. These findings are in line with the *adverse selection* cost view of information asymmetries, the *agency conflict* and *market timing* theory but in contrast to the *neoclassical* theory and *value add* view of information asymmetries.

The results are moderated for the buyout sample when excess IRRs are used. After controlling for public market performance, the results suggest a positive relationship between fund performance and deal activity while the negative relationship between the number of fund closings and vintage performance remains even also if excess IRR is used as dependent variable. This suggests that, holding constant the number of fund closings for given vintage, the performance relative to public markets is better if investments are made during times of high deal activity.

Overall, the results suggest that private equity firms tend to increase the number of fund closings and the subsequent investment activity in certain periods, which often coincide with periods of high valuations of public markets. This unfortunate timing of investments is reflected in the performance pattern, e.g. fund vintages that invest during periods of high private equity activity underperform those that invest in times of only moderate activity.

8 Practical Implications

The contribution of this study for practitioners had been betokened for general partners, limited partners as well as target companies and their respective stake holders. This sections aims to derive practical strategies from the findings presented above.

8.1 General partners' perspective

From a general partner's viewpoint, the findings of the study suggest that investments made in times of brisk activity are likely to turn out as underperformers for private equity funds that are heavily dependent on the dynamics of the private equity industry. In particular, investment quality and fund performance will inevitably suffer, if fund raising can only be achieved following periods of high performance and fund managers are then pressurized to invest not withstanding to realize investments at premiums and with unreasonable leverage. Thus, the study implicitly stresses that ensuring deal flow and fund raising throughout private equity cycles is key to maintain superior fund quality. In addition, empirical results presented above also entail practical results that can be useful to derive an investment strategy based on the wave pattern on industry level which have been discovered in this study.

8.1.1 Approach

Section 6 has documented differences in the wave pattern between the venture capital and buyout subsample as well as between the respective industries. The basic idea of practical implications from a general partner's perspective is to derive investment strategies from the prior findings, utilizing the fact that those differences may provide opportunities to improve fund performance. It is therefore intended to take advantage of the typical wave pattern that involves a trigger by an economic shock, a rise of activity accompanied by rising valuation levels due to bidding contests of private equity firms and a slow down of activity after the first defaults of deals. In order to benefit from this pattern, a private equity firm would have to be a frontrunner in investments into industries that are just about to enter a wave. If it would be possible to identify industry waves early, private equity firms could invest at the beginning of a wave and divest towards the end of the wave hereby benefitting from the rising valuation levels. Such a strategy could target at industries with the following three characteristics: First, the industry should exhibit a certain deal volume, since a focus on an industry with generally minor activity would not allow to benefit from it. Second, the industry should experience waves that are at least as long as a typical holding period of no less than three years. This ensures that acquisition and exit can be realized within one wave. Third, the private equity activity in that industry should be highly sensitive to one or several drivers with a lead, which will allow private equity firms to watch those drivers and to predict the occurrence of a wave. Thus, industries have to be determined that best match the described criteria.

8.1.2 Results

To exploit the findings of the study this section will focus on the identification of industries with a high overall activity, long wave durations and a high predictability with the help of drivers with a time lead.

8.1.3 Selection of Industries

As a measure of overall activity the total number of deals over the 80 quarters under observation will be used. The length of the respective industry waves will be calculated using the wave criterion used in 6.2. In particular, to identify waves for each industry time series of deal activity, 1,000 simulations with the total number of deals had been conducted. Then, waves where identified using the 95-percentile of the obtained distribution of the cumulative two-year activity. Thus, a wave starts once the two-year activity exceed the 95-percentile of the activity distribution and is ended once the two-year activity drops below that threshold.

To precisely capture the predictability of the used proxies, the logic of the rank analysis conducted in section 6.5 will be used. For that analysis, a quartile rank had been assigned to each value of the proxy time series. Proxies that achieved a rank significantly higher or significantly lower than 2.5 had been considered a driver for the deal activity. Thus, a good predictor would be a driver that received rank 4 (or rank 1 respectively). In other words, if an industry proxy time series exhibits rank 4 (or rank 1 respectively) at the start of a wave, the industry may be regarded as highly sensitive to that driver. In order to further detail the predictability or sensitivity of an industry to the proxies, the ranks have been replaced by the actual percentiles of the industry proxy time series. Consequently, an industry would be highly sensitive to that driver if it exhibits a percentile close to 100% (or 0% respectively).

A summary of the described criteria is presented in Table 58.

Industry	Total deal activity	Average length of wave	Average percentile of drivers
Panel A: BO Waves			
Biotechnology	793	9	0.67
Business Products and Services	1,230	7	0.70
Computers and Peripherals	183	8	0.40
Consumer Products and Services	1,810	19	0.63
Electronics/Instrumentation	283	11	0.53
Financial Services	752	8	0.63
Healthcare Services	417	8	0.54
Industrial/Energy	4,608	18	0.60
IT Services	408	8	0.46
Media and Entertainment	1,272	4	0.69
Medical Devices and Equipment	469	14	0.53
Networking and Equipment	747	6	0.59
Retailing/Distribution	178	6	0.68
Semiconductors	874	8	0.61
Software	220	7	0.60
Telecommunications	1,350	8	0.67
Other	447		
Panel B: VC Waves			
Biotechnology	2,532	14	0.63
Business Products and Services	1,348	7	0.51
Computers and Peripherals	404	6	0.52
Consumer Products and Services	1,633	9	0.64
Electronics/Instrumentation	587	12	0.60
Financial Services	785	2	0.56
Healthcare Services	417	10	0.55
Industrial/Energy	4,148	11	0.54
IT Services	1,075	10	0.58
Media and Entertainment	2,039	10	0.68
Medical Devices and Equipment	1,089	12	0.54
Networking and Equipment	1,751	4	0.46
Retailing/Distribution	509	5	0.75
Semiconductors	878	13	0.58
Software	736	6	0.49
Telecommunications	4,200	9	0.50
Other	510		

Table 58: Wave Criteria on Industry Level

This table summarizes wave criteria on industry level relevant for the development of investment strategies. Total deal activity signifies the total number of deal conducted between 1990 and 2009. Average length of wave denotes the average length of an industry wave in quarters. As most industries experience only one wave during the observation period, the average length is equal to the length of this wave. Average percentile of drivers is the average percentile of all industry drivers identified in 6 for the respective industry.

The wave criteria on industry level presented in Table 58 document that the wave pattern on industry level vary substantially across the different industries in terms of the total activity, the duration of a wave and the sensitivity to the identified drivers. In order to ensure sufficient deal activity, it would be advisable to focus on industries with at least 1,000 transactions over the last 80 quarters. This threshold corresponds to 50 transactions per year on average in an industry all over Europe. Although 1,000 appears to be a somewhat arbitrary number, it may be seen as a starting point to this application oriented approach and will be reconsidered if otherwise appealing industries would be discriminated by missing this limit. In addition to the minimum activity criterion, the minimum length of a wave should be at least twelve quarters to allow for an exit after a typical holding period of three to five years (Kaplan and Strömberg 2009, p. 129)

Applying these two criteria to Figure 22 reveals that for the buyout sample only two industries match the requirements of a wave length of at least 12 quarters and at least 1,000 transactions over the last 80 quarters under observation. Industrial/Energy and Consumer Products and Services exhibit a wave length of 18 and 19 quarters, respectively, and thus allow more than four years for investment and exit during one wave. Both industries exhibit by far more deal activity than the required 1,000 transactions over the sample period. A third industry that fulfills the length criterion is Medical Devices and Equipment. However, only 469 deals had been conducted over the sample period, which seems inadequately low to base an industry investment strategy on it.

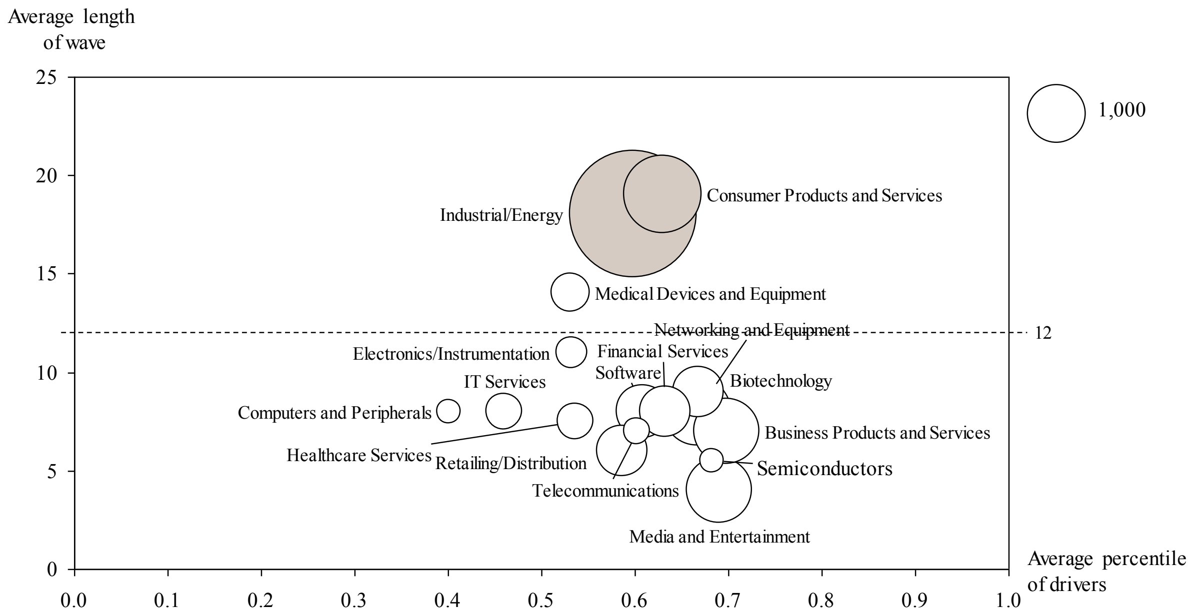

Figure 22: Identification of Industries Using the Three Wave Criteria – Buyouts

This figure illustrates the portfolio of industries in the buyout sample highlighting the average length of wave, the average percentile of drivers and the overall deal activity during the sample period signified by the size of the circle. Industries in the upper right quadrant with a preferably great size of the circle would be suited best for an industry strategy.

The third criterion is the sensitivity of an industry to the drivers identified in this study measured as the average percentile of drivers. This figure has been calculated by obtaining the percentile of each industry proxy time series at the occurrence of an industry wave and taking the simple average across all drivers. For the two industries identified in Figure 22, this value equals 0.7 for Consumer Products and Services and 0.6 for Industrial/ Engery. These values can be interpreted as follows: The six drivers identified in the industry analysis exhibited an average percentile of 0.6 and 0.7, respectively. Thus, each driver had been on average at the 60% or 70% percentile, when an industry wave had started. While both values are above average (0.5), this number seems not to be sufficient as a clear early warning indicator to identify the next wave, since a high predictability would be associated rather with values closer to 1.0. However, the analysis in section 6 had also shown, that economic shock indicators seem not to be a significant driver for buyouts. Thus, the average percentile of drivers is deflated by those drivers already found to be rather irrelevant. Consequently, focusing on selected drivers for both industries may be the more promising strategy. It is also reasonable that different industries may be more sensitive to particular drivers.

For example, some industries might be more volatile with respect to their valuation levels and thus exhibit more abnormal valuation levels than other industries. Pinpointing the most sensitive drivers for the two industries identified above will be the next step after conducting the same analysis for the venture capital sample.

Figure 23 illustrates the wave criteria of the venture capital sample. Compared to the buyout sample the total number of deals is higher since venture capital investments are more frequent but tend to be smaller in terms of deal size. However, there are fewer venture capital waves that exceed the duration of 12 quarters.

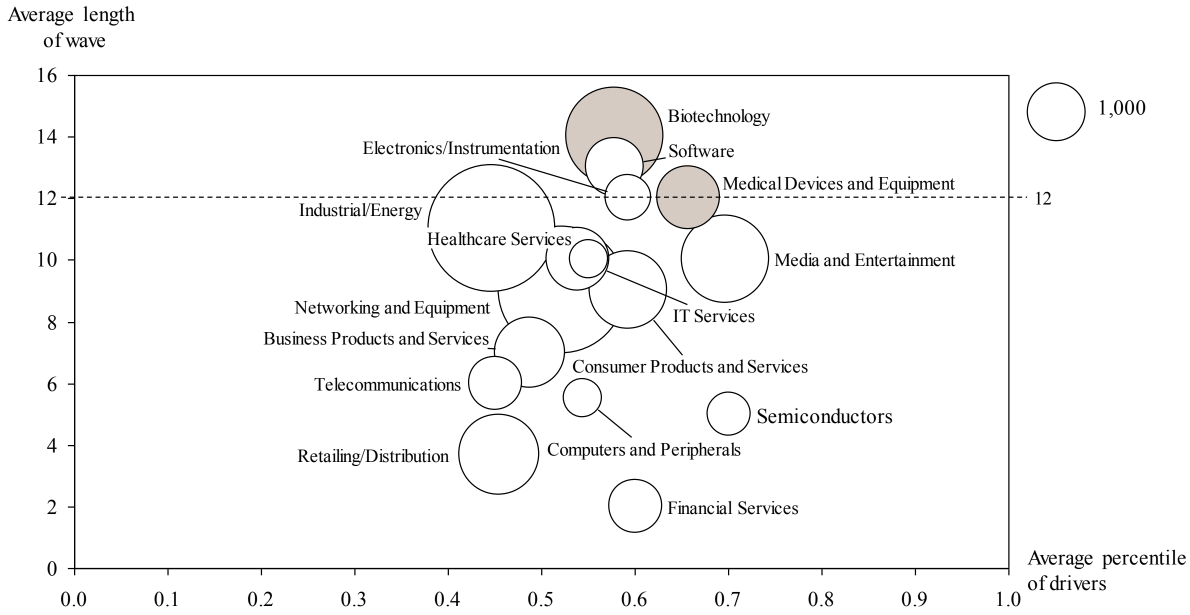

Figure 23: Identification of Industries Using the Three Wave Criteria – Venture Investments

This figure illustrates the portfolio of industries in the buyout sample highlighting the average length of wave, the average percentile of drivers and the overall deal activity during the sample period signified by the size of the circle. Industries in the upper right quadrant with a preferably great size of the circle would be suited best for an industry strategy.

For the venture capital sample, two industries meet the criteria of an average wave length of at least 12 quarters and at least 1,000 transactions during the sample period. Medical Devices and Equipment and Electronics/Instrumentation exhibit a wave length of 12 and 14 quarters, respectively and a total number of deals of 1,089 and 2,532, respectively. Two additional industries might be considered as well, since they only slightly miss only one criteria: Software exhibited only 736 transactions and

Industrial/ Energy had a wave length of only 11 quarters but experienced the greatest venture capital activity of all industries.

The next section will analyze the sensitivity of the respective drivers with the aim to identify the drivers that may be most effective as wave indicators or wave predictors.

8.1.4 Analysis of Sensitivity per Driver

To evaluate the suitability of the drivers as predictors for an industry wave, the sensitivity of the industries has been calculated with regard to the respective drivers. The sensitivity of buyouts in the Consumer Products and Services industry and the Industrial/Industry sector are presented in Figure 24 documenting that variances of the sensitivities vary across the respective drivers.

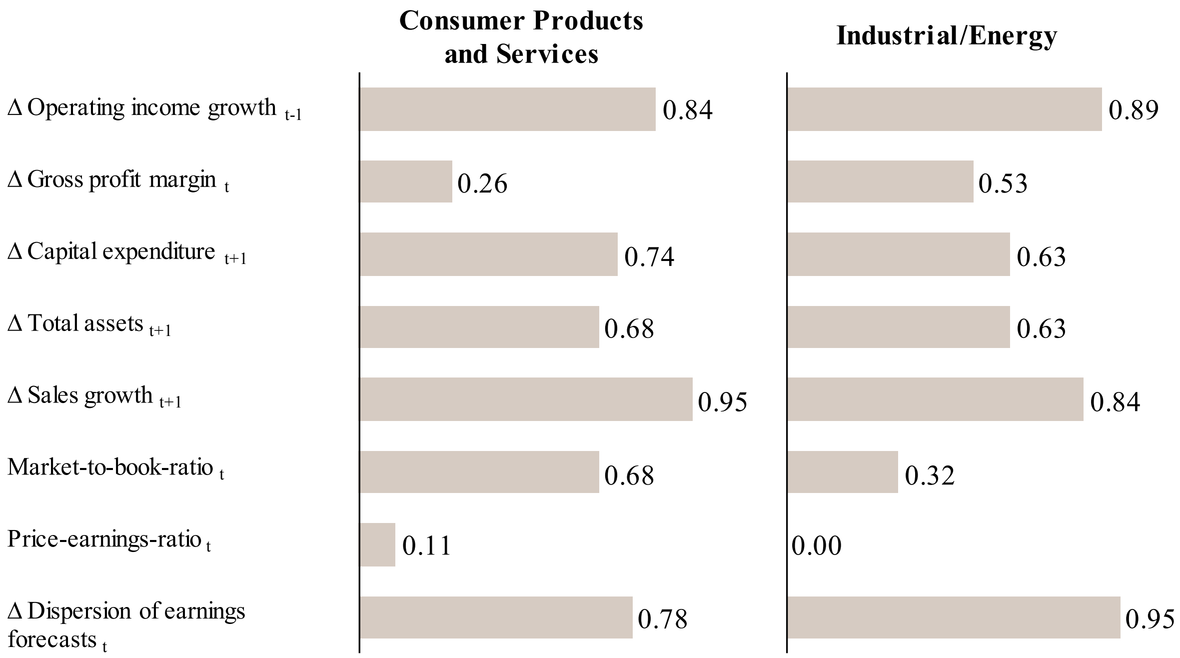

Figure 24: Driver Sensitivity of Selected Industries – Buyouts

This figure shows the driver sensitivity of selected buyout industries. The sensitivity has been calculated as the percentile of the respective driver time series at a start of a wave. For the drivers that had been found to exhibit below average driver values, this percentile had been subtracted from one, in order to achieve a measure for the sensitivity of the industry to the respective driver (e.g. for the dispersion of earnings forecasts). Consequently, a sensitivity close to one represents a high industry sensitivity, while a sensitivity close to zero is equivalent to no sensitivity according to predictions.

Nevertheless, the sensitivities show that operating income growth with a lead of one quarter appears to be a good indicator for a wave in both industries. Sales growth seems to be abnormally high following periods of high transaction activity. However, as the driver is lagged, this ratio is inappropriate as a wave indicator which should lead the wave and thus allow predictions about the development of the transaction activity. The dispersion of earnings forecasts exhibits high sensitivities, too, documenting that low information asymmetries go along with high transaction activity.

The results demonstrate that buyout firms could observe the operating income development and changes in the variance of analyst forecasts of companies operating in Consumer Products and Services and Industrial/ Energy and derive predictions on the development of the buyout activity in both sectors. The overall deal activity and the duration of the waves in the sample period would be sufficient to apply the strategy outlined above, e.g. identifying the start of a wave with the help of two drivers (operating income growth and dispersion of earnings forecasts), investing in that industry and divesting towards the end of the wave. Taking the market-to-book ratio as proxy for the overall valuation level in an industry, this strategy would have led to the following result: investment in the Consumer Products and Services industry in 2003 at an average market-to-book ratio of 2.35 and divestment in 2006 at 2.93. For the Industrial/Energy sector the increase in the valuation level would have been of similar magnitude. From the beginning of the wave in 2003 to the end of the bubble in 2008 the market-to-book ratio increased from 1.14 to 1.78. During this five year period, several exit opportunities with even much higher average valuation levels would have been possible. The results suggest that the strategy of investing at the wave start and divesting towards the end of the high activity period would have provided a beneficial market environment with regard to timing of investment and exit.

For the two industries selected for a venture investment strategy, the picture of drivers is more heterogeneous. In particular, the sensitivity of drivers seems to be heavily dependent on the industry. For Biotechnology firms, operating income growth and the market to book ratio seem to bee fairly good predictors of a wave. Companies in the Medical Devices industry experienced extraordinary gross profit growth and high information asymmetries prior to a venture capital wave.

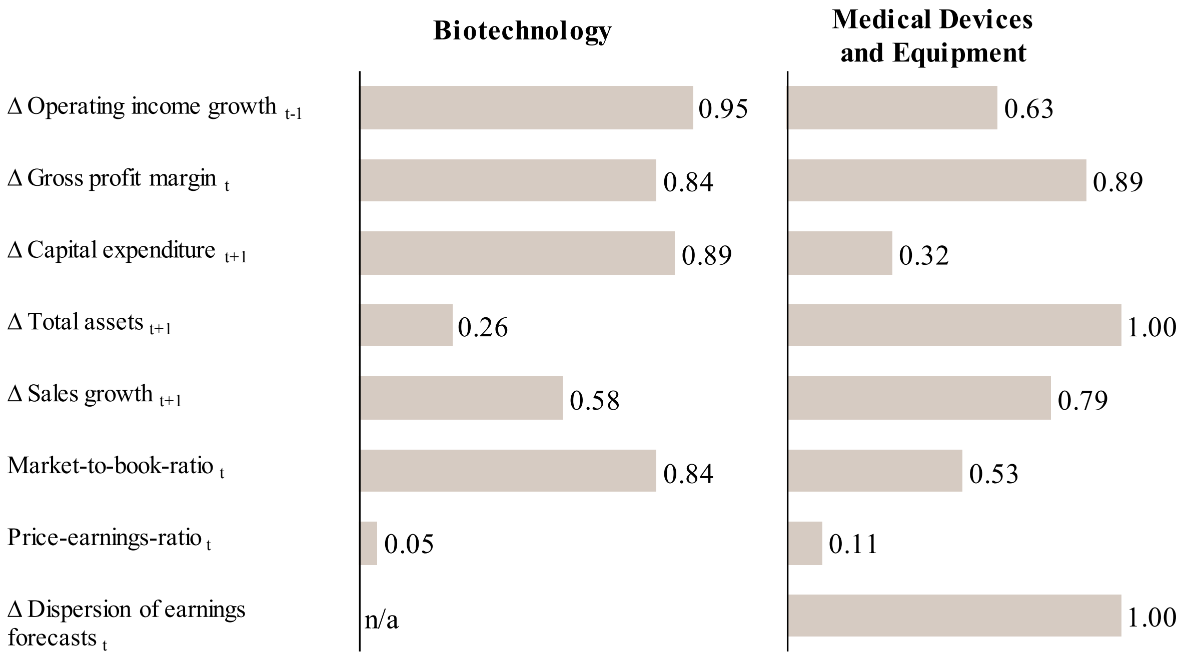

Figure 25: Driver Sensitivity of Selected Industries – Venture Investments

This figure shows the driver sensitivity of selected venture capital industries. The sensitivity has been calculated as the percentile of the respective driver time series at a start of a wave. For the drivers that had been found to exhibit below average driver values, this percentile had been subtracted from one, in order to achieve a measure for the sensitivity of the industry to the respective driver. Consequently, a sensitivity close to one represents a high industry sensitivity, while a sensitivity close to zero is equivalent to no sensitivity according to predictions.

Nevertheless, investing in Biotechnology firms at the wave start in 2002 at a market-to-book ratio of 4.66 and divesting towards the end of the wave in 2006 at an industry wide market-to-book ratio of 5.98 would have been an advantageous timing. Similarly, from 2003 to 2006 the average market-to-book ratio of firms in the Medical Devices industry rose from 4.48 to 5.71.

8.1.5 Summary and Conclusion

The previous analyses illustrated that the findings of this study may be useful for the development of a timing strategy for general partners on industry level. Such strategies aim at a predication of an upcoming industry wave, investment at the beginning of the wave and exit prior to the end of the wave, hereby benefitting from the increasing valuation levels arising from the competition for deals towards the end of the wave.

To apply such a strategy, the overall investment activity should be meaningful enough to allow for an industry focus strategy. In addition, the duration of the wave has to be long enough that an exit is possible after a typical holding period before the market euphoria fades away, liquidity dries up and prices decline. Finally, for each industry the drivers with the most predictive power or highest sensitivity with regard to industry waves have to be identified.

The results document that for buyouts such an industry investment strategy would have been feasible during the sample period for Consumer Products and Services and Industrial/Energy. For venture investments, Biotechnology and Medical Devices and Equipment provided similar chances to benefit from favorable industry wide deal activity and valuation levels.

Evidence with regard to private equity performance suggests that the average private equity firm does not apply the outlined or similar timing strategies. The overall disappointing performance and the dependence of investment activity on fund liquidity of private equity funds in Europe indicates that timing of investments is driven by other incentives than realizing maximum returns for investors. The results of this section may be used to develop timing strategies that pay of for general partners and limited partners alike.

However, the results have not been generated by formulating research hypothesis and conducting quantitative analyses. Instead these findings have been derived from the data set itself and provide a basis for the development of investment strategies on industry level. Further research may investigate whether these findings are robust to different sample periods. In addition, it would be interesting to study if and why particular industries may be especially attractive for private equity investors and allow for timing strategies along the wave pattern.

8.2 Limited Partners' Perspective

For limited partners, the results of this study advise that funds should not be allocated to private equity when record amounts of liquidity are channeled to this asset class. This abundant liquidity apparently leads to a competition for deals that results in premiums paid to the limited number of targets. These premiums subsequently materialize in underperformance relative to private equity investments made in times of sluggish investment activity. In contrast to venture capital investments, for buyouts, the performance seems to slightly beat public markets. However, as the investment activity seems to cluster particularly during periods of temporary high valuation levels, this asset class does not appear too attractive since limited partners thus experience for the larger part the poor performing periods following market peaks. Moreover, the relative performance compared to public markets does neither compensate for the potentially higher risk nor for the illiquidity of this asset class. It has to be noted, that while these findings may hold true for venture capital and buyouts as a whole, particular market segments may be subject to different kind of dynamics. Related research by Kaplan and Schoar (2005), Axelson et al. (2007), Phalippou and Gottschalg (2009) and Axelson et al. (2010) has revealed that the top quartile of private equity funds substantially and sustainably outperforms public markets.

8.3 Incumbent Management's and Shareholders' Perspective

For companies seeking private equity financing and shareholders of private companies who wish to dispose of their shares, the results suggest that at industry level, temporary windows of opportunities arise that entail high valuation levels and a high deal activity. Those busy periods are characterized by bidding contests of private equity for a limited number of target companies that result in premiums paid for investment targets. Consequently, management and shareholders of operating companies should consider private equity as preferred financing alternative when private equity investment activity is high and in particular when there have been a number of recent transactions in comparable companies in the same industry. Consequently, if company managers and shareholders are in a position where they can choose among different financing alternatives or can postpone financing transactions, they should rather avoid periods of low deal activity since such situations often go along with a competition for capital and correspondingly low purchase price levels.

9 Summary and Conclusion

Over the past two decades, private equity has established itself as a permanent asset class in Europe (Chew and Kaplan 2009). To some extent, it has also reshaped corporate financing culture. However, neither the influence wielded by private equity in Europe nor the number and volume of transactions have plotted a steady upward course. On the contrary: Since buyout and venture capital firms began committing to continental Europe in the mid-1990s, the private equity market has experienced tremendous fluctuations in deal activity in line with market cycles worldwide. Although the wave pattern of private equity investments is acknowledged by practitioners and scholars alike (Acharya et al. 2007, pp. 45–46; Chew and Kaplan 2009), academia has so far gained only a limited understanding of what drives these changing levels of aggregate investment activity (Axelson et al. 2007, p. 24).

This study contributes to existing research into private equity by investigating a comprehensive set of drivers of investment activity and examining the return-activity relationship in private equity investments. The theoretical framework of drivers discussed in this study focuses on four different perspectives. First, the neoclassical perspective centers around the idea that investment activity is driven by aggregate capital demand, which fluctuates with the business cycle. Second, the information asymmetry view points to changing levels of information asymmetry and the resultant time-varying adverse selection costs as the causes of private equity waves. Third, the agency theoretical perspective states that boom and bust cycles in private equity are induced by an agency conflict between private equity firms and their fund investors. According to this view, periods of high returns on private equity attract new entrants into the private equity market who then compete for deals and are prone to overinvest. This mechanism is assisted by abundant liquidity in private equity funds and debt markets following periods of high private equity returns. Finally, market timing theories claim that temporary periods of overvaluation allow entrepreneurs and managers as well as shareholders of target companies to dispose of their shares at a premium and to finance such transactions with underpriced credit.

The second empirical research goal was to investigate the relationship between investment activity and subsequent returns. By use of different econometric models for transaction and performance data and using proxies for the postulated drivers, the study has investigated the research questions with the following results.

9.1 Summary of Results

Table 59 briefly summarizes the findings of the study. This exhibit can of course only give a rough summary of the detailed findings reported in the empirical parts of the study without taking account of significance, magnitude of effects and robustness of results to various statistical approaches.

	BO			VC		
	Driver Analysis		Perfor-mance Analysis	Driver Analysis		Perfor-mance Analysis
	Industry	Aggregate		Industry	Aggregate	
Neoclassical view						
Economic shock hypothesis	o	+	o	+	+	o
Capital demand hypothesis	+	o		+	+	
Capital supply hypothesis		+			+	
Information asymmetry view						
Adverse selection hypothesis	+	+	+	o	o	+
Value add hypothesis	o	o	o	+	o	o
Market timing hypothesis	+	o	+	+	o	+
Agency conflict hypothesis		+	+		+	+

+ Results with supporting evidence; o results without supporting evidence.

Table 59: Summary of Findings of the Univariate Driver Analysis at Aggregate Level

This table summarizes the findings of the multivariate analyses conducted at aggregate leve. Individual model refers to multivariate models including only variables for a particular hypothesis. Full model refers to models consisting of proxy variables for all competing hypothesis.

Nevertheless, the results suggest the following story of private equity investments in Europe: The results imply that a considerable part of the variance in private equity investment activity can be explained in line with the *neoclassical* reasoning by the business cycle and the resulting changes in capital demand and supply. One important finding is that a lot of the changing levels of activity can be attributed to industry dynamics as the activity varies substantially across industries. And while *economic shocks* seem to contribute to investment activity at aggregate level, the industry level analysis reveals deeper insights into the investment activity: It seems that venture capital investments are more sensitive to industry dynamics for two reasons: First, venture capital waves lead buyout waves suggesting that venture capitalists react earlier to industry specific cycles. Second, venture capital activy at industry level seems to be much closer related to the financial performance at industry level than buyouts. The latter point may be also due to the fact that typical venture capital financing contract include conditions for staged financing, that explicitly link financing rounds to financial performance.

For the buyout sample, positive economic shocks seem to promote transactions at the aggregate level, while the opposite seems to be true at industry level. In particular, the industry level results suggest that the industries targeted by buyout firms show first signs of deteriorating profitability. This is consistent with buyout firms who prefer to invest in mature industries with proven business models and stable cash flows but with suffient inefficiencies that GPs can create value.

The results for both samples suggest that *capital supply* and in particular the availability of cheap credit plays an important role. However, the *capital demand* seems to be more important for venture capital investments. This might be due to the fact the venture capital investments are by nature investments in start-up or growth companies that require funds to expand their operations or to realize their business plans. Buyouts, however, are in addition often conducted to change ownership, recapitalize companies or to conduct other types of financial engineering that do not necessarily or not primarily result in a fresh money supply for the target company. This means that capital demand of the target company might not (mainly) be the motivation of the transaction.

Another relevant factor for the deal activity is level of *information asymmetries*. The results on aggregate level suggest, in line the *adverse selection* cost hypothesis, that high levels of information asymmetries imply high adverse seletion cost which reduces deal activity for buyout and venture capital investments. On industry level for the venture capital sample, however, the results support a different logic. As predicted by the value add hypothesis, venture capitalists seem to predominantly focus on industries that are (temporarily) subject to high information asymmetries. Industry members of those industries (often high-tech or sectors with new business models) are the kinds of targets, where venture capitalists can add the highest value by mitigating those information asymmetries.

The results presented so far, suggest that deal activity is to a large extent driven by economic fundamentals. Consequently, private equity firms should invest more in times of a promising economic outlook, which would then be reflected in superior results of investments made in times of high activity should outperform those made in periods of sluggish deal flows. However, the findings of the performance analysis imply the opposite. In particular, buyout and venture capital fund vintages of years with high investment and fund closing activity underperform those fund vintages that were closed and that conducted investments in periods of only moderate activity. The fund level analyses further suggest that funds invest heavily after they haved raised exceptional amounts of fund liquidity as predicted by the *agency conflict* hypothesis. This view has also been supported by the driver analysis on aggregate level as investment acitivy increases with fund raising which is followed by a growing number of first-time funds.

While *market timing* seems to play the major role at the level of a specific industry, this view has little explanatory power at aggregate level. This means that bidding battles seem to be temporarily concentrated in certain sectors in which entrepreneurs and shareholders who aim to dispose of their holdings watch transaction prices for comparable companies and are more likely to consider a disposal if valuations levels exceed their private value estimate. However, missing aggregate evidence indicates that these premiums cannot simply be mapped onto unrelated industries. For example, if transaction multiples for healthcare companies temporarily exceed fundamentals on average, it is highly probable that other healthcare firms too will realize comparable or even higher prices. However, it is unlikely that this effect will spill over to completely unrelated sectors. These considerations are consistent with widespread multiple valuation practices, which focus primarily on transaction multiples for comparable companies.

Overall, the results are consistent with private equity cycles being mainly triggered by economic fundamentals and business cycle dynamics on industry level. However, the amplitude of investment cycles may be exaggerated beyond economic fundamentals by other factors that facilitate boom and bust cycles. In particular, agency conflicts between LPs and GPs imply overinvestment incentives for GPs that lead to excessive investment and leverage in periods of abundant fund liquidity and a competition between private equity firms for target companies. This effect is even amplified by the fact that following periods of high returns more liquidity is flushed into funds, which fosters deal activity. The brisk activity further encourages new players to enter the market. These new entrants are particularly prone to overinvestment in lack of experience and under pressure to generate deal flow and to build a track record. The resulting competition for a limited number of suitable targets leads to premiums paid in bidding contests. As the lower quality of investments and declining performance becomes visible to the public, fund raising and refinancing conditions for deal get tougher until the capital supply freezes as it did in 2007 and 2008. From this situation, it takes several months and promising fundamentals, such as an improving outlook of the world economy to revive the private equity activity and a new cycle begins.

Nevertheless, the study has outlined that private equity investments can be timed in order to take advantage of the wave pattern on industry level and has, thus, identified investment strategies that have yet to be put into practice.

9.2 Limitations of Study and Areas of Future Research

The study has several limitations which are, to a large extent, attributable to the availability of transaction data and the operationalization of hypotheses. First, the data used do not allow to define deal activity as a volume in euro amounts. As described in section 4.2.4, deal volume data is available only for a minor part of the sample. Worse still, what data there is appears too inconsistent and unreliable to base scientific work on it. Taking the number of deals as the sole activity criterion omits trends in deal sizes which, as a result, are not reflected in the time series.

Second, the study uses vintage performance data at fund level to analyze the deal-activity-return relationship. A more accurate result could be obtained by using performance data at investment level. Investment-level data have been gathered by CEPRES. However, in June 2008, this database contained only about 4,000 mature investments (Gottschalg 2010a), which would correspond to about 50 deals per quarter over an 80-quarter period. Limiting this sample to European transactions and drilling it down to the industry level would result in very small numbers of transactions per quarter and industry. However, once deal level data becomes available, the analyses conducted in this study could be replicated on such data and thus provide further evidence.

Third, the study relies to a large extent on proxies. This approach generally faces the challenge that proxies are only imperfect measures of the postulated drivers. However, for the proxies used in this study, the main difficulty is that some of them are used ambiguously in financial literature, as there is no generally accepted measure of the postulated drivers. To mitigate these problems, the analyses employ alternative proxies for each hypothesis. Nevertheless, a degree of probability remains that the proxies analyzed might actually establish a different relationship. For example, the market-to-book ratio appears to be a highly significant driver of deal activity at industry level and has been interpreted as a market-timing variable, reflecting the overvaluation of stock relative to fundamentals. However, if the market-to-book ratio was only an indicator of future growth opportunities, a significant relationship would lend support to a neoclassical explanation.

Finally, for some of the analyses conducted for this study, the significance of the results is very sensitive to the statistical method adopted. This may be due to the fact that time series of transaction data are very noisy, which makes it difficult to obtain fully robust results. However, there is also the risk of a data overfit. The latter point would make it difficult for other researchers to replicate the results – a limitation which challenges the external validity of the study.

Further research may benefit from better data availability and explore investment timing strategies which have already been pinpointed in this study.

10 Appendices

10.1 Peer Companies for Industry Level Analysis

Matched SIC Industries		Selected Peer Companies	
SIC code	Industry Title	Ticker Symbol	Company Name
	Panel A: Biotechnology		
8731	Commercial Physical and Biological	BVT-SK	Biovitrum AB
2835	In Vitro & In Vivo Diagnostic	CRXL-AE	Crucell NV
	Substances	GSK-LN	Glaxosmithkline PLC
2836	Biological Products, (No Disgnostic	IJF-DB	Icon PLC
2834	Pharmaceutical Preparation	IPN-FR	Ipsen
		NOVN-VX	Novartis AG
		ORNBV-HE	Orion Corp.
		SAN-FR	Sanofi-Aventis
		SPX-LN	Spirax-Sarco Engineering PLC
		UCB-BT	UCB SA
	Panel B: Business Products and Services		
8742	Services-Management Consulting	ACKB-BT	Ackermans & Van Haaren
7361	Services-Employment Agencies	ADEN-VX	Adecco SA
8748	Business Consulting Services, Not	BVI-FR	Bureau Veritas
	Elsewhere Classified	DMGT-LN	Daily Mail & General Trust PLC
7379	Computer Related Services	FGR-FR	Eiffage
7375	Information Retrieval Services	HAS-LN	Hays PLC
8999	Services	IPS-FR	Ipsos SA
7319	Advertising	MPI-LN	Michael Page International PLC
7372	Services-Prepackaged Software	SW-FR	Sodexo
7359	Services-Equipment Rental &	SGE-LN	The Sage Group PLC
	Leasing		

Table 60: Matched SIC Industries and Peer Companies

Each panel in this table shows the matched SIC industries and identified peer companies for a particular MoneyTree industry. The SIC codes represent common SIC codes found in a subsample of transactions in the relevant MoneyTree industry. The order of appearance represents the frequency of the SIC codes in the subsample. Using these SIC codes, a search for listed companies was conducted, focusing on European firms where possible. The peer companies presented were selected from the search results and assembled into an industry peer group.

Matched SIC Industries		Selected Peer Companies	
SIC code	Industry Title	Ticker Symbol	Company Name
		Panel C: Computers and Peripherals	
3570	Computer & office Equipment	AAPL-O	Apple Inc
3571	Electronic Computers	2324-TW	Compal Electronics Inc
3572	Computer Storage Devices	DELL-O	Dell Inc
3575	Computer Terminals	HPQ-N	Hewlett-Packard Company
3577	Computer Peripheral Equipment	MSFT-O	Microsoft Corp.
3578	Calculating & Accounting Machines	OCX-T	Onex Corp.
3579	Office Machines	SAP-FF	SAP AG
7372	Services-Prepackaged Software	SOW-FF	Software AG
7373	Services-Computer Integrated Systems	6502-TO	Toshiba Corporation
7379	Computer Related Services	ULE-LN	Ultra Electronic Holdings PLC
		Panel D: Consumer Products and Services	
5812	Retail-Eating Places	AC-FR	Accor
7011	Hotels & Motels	INBS-BT	Anheuser-Busch Inbev SA
4724	Travel Agencies	AGL-MI	Autogrill
6799	Investors	BUL-MI	Bulgari
2844	Perfumes, Cosmetics & Other Toilet	CARL'B-KO	Carlsberg AS
2086	Bottled & Canned Soft Drinks &	CDI-FR	Christian Dior
5990	Retail-Retail Stores	CCOLA-IS	Coca Cola Icecek AS
5999	Miscellaneous Retail Stores	BN-FR	Danone
		LHA-FF	Deutsche Lufthansa AG
		DOU-FF	Douglas Holding AG
		HEIA-AE	Heineken NV
		HEN-FF	Henkel AG & Company Kgaa
		RMS-FR	Hermes International
		BOS3-FF	Hugo Boss AG
		OR-FR	L'Oreal
		NESN-VX	Nestle SA
		RI-FR	Pernod-Ricard
		SW-FR	Sodexo
		TUI1-FF	TUI AG
		Panel E: Electronics/Instrumentation	
3679	Electronic Components	ASSA'B-SK	Assa Abloy AB
3829	Measuring & Controlling Devices	PHIA-AE	Koninklijke Philips Electronics Na
7382	Security Systems Services	RLO-JO	Reunert Limited
3691	Storage Batteries	SECU'B-SK	Securitas AB
3629	Electrical Industrial Apparatus	S92-FF	SMA Solar Technology AG
3826	Laboratory Analytical Instruments	STM-FR	Stmicroelectronics NV
3829	Measuring & Controlling Devices	HO-FR	Thales SA
		VOS-FF	Vossloh AG

Table 60 (continued)

Matched SIC Industries		Selected Peer Companies	
SIC code	Industry Title	Ticker Symbol	Company Name
	Panel F: Financial Services		
6282	Investment Advice	C000073881	AWD Holding AG
6799	Investors	CS-FR	AXA
6531	Real Estate Agents & Managers (For	CRG-MI	Banca Carige
6411	Insurance Agents, Brokers & Service	BIR-DB	Bank Of Ireland
6552	Land Subdividers & Developers (No	ACA-FR	Credit Agricole SA
6211	Security Brokers, Dealers & Flotation	CSGN-VX	Credit Suisse Group AG
6311	Life Insurance	DANSKE-KO	Danske Bank A/S
6000	Depository Institutions	EVG2-FF	Ergo Versicherung AG
		ELE-FR	Euler Hermes
		LUKN-EB	Luzerner Kantonalbank AG
		KN-FR	Natixis
		RLD-EB	Rothschild
		SR-AE	SNS Reaal
		SL.-LN	Standard Life PLC
		TW.-LN	Taylor Wimpey PLC
		UBSN-VX	UBS AG
	Panel G: Healthcare Services		
8062	Services-General Medical & Surgical Hospitals	ALM-MC	Almirall SA
8051	Services-Skilled Nursing Care Facilities	BIM-FR	Biomerieux SA
8082	Services-Home Health Care Services	CIR-MI	CIR
8099	Health and Allied Services	EKTA'B-SK	Elekta AB
8021	Offices and Clinics of Dentists	FME-FF	Fresenius Medical Care AG
8351	Services-Child Day Care Services	MDC-JO	Medi Clinic Corp. Limited
8361	Residential Care	NTC-JO	Netcare Limited
8011	Services-Offices & Clinics of Doctors	ORP-FR	Orpea SA
8063	Psychiatric Hospitals	QIA-FF	Qiagen NV
		RHK-FF	Rhoen-Klinikum AG

Table 60 (continued)

Matched SIC Industries		Selected Peer Companies	
SIC code	Industry Title	Ticker Symbol	Company Name
		Panel H: Industrial/Energy	
3714	Motor Vehicle Parts & Accessories	ABBN-VX	ABB Limited
3089	Plastics Products	ALO-FR	Alstom SA
4911	Electric Services	BAB-LN	Babcock International Group PLC
8711	Services-Engineering Services	BMW-FF	BMW AG
3711	Motor Vehicles & Passenger Car	BP.-LN	BP PLC
1311	Crude Petroleum & Natural Gas	CKWN-EB	Centralschweizerische Kraftwerke AG
3511	Turbines and Turbine Generator Sets	DAI-FF	Daimler AG
		DYK-FF	Dyckerhoff AG
		EOAN-FF	E On AG
		EDF-FR	Electricite De France
		ELE-MC	Endesa SA
		FEES-MZ	Federal Grid Company Of Unified Energy
		GAZP-MZ	Gazprom OAO
		HOT-FF	Hochtief AG
		IPR-LN	International Power PLC
		LG-FR	Lafarge SA
		MAN-FF	Man SE
		MSRS-MZ	Moscow Integrated Electricity Distributi
		OMV-VI	OMV AG
		RHM-FF	Rheinmetall AG
		SIE-FF	Siemens AG
		SWV-FF	Solarworld AG
		TKA-FF	Thyssenkrupp AG
		FP-FR	Total SA
		BAAUNIPE-PR	Unipetrol AS
		VOW-FF	Volkswagen AG
		ZC-FR	Zodiac Aerospace SA
		Panel I: IT-Services	
7375	Information Retrieval Services	AOL-N	AOL Inc
7379	Computer Related Services	CAP-FR	Cap Gemini SA
7371	Services-Computer Programming	FTNT-O	Fortinet Inc
7376	Computer Facilities Management	LOG-LN	Logica PLC
7373	Services-Computer Integrated Systems	QQ.-LN	Qinetiq Group PLC
7374	Services-Computer Processing &	RMV-LN	Rightmove PLC
	Data Preparation	SAF-NR	Safaricom Limited
		TIE1V-HE	Tieto OYJ
		UTDI-FF	United Internet AG

Table 60 (continued)

Matched SIC Industries		Selected Peer Companies	
SIC code	Industry Title	Ticker Symbol	Company Name
Panel J: Media and Entertainment			
7375	Information Retrieval Services	SPR-FF	Axel Springer AG
4841	Cable & Other Pay Television Services	BTG4-FF	Bertelsmann AG
7999	Amusement and Entertainment	BSY-LN	British Sky Broadcasting Group PLC
4833	Television Broadcasting Stations	HT.R.A-ZG	Hrvatski Telekom DD
2731	Books: Publishing or Publishing &	KD8-FF	Kabel Deutschland Holding AG
	Printing	MMT-FR	M6-Metropole TV
7991	Physical Fitness Facilities	PSON-LN	Pearson PLC
7812	Services-Motion Picture & Video Tape	PSM-FF	Prosieben SAT 1 Media AG
3944	Games, Toys & Children's Vehicles (No	REN-AE	Reed Elsevier NV
2721	Periodicals: Publishing or Publishing &	7453-LU	RTL Group
		TEL-OS	Telenor ASA
		UBM-LN	United Business Media Limited
		VMED-O	Virgin Media Inc
		ZON-LB	ZON Multimedia SA
Panel K: Medical Devices and Equipment			
3841	Surgical & Medical Instruments &	AIP-JO	ADCOCK INGRAM HOLDINGS LIMITED
	Apparatus	ACL-N	Alcon Inc
3845	Electromedical &	COLO'B-KO	Coloplast A/S
	Electrotherapeutic Apparatus	EKTA'B-SK	Elekta AB
3842	Amusement and Entertainment	GETI'B-SK	Getinge AB
5047	Wholesale-Medical, Dental &	GN-KO	GN Store Nord A/S
	Hospital Equipment & Supplies	NOBN-VX	Nobel Biocare Holding AG
2834	Pharmaceutical Preparations	SN.-LN	Smith & Nephew PLC
8071	Physical Fitness Facilities	SPR-FR	Sperian Protection
8731	Services-Commercial Physical &	SUN-EB	Sulzer AG
	Biological Research	SYST-VX	Synthes Inc
3843	Dental Equipment & Supplies		
Panel L: Networking and Equipment			
4813	Telephone Communications	BELG-BT	Belgacom SA
	(No Radiotelephone)	BT.A-LN	BT Group PLC
3661	Telephone & Telegraph Apparatus	KD8-FF	Kabel Deutschland Holding AG
3663	Radio & Tv Broadcasting &	TKG-JO	Telkom SA Limited
	Communications Equipment	TFI-FR	TF1 (Television Francaise 1)
7376	Computer Facilities Management	TIE1V-HE	Tieto OYJ
	Services-Computer Integrated Systems		
7373	Design		
7375	Information Retrieval Services		
7379	Computer Related Services		
3357	Drawing & Insulating of Nonferrous		
	Wire		

Table 60 (continued)

Matched SIC Industries		Selected Peer Companies	
SIC code	Industry Title	Ticker Symbol	Company Name
	Panel M: Retailing/Distribution		
5999	Miscellaneous Retail Stores	DOU-FF	Douglas Holding AG
5990	Retail-Retail Stores	HM'B-SK	H & M Hennes & Mauritz AB
5411	Retail-Grocery Stores	BOS3-FF	Hugo Boss AG
2051	Bread, Cake, and Related Products	ITX-MC	Inditex SA
5311	Retail-Department Stores	KGF-LN	Kingfisher PLC
5310	Department Stores	MEO-FF	Metro AG
2099	Food Preparations	MRW-LN	Morrison (WM) Supermarkets PLC
5961	Retail-Catalog & Mail-Order Houses	PLT-MI	Parmalat Spa
5651	Retail-Family Clothing Stores	SBRY-LN	Sainsbury (J) PLC
2038	Frozen Spezialties	SZU-FF	Suedzucker AG
5621	Retail-Women's Clothing Stores	WHL-JO	Woolworths Holdings Limited
	Panel N: Semiconductors		
3674	Semiconductors & Related Devices	ARM-LN	Arm Holdings PLC
3827	Optical Instruments & Lenses	CSR-LN	CSR PLC
3679	Electronic Components	HEXA'B-SK	Hexagon AB
3672	Printed Circuit Boards	IFX-FF	Infineon Technologies AG
3662	Radio and tv communication equipment	PHIA-AE	Koninklijke Philips Electronics Na
3629	Electrical Industrial Apparatus	OERL-EB	OC Oerlikon Corp. AG
3621	Motors & Generators	REC-OS	Renewable Energy Corp.
		STM-FR	Stmicroelectronics NV
	Panel O: Software		
7372	Services-Prepackaged Software	ACN-N	Accenture PLC
7375	Information Retrieval Services	CAP-FR	Cap Gemini SA
7379	Computer Related Services	EXPN-LN	Experian PLC
7371	Services-Computer Programming	MCRO-LN	Micro Focus International PLC
7373	Services-Computer Integrated Systems	MSY-LN	Misys PLC
7389	Services-Business Services	SAP-FF	SAP AG
8748	Business Consulting Services	UTDI-FF	United Internet AG
8742	Services-Management Consulting		
	Panel P: Telecommunication		
4813	Telephone Communications	ALU-FR	Alcatel-Lucent
4812	Radiotelephone Communications	CWC-LN	Cable & Wireless Communications PLC
4899	Communications Services	DTE-FF	Deutsche Telekom AG
3663	Radio & Tv Broadcasting &	ERIC'B-SK	Ericsson Telephone AB
	Communications Equipment	FTE-FR	France Telecom
7389	Services-Business Services	NOK1V-HE	Nokia Corporation
3674	Semiconductors & Related Devices	SCMN-VX	Swisscom
3669	Communications Equipment	TEF-MC	Telefonica SA
3661	Telephone & Telegraph Apparatus	VOD-LN	Vodafone Group PLC
4822	Telegraph & Other Message		

Table 60 (continued)

10.2 Rank Model Approach – Illustrations

Market-to-Book Ratio	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Mean
Media and Entertainment																					
Axel Springer AG	5.0	3.4	3.8	3.9	3.4	4.7	4.2	4.8	4.7	6.8	5.8	5.4	4.0	3.9	3.1	2.8	2.4	2.6	1.5	2.0	3.9
Pearson PLC	2.5	1.9	2.0	3.4	3.0	4.2	11.0	29.9	7.0	9.3	3.2	1.8	1.4	1.7	1.9	1.6	1.8	1.6	1.1	1.6	4.6
M6-Metropole TV	0.0	0.0	0.0	0.0	8.7	6.5	5.6	7.0	10.0	28.6	26.3	16.3	9.3	8.6	6.1	6.1	4.5	3.0	2.2	2.8	7.6
United Business Media	3.1	3.6	6.3	3.8	3.7	6.0	-12.2	-5.6	3.1	6.1	1.8	2.7	4.7	13.4	9.1	4.0	3.7	4.3	2.7	3.0	3.4
Telenor ASA	-	-	-	-	-	-	-	-	-	-	1.9	1.6	1.4	2.1	2.5	2.4	3.4	3.2	0.9	1.8	2.1
Industry Mean	2.7	2.2	3.0	2.7	4.7	5.4	2.1	9.0	6.2	12.7	7.8	5.6	4.1	5.9	4.5	3.4	3.1	2.9	1.7	2.2	4.6
Rank	1	1	2	2	3	3	1	4	4	4	4	3	3	4	3	2	2	2	1	1	2.5
Financial Services																					
AWD Holding AG																					
Danske Bank A/S	0.7	0.8	0.7	1.0	0.9	0.9	1.0	1.8	1.5	1.4	2.1	1.7	1.4	1.6	1.8	1.9	1.8	1.3	0.4	0.8	1.3
Euler Hermes	-	-	-	-	-	-	-	-	-	-	2.3	1.8	0.9	1.4	1.7	2.1	2.7	1.9	0.9	1.3	1.7
Rothschild	-	-	-	-	1.7	1.4	1.3	1.3	1.6	1.3	1.9	1.5	1.1	1.7	1.7	2.2	2.6	3.7	2.4	2.3	1.8
Natixis	-	-	-	-	-	-	-	-	-	1.0	1.2	1.2	1.0	1.1	1.2	1.2	1.5	0.9	0.2	0.5	1.0
Industry Mean	0.7	0.8	0.7	1.0	1.3	1.1	1.1	1.5	1.6	1.3	1.9	1.5	1.1	1.4	1.6	1.8	2.2	2.0	1.0	1.2	1.3
Rank	1	1	1	1	3	2	2	3	3	2	4	3	2	3	4	4	4	4	1	2	2.5

Industry	Wave start	Proxy value	Rank	T-statistic	p-value
Media and Entertainment	2000	7.8	4		
Media and Entertainment	2004	4.5	3		
Financial Services	2004	1.6	4		
Financial Services	2006	2.2	4		
Median		3.3	4		
Mean			3.8		
H_0: rank < 2.5				5.0	0.008

Table 61: Rank Model – Illustration of Methodology, Example excluding High Book-to-Market Firms

Market-to-Book Ratio	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Mean
Media and Entertainment																					
Axel Springer AG	5.0	3.4	3.8	3.9	3.4	4.7	4.2	4.8	4.7	6.8	5.8	5.4	4.0	3.9	3.1	2.8	2.4	2.6	1.5	2.0	3.9
Pearson PLC	2.5	1.9	2.0	3.4	3.0	4.2	11.0	29.9	7.0	9.3	3.2	1.8	1.4	1.7	1.9	1.6	1.8	1.6	1.1	1.6	4.6
M6-Metropole TV	0.0	0.0	0.0	0.0	8.7	6.5	5.6	7.0	10.0	28.6	26.3	16.3	9.3	8.6	6.1	6.1	4.5	3.0	2.2	2.8	7.6
United Business Media	3.1	3.6	6.3	3.8	3.7	6.0	-12.2	-5.6	3.1	6.1	1.8	2.7	4.7	13.4	9.1	4.0	3.7	4.3	2.7	3.0	3.4
Telenor ASA																					
Industry Mean	2.7	2.2	3.0	2.7	4.7	5.4	2.1	9.0	6.2	12.7	9.3	6.6	4.8	6.9	5.0	3.6	3.1	2.9	1.9	2.4	4.9
Rank	1	1	2	2	3	3	1	4	3	4	4	4	3	4	3	2	2	2	1	1	2.5
Financial Services																					
AWD Holding AG																					
Danske Bank A/S	0.7	0.8	0.7	1.0	0.9	0.9	1.0	1.8	1.5	1.4	2.1	1.7	1.4	1.6	1.8	1.9	1.8	1.3	0.4	0.8	1.3
Euler Hermes																					
Rothschild																					
Natixis																					
Industry Mean	0.7	0.8	0.7	1.0	0.9	0.9	1.0	1.8	1.5	1.4	2.1	1.7	1.4	1.6	1.8	1.9	1.8	1.3	0.4	0.8	1.3
Rank	1	1	1	2	2	2	2	4	3	3	4	3	3	3	4	4	4	2	1	1	2.5

Industry	Wave start	Proxy value	Rank	T-statistic	p-value
Media and Entertainment	2000	9.3	4		
Media and Entertainment	2004	5.0	3		
Financial Services	2004	1.8	4		
Financial Services	2006	1.8	4		
Median		3.4	4		
Mean			3.8		
H_0: rank < 2.5				5.0	0.008

Table 62: Rank Model – Illustration of Methodology, Example excluding Firms with Missing Values

10.3 Tables for the Aggregate Analysis of Drivers

	Coefficient	t-statistic	R^2	F	*d*-statistic
Economic shock variables					
GDP $_t$	0.71	6.39 ***	0.281	34.88 ***	2.19 ††
Industrial production $_{t-3}$	1.98	0.40	0.000	2.76 *	2.20 ††
Business climate index $_{t-1}$	2.09	0.46	0.000	2.31	2.23 ††
Δ Operating income growth $_{t-2}$	-0.09	-0.27	0.000	0.00	2.01 ††
Ø Gross profit margin $_{t-2}$	2.89	2.21 ***	0.087	3.64 *	1.86 ††
Probability of default $_t$	-0.15	-1.81 *	0.274	13.17 ***	2.14 ††
Capital demand variables					
Fixed asset investments $_t$	0.39	13.08 ***	0.687	162.62 ***	2.12 ††
Δ Sales growth $_{t-1}$	-1.07	-1.54	0.074	3.25 *	2.01 ††
Ø Capital expenditure $_{t-2}$	0.85	0.35	0.000	0.00	2.01 ††
Δ Total assets $_t$	-7.55	-1.30	0.102	16.86 ***	1.93 ††
Capital supply variables					
Domestic credit $_t$	0.07	1.36	0.000	5.81 ***	2.17 ††
High yield index $_t$	2.15	2.05 **	0.093	4.32 **	2.01 ††
Debt issuance $_t$	0.01	0.63	0.000	3.69 **	2.19 ††
EURIBOR $_t$	20.95	1.60	0.013	0.83	2.20 ††
LIBOR $_t$	6.73	1.25	0.000	2.47	2.27 ††
Spread AAA vs. CCC $_t$	3.03	-2.95 ***	0.245	12.30 ***	2.11 ††
Information asymmetry variables					
Δ Dispersion of earnings forecasts	-40.15	-1.11	0.000	0.00	2.19 ††
Trading volume $_t$	-1.73	-1.75 *	0.019	1.49	2.10 ††
Δ M2B non-dividend payers $_{t-3}$	0.94	0.71	0.000	0.00	1.97 ††
Market timing variables					
Market to book ratio $_{t-3}$	-21.55	3.16 ***	0.192	10.24 ***	1.70 ††
IPO volume $_t$	0.52	0.78	0.000	0.00	2.19 ††
Agency variables					
BO capital raised $_{t-2}$	0.70	1.16	0.000	2.79 *	2.28 ††
Number of first time BO funds $_{t+2}$	-2.10	-0.67	0.000	0.00	2.20 ††
BO fund performance $_t$	0.23	0.62	0.000	0.00	2.18 ††
BO fund performance, liquidated $_t$	-0.33	-1.03	0.000	0.00	2.13 ††

Table 63: FGLS Regressions with Variable Transformations Following OLS Results – Buyouts

	Coefficient	*t*-statistic	R^2	F	*d*-statistic
Economic shock variables					
GDP $_t$	0.94 ***	3.17	0.071	10.67 ***	2.42 ††
Industrial production $_t$	16.73 ***	3.39	0.092	11.38 ***	2.37 ††
Business climate index $_t$	12.81 *	1.98	0.010	3.37 **	2.47 ††
Ø Operating income growth $_{t-2}$	0.00 *	1.98	0.012	0.58	2.01 ††
Δ Gross profit margin $_t$	69.04	1.55	0.209	9.79 *	2.35 ††
Probability of default $_t$	-0.13	-0.65	0.291	14.36 ***	2.29 ††
Capital demand variables					
Fixed asset investments $_t$	0.55 ***	4.90	0.231	27.93 ***	2.37 ††
Δ Sales growth $_{t+4}$	4.38 ***	3.33	0.349	19.85 ***	2.37 ††
Ø Capital expenditure $_{t+3}$	4.77	0.84	0.000	0.00	2.23 ††
Δ Total assets $_t$	-11.13	-0.82	0.071	3.13 *	2.26 ††
Capital supply variables					
Domestic credit $_t$	0.09	1.48	0.000	4.19 **	2.45 ††
High yield index $_{t+1}$	3.40	1.35	0.000	0.00	2.19 ††
Debt issuance $_t$	0.03	1.28	0.000	4.86 **	2.44 ††
EURIBOR $_t$	10.07	0.36	0.000	0.00	2.42 ††
LIBOR $_t$	6.73	0.54	0.000	0.00	2.48 ††
Spread AAA vs. CCC $_{t+1}$	-3.26	-1.28	0.189	8.40 ***	2.37 ††
Information asymmetry variables					
Δ Dispersion of earnings forecasts	20.16	0.25	0.000	0.00	2.48 ††
Trading volume $_t$	-5.19 ***	-2.46	0.061	5.02 **	2.42 ††
Δ M2B non-dividend payers $_t$	-8.64 ***	-3.35	0.185	9.28 ***	2.12 ††
Market timing variables					
Market to book ratio $_{t+2}$	38.52 ***	2.22	0.173	8.56 ***	1.83 ††
IPO volume $_t$	0.06	0.00	0.000	0.00	2.47 ††
Agency variables					
VC capital raised $_{t+1}$	0.00	0.46	0.000	0.00	2.50 ††
Number of first time VC funds $_{t+1}$	3.84	1.52	0.014	1.11	2.50 ††
VC fund performance $_{t-1}$	-0.69	-0.64	0.000	0.00	2.18 ††
VC fund performance, liquidated $_t$	-0.84	-0.88	0.000	0.00	2.42 ††

Table 64: FGLS Regressions with Variable Transformations Following OLS Results – Venture Investments

	(1)	(2)	(3)	(4)	(5)	(6)
Economic shock variables						
GDP $_{t-4}$	6.11	1.57				
Industrial production $_{t-1}$	5.87	22.47				
Business climate index $_{t-1}$	2.11	1.57				
Ø Gross profit margin $_{t-2}$	1.68					
Probability of default $_{t}$	2.86					
Capital demand variables						
Fixed asset investments $_{t}$			1.120	1.00		
Δ Sales growth $_{t-1}$			1.170	1.00		
Ø Capital expenditure $_{t-2}$			1.270			
Capital supply variables						
Domestic credit $_{t}$					85.75	
High yield index $_{t}$					1.39	1.050
Debt issuance $_{t}$					92.15	
EURIBOR $_{t}$					4.09	1.050
Control variables						
1st quarter dummy	1.92		1.720		1.52	
2nd quarter dummy	1.62		1.800		1.52	
3rd quarter dummy	1.83		1.660		1.52	

Table 65: Variance Inflation Factors for Multivariate Buyout Models I (Table 31, p. 149)

	(1)	(2)	(3)	(4)	(5)	(6)
Information asymmetry variables						
Trading volume $_{t-1}$	1.99	1.00				
Δ M2B non-dividend $_{t-3}$	1.06	1.00				
Market timing variables						
Market to book ratio $_{t-3}$			2.100	1.19		
IPO volume			1.230	1.18		
Spread AAA vs. CCC $_{t}$			1.140	1.04		
Agency variables						
BO capital raised $_{t-2}$					1.13	1.010
Number of first time BO funds $_{t+2}$					1.02	1.010
Control variables						
1st quarter dummy	1.61		2.140		1.69	
2nd quarter dummy	1.62		1.880		1.69	
3rd quarter dummy	2.03		1.570		1.59	

Table 66: Variance Inflation Factors for Multivariate Buyout Models II (Table 32, p. 151)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Economic shock variables							
GDP $_{t-4}$	175.70	174.31	164.91	160.55	158.73	156.69	17.38
Industrial production $_{t-1}$	71.25	69.59	9.73	27.03	26.60	25.75	7.36
Business climate index $_{t-1}$	4.30	4.26	4.26				
Capital demand variables							
Fixed asset investments $_{t}$	48.31	48.29	47.90	39.78	37.17	36.90	8.90
Capital supply variables							
Domestic credit	112.15	106.96	106.76	85.04	81.92	81.47	36.48
Debt issuance	217.96	217.96	209.68	194.09	192.64	188.63	58.28
Information asymmetry variables							
Trading volume $_{t-1}$	3.05	3.01	2.91	2.83	2.81		
Market timing variables							
IPO volume	1.53	1.52	1.51	1.47			
Agency variables							
BO capital raised	4.13						
No. of first time BO funds	1.45	1.45					

Table 67: Variance Inflation Factors for Buyout Models III (Table 33, p. 152)

	(1)	(2)	(3)	(4)	(5)	(6)
Economic shock variables						
GDP $_{t-4}$			3.63	2.55	1.31	1.13
Probability of default $_{t}$	3.06	1.32				
Capital demand variables						
Fixed asset investments $_{t+1}$	2.08	1.61				
Δ Sales growth $_{t+4}$	1.04	1.03	1.07	1.09	1.17	1.02
Capital supply variables						
Domestic credit						
High yield index	4.03					
EURIBOR	1.91	1.25	1.92	1.47	1.14	
Information asymmetry variables						
Trading volume $_{t-1}$			1.13	1.11	1.16	1.11
Market timing variables						
IPO volume				1.18	1.09	1.06
Spread AAA vs. CCC			3.03			
Agency variables						
BO capital raised			2.64	2.70		
No. of first time BO funds					1.24	

Table 68: Variance Inflation Factors for Combined Buyout Models (Table 34, p. 155)

	(1)	(2)	(3)	(4)	(5)	(6)
Economic shock variables						
GDP $_{t-4}$	4.12	15.08				
Industrial production $_{t-1}$	3.60	16.95				
Business climate index $_{t-1}$	2.71	1.54				
Ø Gross profit margin $_{t-2}$	2.21					
Probability of default $_{t}$	3.79					
Capital demand variables						
Fixed asset investments $_{t}$			1.010	1.01		
Δ Sales growth $_{t-1}$			1.120	1.01		
Capital supply variables						
Domestic credit $_{t-2}$					72.92	70.580
High yield index $_{t}$					1.27	1.230
Debt issuance $_{t}$					82.69	79.990
EURIBOR $_{t}$					6.67	6.430
Control variables						
1st quarter dummy	1.95		1.570		1.51	
2nd quarter dummy	1.89		1.570		1.54	
3rd quarter dummy	1.64		1.620		1.51	

Table 69: Variance Inflation Factors for Multivariate Venture Capital Models I (Table 35, p. 157)

	(1)	(2)	(3)	(4)	(5)	(6)
Information asymmetry variables						
Trading volume $_{t-1}$	1.99	1.00				
Δ M2B non-dividend $_{t-3}$	1.06	1.00				
Market timing variables						
Market to book ratio $_{t+2}$			1.19	1.09		
IPO volume			1.18	1.09		
Spread AAA vs. CCC $_{t}$			1.04	1.00		
Agency variables						
VC capital raised $_{t+1/t-1}$					1.65	1.13
Number of first time VC funds $_{t+1}$					1.56	1.10
VC fund performance $_{t-1}$					1.19	1.09
Control variables						
1st quarter dummy	1.61		1.60		1.72	
2nd quarter dummy	1.62		1.45		1.57	
3rd quarter dummy	2.03		1.70		1.78	

Table 70: Variance Inflation Factors for Multivariate Venture Capital Models II (Table 36, p. 158)

	(1)	(2)	(3)	(4)	(5)	(6)
Economic shock variables						
Probability of default $_{t}$	3.06	1.32				
Capital demand variables						
Fixed asset investments $_{t+1}$	2.08	1.61	1.75	1.81	1.81	1.81
Δ Sales growth $_{t+4}$	1.04	1.03	1.03	1.10	1.08	1.14
Capital supply variables						
High yield index $_{t}$	4.03		1.62	1.66	1.65	1.88
EURIBOR $_{t}$	1.91	1.25	1.41	1.77	1.43	1.86
Information asymmetry variables						
Trading volume $_{t}$				1.11	1.09	1.22
Market timing variables						
IPO volume $_{t}$				1.04		
Market to book ratio $_{t+2}$						1.69
Agency variables						
VC capital raised $_{t-1}$				1.36		
No. of first time VC funds $_{t-1}$						2.48

Table 71: Variance Inflation Factors for Multivariate Venture Capital Models III (Table 37, p. 160)

	(1)	(2)	(3)	(4)	(5)	(6)
Economic shock variables						
Probability of default $_{t}$	3.06	1.32				
Capital demand variables						
Fixed asset investments $_{t+1}$	2.08	1.61	1.75	1.81	1.81	1.81
Δ Sales growth $_{t+4}$	1.04	1.03	1.03	1.10	1.08	1.14
Capital supply variables						
High yield index $_{t}$	4.03		1.62	1.66	1.65	1.88
EURIBOR $_{t}$	1.91	1.25	1.41	1.77	1.43	1.86
Information asymmetry variables						
Trading volume $_{t}$				1.11	1.09	1.22
Market timing variables						
IPO volume $_{t}$				1.04		
Market to book ratio $_{t+2}$						1.69
Agency variables						
VC capital raised $_{t-1}$				1.36		
No. of first time VC funds $_{t-1}$						2.48

Table 72: Variance Inflation Factors for Combined Venture Capital Models (Table 38, p. 162)

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-74248	-98337	-210242 ***	-172507 ***	-126106 ***	-56957 ***
	(-0.30)	(-1.51)	(-3.91)	(-4.68)	(-5.33)	(-3.16)
Economic shock variables						
GDP $_{t-4}$	70.24	12.51				
	(0.55)	(0.35)				
Industrial production $_{t-1}$	794.49	1798.64 **				
	(0.40)	(2.47)				
Business climate index $_{t-1}$	-1152.66	-720.11				
	(-0.55)	(-1.03)				
Ø Gross profit margin $_{t-2}$	580.69					
	(0.63)					
Probability of default $_{t}$	-82.04					
	(-1.47)					
Capital demand variables						
Fixed asset investments $_{t+1}$			96.46 ***	86.92 ***		
			(4.64)	(5.47)		
Δ Sales growth $_{t+4}$			72.14	-74.18		
			(0.63)	(-0.98)		
Ø Capital expenditure $_{t+2}$			1280.96			
			(0.99)			
Capital supply variables						
Domestic credit $_{t}$					27.76	
					(1.00)	
High yield index $_{t}$					932.01 ***	705.87 ***
					(3.70)	(3.30)
Debt issuance $_{t}$					-5.52	
					(-0.51)	
EURIBOR $_{t}$					7794.14	7662.89 ***
					(1.63)	(3.36)
Control variables						
1st quarter dummy	9445.99		3508.25		6067.44	
	(0.59)		(0.25)		(0.60)	
2nd quarter dummy	3251.46		4920.53		1888.69	
	(0.33)		(0.62)		(0.27)	
3rd quarter dummy	12515.35		8557.31		4648.34	
	(1.13)		(1.09)		(0.65)	
Number of observations	32	75	37	39	44	44
F-statistic	4.68 ***	31.87 ***	6.67 ***	16.08 ***	7.15 ***	12.480 ***
Adjusted R^2	0.130	0.535	0.204	0.299	0.301	0.197

***, **, * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 73: Neoclassical Models of Buyout Volumes

This table presents multivariate Newey-West regression results with the buyout volume in Euro amounts as dependent variables. *T*-statistics are presented in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-43713	-19964	-49535 ***	-50019 ***	-31068 ***	-28605 ***
	(-0.49)	(-1.21)	(-4.56)	(1.22)	(-3.28)	(-3.08)
Economic shock variables						
GDP $_{t-4}$	0.90	-7.68				
	(0.03)	.-78				
Industrial production $_{t}$	612.74	646.05 ***				
	(1.21)	(3.11)				
Business climate index $_{t}$	-39.90	-231.04				
	(-0.04)	(-1.26)				
Δ Gross profit margin $_{t}$	-131.82					
	(-0.45)					
Probability of default $_{t}$	-21.42					
	(-0.96)					
Capital demand variables						
Fixed asset investments $_{t+1}$			24.12 ***	24.33 ***		
			(5.26)	(5.51)		
Δ Sales growth $_{t+4}$			-42.36 **	-43.69 **		
			(-2.31)	(-2.34)		
Capital supply variables						
Domestic credit $_{t-2}$					6.49	7.64
					(0.82)	(1.03)
High yield index $_{t}$					183.04 ***	171.35 ***
					(2.96)	(2.96)
Debt issuance $_{t}$					-0.80	-1.30
					(-0.26)	(-0.44)
EURIBOR $_{t}$					1766.44	1472.95
					(0.26)	(0.96)
Control variables						
1st quarter dummy	679.22		792.12		1734.00	
	(0.20)		(0.26)		(0.51)	
2nd quarter dummy	-395.11		-566.31		-915.00	
	(-0.18)		(-0.32)		(-0.57)	
3rd quarter dummy	-45.97		-196.50		-189.96	
	(-0.01)		(-0.09)		(-0.10)	
	32	75	39	39	44	44
	5.03 ***	22.47 ***	9.59 ***	17.81 ***	5.03 ***	8.03 ***
	0.158	0.492	0.269	0.324	0.331	0.359

***, **, * Significance at the 1%, 5%, and 10% levels in two-sided significance tests.

Table 74: Neoclassical Models of Venture Capital Volumes

This table presents multivariate Newey-West regression results with the venture capital investment volume in Euro amounts as dependent variables. *T*-statistics are presented in parentheses.

Year	Total number of funds	Number of funds first time funds	Share of first time funds	Number of deals
1990	15	6	40%	44
1991	14	5	36%	59
1992	6	3	50%	83
1993	10	0	0%	83
1994	13	4	31%	138
1995	13	3	23%	167
1996	20	3	15%	329
1997	29	6	21%	311
1998	32	9	28%	569
1999	36	4	11%	897
2000	33	6	18%	1,403
2001	22	8	36%	1,161
2002	28	6	21%	746
2003	21	3	14%	1,347
2004	17	5	29%	1,751
2005	36	4	11%	1,651
2006	36	4	11%	1,290
2007	17	0	0%	1,720
2008	17	0	0%	1,489
2009	-	-	-	803
Total	415	79		16,041
Average	22	4	19%	802
Correlation with number of deals	0.46	-0.11	-0.47	1.00

Table 75: Number of Funds per Vintage and Share of First-Time Funds – Buyouts

Year	Total number of funds	Number of funds first time funds	Share of first time funds	Number of deals
1990	12	0	0%	89
1991	12	3	25%	107
1992	6	0	0%	125
1993	11	4	36%	144
1994	17	5	29%	163
1995	16	5	31%	233
1996	18	6	33%	420
1997	40	20	50%	329
1998	41	8	20%	660
1999	64	23	36%	1,259
2000	105	39	37%	3,079
2001	62	23	37%	2,550
2002	35	7	20%	1,496
2003	40	19	48%	2,829
2004	43	8	19%	2,863
2005	43	5	12%	2,342
2006	39	4	10%	1,906
2007	43	8	19%	1,538
2008	35	5	14%	1,470
2009	-	-	-	1,039
Total	682	192		24,641
Average	36	10	28%	1,232
Correlation with number of deals	0.76	0.57	0.14	1.00

Table 76: Number of Funds per Vintage and Share of First-Time Funds – Venture Capital

11 Bibliography

Abberger, Klaus (2004). *Nonparametric Regression and the Detection of Turning Points in The Ifo Business Climate Index.* Working Paper.

Acharya, Viral V., Julian Franks and Henri Servaes (2007). Private Equity: Boom and Bust? *Journal of Applied Corporate Finance*. 19.4: 44–55.

Acharya, Viral V., Moritz Hahn and Conor Kehoe (2009). *Corporate Governance and Value Creation: Evidence from Private Equity.* Working Paper NY Stern University.

Achleitner, Ann-Kristin (2002). Entrepreneurial Finance - Herausforderung auch in Deutschland. *Betriebs-Berater*. 57.3: 142–145.

Achleitner, Ann-Kristin, André Betzer and Jasmin Gider (2010). Do Corporate Governance Motives Drive Hedge Fund and Private Equity Fund Activities? *European Financial Management*. 16.5.

Achleitner, Ann-Kristin, Reiner Braun and Nico Engel, et al. (2010). Value Creation Drivers in Private Equity Buyouts: Empirical Evidence from Europe. *The Journal of Private Equity*. 13.2: 17–27.

Achleitner, Ann-Kristin and Oliver Klöckner (2005). *Employment contribution of Private Equity and Venture Capital in Europe.* Working Paper.

Achleitner, Ann-Kristin, Hansjörg Zelger, Sven Beyer and Kay Müller (2004). Venture Capital/Private Equity-Studie 2004: Company (E)valuation und EVCA Valuation Guidelines: Eine Bestandsaufnahme der Unternehmensbewertungspraxis von Beteiligungskapitalgesellschaften. *Finanz Betrieb*. 6.10: 701–709.

Ajzen, Icek (1985). From Intentions to Actions: A Theory of Planned Behaviour. Julius Kuhl, and Jürgen Beckmann (Ed.). *Action control: From Cognition to Behavior.* pp. 12–39. Berlin: Springer.

Akerlof, George A. (1970). The Market for "Lemons": Quality Uncertainty and the Market Mechanism. *The Quarterly Journal of Economics*. 84.3: 488–500.

Alchian, Armen A. and Harold Demsetz (1972). Production, Information Costs, and Economic Organization. *The American Economic Review*. 62.5: 777–795.

Alti, Aydogan (2006). How Persistent Is the Impact of Market Timing on Capital Structure? *The Journal of Finance*. 61.4: 1681–1710.

Altman, Edward I. (2007). Global Debt Markets in 2007: New Paradigm or the Great Credit Bubble? *Journal of Applied Corporate Finance*. 19.3: 17–31.

Amess, Kevin, Sourafel Girma and Mike Wright (2008). *What are the Wage and Employment Consequences of Leveraged Buyouts, Private Equity and Acquisitions in the UK?* Working Paper Nottingham University.

Amess, Kevin and Mike Wright (2007). *Babarians at the Gate? Leveraged Buyouts, Private Equity and Jobs.* Working Paper.

Amit, Raphael, James Brander and Christoph Zott (1998). Why Do Venture Capital Firms Exist? Theory and Canadia Evidence: 13, 441–466. *Journal of Business Venturing*. 13: 441–466.

Anderson, David, Thomas A. Williams and Dennis J. Sweeney (2008). *Essentials of Statistics for Business and Economics.* 5th ed. Mason, Ohio: South-Western College Publishing.

Anderson, Evan W., Eric Ghysels and Jennifer L. Juergens (2005). Do Heterogeneous Beliefs Matter for Asset Pricing? *Review of Financial Studies*. 18.3: 875–924.

Andrade, Gregor and Steven N. Kaplan (1998). How Costly is Financial (Not Economic) Distress? Evidence from Highly Leveraged Transactions that Became Distressed. *The Journal of Finance*. 53.5: 1443–1493.

Andres, Christian, André Betzer and Charlie Weir (2007). Shareholder Wealth Gains Through Better Corporate Governance—The Case of European LBO-transactions. *Financial Markets and Portfolio Management*. 21.4: 403–424.

Arnold, Martin and Henny Sender March 06; 2009). Private Equity: Bombed-Out Buy-Out. *Financial Times*.

Aspachs, Oriol, Charles A. E. Goodhart, Dimitrios P. Tsomocos and Lea Zicchino (2007). Towards a Measure of Financial Fragility. *Annals of Finance*. 3.1: 37–74.

Autore, Don M. and Tunde Kovacs (2009). *Equity Issues and Temporal Variation in Information Asymmetry.* Working Paper.

Axelson, Ulf, Tim Jenkinson, Per J. Strömberg and Michael S. Weisbach (2007). *Leverage and Pricing in Buyouts: An Empirical Analysis.* Working Paper Swedish Institute for Financial Research.

Axelson, Ulf, Tim Jenkinson, Per J. Strömberg and Michael S. Weisbach (2010). *Borrow Cheap, Buy High? The Determinants of Leverage and Pricing in Buyouts.* NBER Working Paper.

Axelson, Ulf, Per Strömberg and Michael S. Weisbach (2007). *Why are Buyouts Levered: The Financial Structure of Private Equity Funds.* NBER Working Paper.

Baker, George P. and George D. Smith (1998). *The New Financial Capitalists. Kohlberg Kravis Roberts and the Creation of Corporate Value.* Cambridge: Cambridge Univ. Press.

Baker, Harold K. (2009). *Dividends and Dividend Policy.* Hoboken, NJ: John Wiley.

Baker, Malcom P. and Jeffrey A. Wurgler (2002). Market Timing and Capital Structure: Malcolm Baker and Jeffrey Wurgler. The Journal of Finance. 57.1: 1–32.

Baker, Malcolm P. and Jeffrey A. Wurgler (2004a). A Catering Theory of Dividends. *The Journal of Finance*. 59: 1125–1164.

Baker, Malcolm P. and Jeffrey A. Wurgler (2004b). Appearing and Disappering Dividends: The Link to Catering Incentives. *Journal of Financial Economics*. 73.1: 271–288.

Baker, Malcom P. and Jeffrey A. Wurgler (2007). Investor Sentiment in the Stock Market. *Journal of Economic Perspectives*. 21.2: 129–151.

Baltagi, Badi H. (2008). *Econometrics.* 4th ed. Berlin, Heidelberg: Springer.

Barrachdi, Faysal (2008). *Private Equity "Club Deals" and European Competition Law.* Working Paper.

Barrow, Michael (2009). *Statistics for Economics, Accounting and Business Studies.* 5th ed. Harlow: Pearson Education.

Bartholdy, Jan, Benjamin W. Blunck and Thomas Poulsen (2009). *What Drives Private and Public Merger Waves in Europe.* Working Paper.

Becker, Gary S. (1962). Irrational Behavior and Ecnomic Theory. *The Journal of Political Economy*. 70.1: 1–13.

Berk, Jonathan B., Richard Stanton and Josef Zechner (2010). Human Capital, Bankruptcy, and Capital Structure: *The Journal of Finance*. 65.3: 891–926.

Bernard, David (2009). "Private Equity Performance Benchmarks": FVCA Spring Seminar. Ruka, Finland.

Bernstein, Shay, Josh Lerner, Morten Sørensen and Per J. Strömberg (2010). *Private Equity and Industry Performance.* NBER Working Paper.

Bloomberg (2010). Investments der Beteiligungsbranche erreichen Rekordhöhe. *Handelsblatt*. October 22, 2009.

Bottazzi, Laura (2010). Private Equity in Europe. Douglas Cumming (Ed.). *Private Equity: Fund Types, Risks and Returns, and Regulation:* 437–461. Hoboken, NJ: Wiley.

Böttger, Andreas (2007). Bedeutung von Turnaround Fonds für die Restrukturierung. Ulrich Krystek, and Ralf Moldenhauer (Ed.). *Handbuch Krisen- und Restrukturierungsmanagement: Generelle Konzepte, Spezialprobleme, Praxisberichte:* 278–292. Stuttgart: Kohlhammer.

Brav, Omer (2009). Access to Capital, Capital Structure, and the Funding of the Firm. *The Journal of Finance*. 64.1: 263–308.

Brealey, Richard A., Stewart C. Myers and Franklin Allen (2008). *Principles of Corporate Finance.* 9. ed., internat. ed. Boston, Mass.: McGraw-Hill/Irwin.

Breusch, Trevor S. and Adrian R. Pangan (1979). A Simple Test for Heteroscedasticity and Random Coefficient Variation. *Econometrica*. 47.5: 1287–1294.

Brooks, Chris (2008). *Introductory Econometrics for Finance;*. 2nd ed. Cambridge: Cambridge Univ. Press.

Bruining, Hans and Mike Wright (2002). Entrepreneurial Orientation in Management-Buyouts and the Contribution of Venture Capital. *Venture Capital: An International Journal of Entrepreneurial Finance*. 4.2: 147–168.

Burrough, Bryan and John Helyar (2004). *Barbarians at the Gate. The Fall of RJR Nabisco.* London: Arrow.

Butler, Alexander W., Jess Cornaggia, Grullon Gustavo and James P. Weston (2009). *Corporate Financing Decisions and Managerial Market.* Working Paper.

BVCA (2006). *BVCA Private Equity and Venture Capital Performance Measurement Survey 2005.* London.

Campbell, John Y. and Pierre Perron (1991). *Pitfalls and Opportunities: What Macroeconomists Should Know about Unit Roots.* NBER Working Paper.

Cao, Jerry, Joe Mason and Wei-Ling Song (2009). *Business Aggression, Institutional Loans, and Credit Crisis: Evidence from Lending Practices in Leveraged Buyouts.* Working Paper.

Cassidy, John (2008). The Minsky Moment. *The New Yorker*. February 04, 2002.

Cassidy, John (2010). Irrational Rationality: Interview with Eugene Fama. *The New Yorker*. (January 13, 2010).

Cauchi, Marietta and Paul Hodkinson (2010). Terra Firma Chief Gives Gloomy Equity Outlook. *The Wall Street Journal Europe*. February 11, 2010.

Chang, Bin (2006). *Does the Market React Less Negatively to Dividend Payers' Seasoned Equity.* Working Paper.

Cheffins, Brian and John Armour (2008). The Eclipse of Private Equity. *Delaware Journal of Corporate Law*. 33.1.

Chen, Hui (2010). Macroeconomic Conditions and the Puzzles of Credit Spreads and Capital Structure. *The Journal of Finance*. 65:6: 2171-2212.

Chew, Donald H. and Steven N. Kaplan (2007). Private Equity: Past, Present, and Future. *Journal of Applied Corporate Finance*. 19.3: 8–16.

Chew, Donald H. and Steven N. Kaplan (2009). The Future of Private Equity. *Journal of Applied Corporate Finance*. 21.3: 8–20.

Choe, Hyuk, Ronald W. Masulis and Vikram Nanda (1993). Common Stock Offerings Across the Business Cycle. *Journal of Empirical Finance*. 1.1: 3–31.

Chung, Ji-Woong, Berk A. Sensoy, Léa H. Stern and Michael S. Weisbach (2010). *Pay for Performance from Future Fund Flows: The Case of Private Equiry.* Working Paper.

Cochrane, Donald and Guy H. Orcutt (1994). Application of Least Squares Regression to Relationships Containing Autocorrelated Error Terms. *Journal of the American Statistical Association*. 44: 32–61.

Cochrane, John H. (2006). *Financial Markets and the Real Economy.* An Elgar Reference Collection 18. Cheltenham: Elgar.

Cochrane, John H. (1991). Pitfalls and Opportunities: What Macroeconomists Should Know about Unit Roots. *NBER Macroeconomics Annual*. 6: 201–210.

Cochrane, John H. (2005). The Risk and Return of Venture Capital. *Journal of Financial Economics*. 75.1: 3–52.

Conroy, Robert M. and Robert S. Harris (2007). How Good are Private Equity Returns? *Journal of Applied Corporate Finance*. 19.3: 96–108.

Cook, Dennis R. (1977). Detection of Influential Observation in Linear Regression. *Technometrics*. 19.1: 15–18.

Cornelius, Peter, Broes Langelaar and Maarten van Rossum (2007). Big is Better: Growth and Market Structure in Global Buyouts. *Journal of Applied Corporate Finance*. 19.3: 109–116.

Creswell, John W. (2008). *Research Design. Qualitative, Quantitative, and Mixed Methods Approaches.* 2. ed., reprinted. Thousand Oaks, Calif.: SAGE Publ.

Cumming, Douglas and Sofia Johan (2008). Information Asymmetries, Agency Costs and Venture Capital Exit Outcomes. *Venture Capital: An International Journal of Entrepreneurial Finance*. 10.3: 197–231.

Cumming, Douglas, Donald S. Siegel and Mike Wright (2007). Private Equity, Leveraged Buyouts and Governance. *Journal of Corporate Finance*. 13.4: 439–460.

Cumming, Douglas and Uwe Walz (2010). Private Equity Returns and Disclosure Around the World. *Journal of International Business Studies*. 41.4: 727–754.

Cuny, Charles J. and Eli Talmor (2005). *The Staging of Venture Capital Financing: Milesstones vs. Round.* Working Paper.

Curran, John J. (1990). Hard Lessons from the Debt Decade. *Fortune Magazine*. June 18, 1990.

Damodaran, Aswath (2010). *Applied Corporate Finance.* 3. ed. Hoboken, NJ: Wiley.

Daniel, Kent, David Hirshleifer and Siew H. Teoh (2002). Investor Psychology in Capital Markets: Evidence and Policy Implications. *Journal of Monetary Economics*. 49.1: 139–209.

Davidson, Russell and James G. MacKinnon (1993). *Estimation and Inference in Econometrics.* New York: Oxford Univ. Press.

Davis, Steven J., John Haltiwanger and Ron Jarmin, et al. (2008). Private Equity and Employment. World Economic Forum (Ed.). *The Global Economic Impact of Private Equity Report 2008: Globalization of Alternative Investments.* pp. 45–64. New York.

Davis Service Group (2004). *Completion of sale of HSS Hire Service Group Plc.* 2004. September 24. <http://www.dsgplc.com/news/risnews/?page=33&id=94432>.

Deb, Soumya G. and Jaydeep Mukherjee (2008). Does Stock Market Development Cause Economic Growth? A Time Series Analysis for the Indian Economy. *International Research Journal of Finance and Economics*. 21: 142–149.

DeMaris, Alfred (1992). *Logit Modeling: Practical Applications.* Sage University Paper Series on Quantitative Applications in the Social Sciences, series no. 07-086. Newbury Park: SAGE Publ.

Dickey, David A. and Wayne A. Fuller (1979). Distribution of the Estimators for Autoregressive Time Series With a Unit Root. *Journal of the American Statistical Association*. 74.366: 427-341.

Diller, Christian and Christoph Kaserer (2009). What Drives Private Equity Returns? – Fund Inflows, Skilled GPs, and/or Risk? *European Financial Management*. 15.3: 643–675.

Dittmar, Amy K. and Robert F. Dittmar (2008). The Timing of Financing Decisions: An Examination of the Correlation in Financing Waves. *Journal of Financial Economics*. 90.1: 59–83.

Dollery, Brian E. and Joe L. Wallis (2003). New Institutional Economics. Jack Rabin (Ed.). *Encyclopedia of Public Administration and Public Policy.* pp. 807–811. New York, NY: Dekker.

Driessen, Joost, Tsa-Chun Lin and Ludovic Phalippou (2007). *Estimating the Performance and Risk Exposure of Private Equity.* NBER Working Paper.

Driessen, Joost, Tsa-Chun Lin and Ludovic Phalippou (2008). *A New Method to Estimate Risk and Return of Non-traded Assets from Cash Flows: The Case of Private Equity Funds.* NBER Working Paper.

Durbin, James (1970). Testing for Serial Correlation in Least-Squares Regression When Some of the Regressors are Lagged Dependent Variables. *Econometrica*. 38.3: 410–421.

Dutordoir, Marie and Linda Van de Gucht (2007). Are there Windows of Opportunity for Convertible Debt Issuance: Evidence from Western Europe. *Journal of Banking and Finance*. 31.9: 2828–2846.

Easley, David, Soeren Hvidkjaer and Maureen O'Hara (2002). Is Information Risk a Determinant of Asset Returns? *The Journal of Finance*. 57.5: 2185–2221.

Easley, David, Nicholas M. Kiefer, Maureen O'Hara and Joseph B. Paperman (1996). Liquidity, Information, and Infrequently Traded Stocks. *The Journal of Finance*. 51.4: 1405–1436.

Eichengreen, Barry, Ashoka Mody, Milan Nedeljkovic and Lucio Sarno (2009). *How the Subprime Crisis Went Global: Evidence from Bank Credit Defaults Swap Spreads.* NBER Working Paper.

Eisenhardt, Kathleen M. (1989). Agency Theory: An Assessment and Review. *The Academy of Management Review*. 14.1: 57–74.

Elder, John and Peter E. Kennedy (2001). Testing for Unit Roots: What Should Students Be Taught? *Journal of Economic Education*. 32.2: 137–146.

Engle, Robert F. (1982). Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica*. 50.4: 987–1007.

Engle, Robert F. and Clive W. J. Granger (1987). Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*. 55.2: 251–276.

European Foundation for the Improvement of Living and Working Conditions (2005). *EMCC Case Studies: Restructuring of Europe's Telecom Incumbents.* <http://www.eurofound.europa.eu/emcc/publications/2005/ef0567enC1.pdf>.

Evanoff, Douglas D. and Larry D. Wall (2001). Sub-debt Risk Spreads as Bank Risk Measure. *Journal of Financial Services Research*. 20.2/3: 121–145.

EVCA (2009). *EVCA Yearbook 2009.*

EVCA (2009). *International Private Equity and Venture Capital Valuation Guidelines.* <http://www.privateequityvaluation.com/documents/International_PE_VC_Valuation_Guidelines_Sep_2009.pdf>.

EVCA (Hrsg.) (2004). *Performance Measurement and Asset Allocation for European Private Equity Funds.* Working Paper.

EVCA (Hrsg.) (2007). *The European Venture Capital Market: Scaling Beyond Current Boundaries.* Working Paper.

Fama, Eugene F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance*. 25.2: 383–417.

Fama, Eugene F. (1998). Market Efficiency, Long-term Returns, and Behavioral Finance. *Journal of Financial Economics*. 49.3: 283–306.

Fama, Eugene F. and Kenneth R. French (1992). The Cross-Section of Expected Stock Returns. *The Journal of Finance*. 47.2: 427–465.

Fama, Eugene F. and Kenneth R. French (1993). Common Risk Factors in the Returns on Stocks and Bonds. *Journal of Financial Economics*. 33.2: 3–56.

Fenn, George W., Nellie Liang and Stephen Prowse (1998). The Economics of the Private Equity Market. *Federal Reserve Bank of Dallas Economic Review*. 3.

Fischer, Edwin O., Robert Heinkel and Josef Zechner (1989). Dynamic Capital Structure Choice: Theory and Tests. *The Journal of Finance*. 44.1: 19–44.

Frank, Murray Z. and Vidhan K. Goyal (2009). Capital Structure Decisions: Which Factors Are Reliably Important? *Financial Management*. 1: 1–37.

Franzoni, Francesco, Eric Nowak and Ludovic Phalippou (2010). *Private Equity Performance and Liquidity Risk.* Working Paper.

Fraser-Sampson, Guy (2010). *Private Equity as an Asset Class.* 2nd ed. Wiley finance series. Chichester: Wiley.

Frick, Uli (2010). "What Kind of Future for Finance?": European Business Summit. Brussels. June 30; 2010.

Fuller, Wayne A. (1996). *Introduction to Statistical Time Series.* 2nd ed. New York, NY: John Wiley & Sons.

Garten, Jeffrey (2007). Private Equity Can Help Itself – And the Public. *Financial Times*. March 14, 2007.

Getzmann, André and Sebastian Lang (2010). *Determinants of the Target Capital Structure and Adjustment Speed - Evidence from Asian, European and U.S.-capital Markets.* Working Paper.

Ghysels, Eric and Jennifer L. Juergens (2001). *Stock Market Fundamentals and Heterogeneity of Beliefs: Tests Based on a Decomposition of Returns and Volatility.* Working Paper.

Gibbert, Michael, Winfried Ruigrok and Barbara Wicki (2008). What Passes a Rigorous Case Study? *Strategic Management Journal*. 29.13: 1465–1474.

Gilligan, John and Mike Wright (2008). *Private Equity Demystified. An Explanatory Guide.* London.

Givoly, Dan, Carla Hayn and Reuven Lehavy (2009). The Quality of Analysts' Cash Flow Forecasts. *The Accounting Review*. 84.6: 1877–1911.

Gliner, Jeffrey A. and George A. Morgan (2000). *Research Methods in Applied Settings: An Integrated Approach to Design and Analysis.* Mahwah, NJ: Lawrence Erlbaum Associates.

Gompers, Paul A. (1995). Optimal Investment, Monitoring, and the Staging of Venture Capital. *The Journal of Finance*. 50.5: 1461–1489.

Gompers, Paul A. (2004). *The Venture Capital Cycle;.* 2nd ed. Cambridge, Mass.: MIT Press.

Gompers, Paul A., Anna Kovner, Josh Lerner and David Scharfstein (2008). Venture Capital Investment Cycles. *Journal of Financial Economics*. 87.1: 1–23.

Gompers, Paul A. and Josh Lerner (1996). The Use of Covenants: An Empirical Analysis of Venture Partnership Agreements. *Journal of Law and Economics*. 39.2: 463–498.

Gompers, Paul A. and Josh Lerner (1998). What Drives Venture Capital Fundraising? *Brookings Proceedings on Economic Activity - Microeconomics*. 1998: 149–204.

Gompers, Paul A. and Josh Lerner (2000). Money Chasing Deals? The Impact of Fund Inflows on Private Equity Valuations. *Journal of Financial Economics*. 55.2: 281–325.

Gompers, Paul A. and Josh Lerner (2001). The Venture Capital Revolution. *Journal of Economic Perspectives*. 15.2: 145–168.

Gottschalg, Oliver (2010a). Private Equity Fund Selection: How to Find True Top-Quartile Performers. Douglas Cumming (Ed.). *Private Equity: Fund Types, Risks, Returns, and Regulation.* Hoboken, NJ: Wiley.

Gottschalg, Oliver (2010b). *The Real Reasons to Invest in Private Equity.* Working Paper.

Gottschalg, Oliver and Ludovic Phalippou (2009). The Performance of Private Equity Funds. *Review of Financial Studies*. 22.4: 1747–1776.

Gou, Shourun, Edith S. Hotchkiss and Weihong Song (2009). *Do Buyouts (Still) Create Value?* Working Paper Boston College.

Grabenwarter, Ulrich and Tom Weidig (2005). *Exposed to the J-Curve: Understanding and Managing Private Equity Fund Investments.* Working Paper.

Graham, John R. and R. C. Harvey (2001). The Theory and Practice of Corporate Finance: Evidence from the Field. *Journal of Financial Economics*. 60.2: 187–243.

Granger, Clive W. J. (1981). Some Properties of Time Series Data and their Use in Econometric Model Specification. *Journal of Econometrics*. 16.1: 121–130.

Granger, Clive W. J. and Paul Newbold (1974). Spurious Regressions in Econometrics. *Journal of Econometrics*. 2.2: 111–120.

Greene, William H. (2000). *Econometric Analysis.* 4th ed. Upper Saddle River, NJ: Prentice Hall.

Gujarati, Damodar N. and Dawn C. Porter (2009). *Basic Econometrics.* 5. ed. Boston, Mass.: McGraw-Hill Irwin.

Gupta, Udayan (2000). *Done Deals: Venture Capitalists Tell Their Stories.* Boston: Harvard Business School Press.

Hair, Joseph , William Black, Barry Babin and Rolph Anderson (2009). *Multivariate Data Analysis: A Global Perspective*. 7th ed. Upper Saddle River, NJ: Pearson/Prentice-Hall.

Hamilton, James D. (1994). *Time Series Analysis.* 1st ed. Princeton: University Press.

Hamilton, Lawrence C. (2009). *Statistics with Stata. Updated for Version 10.* Belmont, Calif.: Cengage.

Hamm, Steve (2009). Private Equity's Lessons from the Meltdown. *Business Week*. June 15, 2009.

Harford, Jerrad (2005). What Drives Merger Waves? *Journal of Financial Economics*. 77.3: 529–560.

Hege, Ulrich, Frédéric Palomino and Armin Schwienbacher (2008). *Venture Capital Performance: The Disparity Between Europe and the United States.* Working Paper HEC Paris.

Herman, Michael (2004). Rothschild Helps Phoenix Exit HPI for £120m. *Financial News*. August 17, 2004.

Hirshleifer, Jack (1958). On the Theory of Optimal Investment Decision. *Journal of Political Economy*. 66: 329–352.

Hjalmarsson, Erik (2008). *Inference in Long-Horizon Regressions.* Working paper Federal Reserve Board Washington.

Hochberg, Yael V., Alexander Ljungqvist and Annette Vissing-Jørgensen (2010). *Informational Hold-up and Performance Persistence in Venture Capital.* Working Paper.

Hovenkamp, Herbert (2009). Neoclassicism and the Separation of Ownership and Control. *Virginia Law & Business Review*. 4.2: 373–402.

Hülsewig, Oliver, Johannes Mayr and Timo Wollmershäuser (2008). *Forecasting Euro Area Quarterly Real GDP: Optimal Pooling of Information.* Working Paper.

Hyman, Eric L. (1981). The Uses, Validity, and Reliabilty of Perceived Environmental Quality Indicators. *Social Indicators Research*. 9.1: 85–110.

Ibbotson, Roger G. and Jeffrey F. Jaffe (1975). "Hot Issue" Markets. *The Journal of Finance*. 30.4: 1027–1042.

Jensen, Michael C. (1986). Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers. *The American Economic Review*. 76.2: 323–329.

Jensen, Michael C. (1989). The Eclipse of the Public Corporation. *Harvard Business Review*. 63.5.

Jensen, Michael C. (1991). Corporate Control and the Politics Of Finance. *Journal of Applied Corporate Finance*. 4.2: 13–33.

Jensen, Michael C. (1993). The Modern Industrial Revolution, Exit, and the Failure of Internal Control Systems. *The Journal of Finance*. 48.3: 831–880.

Jensen, Michael C. (2004). *Agency Costs of Overvalued Equity.* Working Paper.

Jensen, Michael C. (2007). *The Economic Case For Private Equity (and Some Concerns).* Working Paper.

Jensen, Michael C. (2010). Active Investors, LBOs, and the Privatization of Bankruptcy. *Journal of Applied Corporate Finance*. 22.1: 77–85.

Jensen, Michael C. and Donald H. Chew (2000). U.S. Corporate Governance: Lessons from the 1980s. Michael C. Jensen (Ed.). *A Theory of the Firm: Governance, Residual Claims, and Organizational Forms.* pp. 9–15. Cambridge, Mass.: Harvard Univ. Press.

Jensen, Michael C. and William H. Meckling (1976). Theory of the Firm: Managerial Behavior, Agency Costs, and Ownership Structure. Michael C. Jensen (Ed.) (2000). *A Theory of the Firm: Governance, Residual Claims, and Organizational Forms.* pp. 83–135. Cambridge, Mass.: Harvard Univ. Press.

Johansen, Søren (1991). Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models. *Econometrica*. 59.6: 1551–1580.

Jones, Charles M. and Matthew Rhodes-Kropf (2003). *The Price of Diversifiable Risk in Venture Capital and Private Equity.* Working Paper.

Kaplan, Steven N. (1989). The Effects of Management Buyouts on Operating Performance and Value. *Journal of Financial Economics*. 24.2: 217–254.

Kaplan, Steven N. (1997). *The Evolution of U.S. Corporate Governance: We Are All Henry Kravis Now.* NBER Working Paper.

Kaplan, Steven N. and Bengt Holmstrom (2001). *Corporate Governance and Merger Activity in the U.S.: Making sense of the 1980s and 1990s.* NBER Working Paper.

Kaplan, Steven N. and Josh Lerner (2010). It Ain't Broke: The Past, Present, and Future of Venture Capital. *Journal of Applied Corporate Finance*. 22.2: 36–47.

Kaplan, Steven N. and Antoinette Schoar (2005). Private Equity Returns: Persistence and Capital Flows. *The Journal of Finance*. 60.4: 1791–1823.

Kaplan, Steven N. and Jeremy C. Stein (1993). The Evolution of Buyout Pricing and Financial Structure in the 1980s. *Quarterly Journal of Economics*. 108.2: 313–357.

Kaplan, Steven N. and Per Strömberg (2001). Venture Capitalists as Principals: Contracting, Screening, and Monitoring. *The American Economic Review*. 91.2: 426–430.

Kaplan, Steven N. and Per Strömberg (2003). Financial Contracting Theory Meets the Real World: An Empirical Analysis of Venture Capital Contracts. *The Review of Economic Studies*. 70.2: 281–315.

Kaplan, Steven N. and Per J. Strömberg (2009). Leveraged Buyouts and Private Equity. *Journal of Economic Perspectives*. 23.1: 121–146.

Kaserer, Christoph and Christian Diller (2004). *European Private Equity Funds - a Cash Flow Based Performance Analysis.* Working Paper TU München.

Kelly, Jason (2009). *Blackstone's InBev Parks Deal May Signal Resurgence of Buyouts.* <http://www.bloomberg.com/apps/news?pid=20670001&sid=a6O4eCe5c_6g>.

Kennedy, Peter E. (1998). *A Guide to Econometrics.* 4. ed. Oxford: Blackwell.

KfW (2010). *Europäischer Verbriefungsmarkt.* <http://www.kfw.de/DE_Home/Kreditverbriefung/Europaeischer_Verbriefungsmarkt/index.jsp>.

Kirchgässner, Gebhard and Jürgen Wolters (2007). *Introduction to Modern Time Series Analysis.* Berlin: Springer.

Kleinbaum, David G. (1998). *Applied Regression Analysis and other Multivariate Methods.* 3. ed., rev. An Alexander Kugushev book. Pacific Grove: Duxbury Press.

Korajczyk, Robert A. and Amnon Levy (2003). Capital Struture Choice: Macroeconomic Conditions and Financial Constraints. *Journal of Financial Economics*. 68.1: 75–109.

Korajczyk, Robert A., Deborah J. Lucas and Robert L. McDonald (1992). Equity Issues with Time-Varying Asymmetric Information. *The Journal of Financial and Quantitative Analysis*. 27.3: 397–417.

Krassoff, Jay and John O'Neill (2006). The Role of Distressed Investing and Hedge Funds in Turnarounds and Buyouts and How This Affects Middle-Market Companies. *The Journal of Private Equity*. 9.2: 17–22.

Krishnaswami, Sudha and Venkat Subramaniam (1999). Information Asymmetry, Valuation, and the Corporate Spin-off Decision. *Journal of Financial Economics*. 53.1: 73–112.

Kucher, Andreas B. and Matthias Meitner (2004). Private Equity for Distressed Companies in Germany. *The Journal of Private Equity*. Winter.

Leachman, Lori, Vinay Kumar and Scott Orleck (2002). *Explaining Variations in Private Equity: A Panel Approach.* Working Paper.

Leary, Mark T. and Michael R. Roberts (2010). The Pecking Order, Debt Capacity, and Information Asymmetry. *Journal of Financial Economics*. 95.3: 332–355.

Lerner, Josh, Antoinette Schoar and Wan Wongsunwai (2007). Smart Instititutions, Foolish Choices: The Limited Partner Performance Puzzle. *The Journal of Finance*. 62.2: 731–764.

Lerner, Josh, Per J. Strömberg and Morten Sørensen (2009). *Private Equity and Long-Run Investment: The Case of Innovation.* Working Paper Swedish Institute for Financial Research.

Ljungqvist, Alexander and Matthew Richardson (2003a). *The Cash Flow, Return and Risk Characteristics of Private Equity.* NBER Working Paper.

Ljungqvist, Alexander and Matthew Richardson (2003b). *The Investment Behavior of Private Equity Fund Managers.* Working Paper.

Ljungqvist, Alexander, Matthew Richardson and Daniel Wolfenzon (2008). *The Investment Behavior of Buyout Funds – Theory and Evidence.* NBER Working Paper.

Long, Austin M. and Craig J. Nickels (1996). *A Private Investment Benchmark.* Working Paper.

Loos, Nicolaus (2006). *Value Creation in Leveraged Buyouts. Analysis of Factors Driving Private Equity Investment Performance.* 1st ed. Wiesbaden: Deutscher Universitätsverlag.

Lovell, Michael C. (1983). Data Mining. *The Review of Economics and Statistics*. 65.1: 1–12.

Lowry, Michelle (2003). Why Does IPO Volume Fluctuate so Much? *Journal of Financial Economics*. 67.1: 3–40.

Lütkepohl, Helmut and Markus Krätzig (2008). *Applied Time Series Econometrics.* Reprinted. Cambridge: Cambridge Univ. Press.

MacKinnon, James G. and Halber White (1985). Some Heteroskedasticity-Consistent Covariance Matrix Estimators With Improved Finite Sample Properties. *Journal of Econometrics*. 29.3: 305–325.

Mankiw, N. G. (1990). A Quick Refresher Course in Macroeconomics. *Journal of Economic Literature*. 28.4: 1645–1660.

Mannepalli, Bobby and J. S. Victor (2009). From Burst Bubble to Severe Recession: The Capital Markets for 2009. *The Journal of Corporate Renewal*. 22.2.

Marti, Jose and Marina Balboa (2001). *Determinants of Private Equity Fundraising in Western Europe.* Working Paper.

Matthews, Gary, Mark Bye and James Howland (2009). Operational Improvement: The Key to Value Creation in Private Equity. *Journal of Applied Corporate Finance*. 12.3: 21–27.

McCahery, Joseph A. and Erik P. Vermeulen (2010). Private Equity Regulation: A Comparative Analysis. Douglas Cumming (Ed.). *Private Equity: Fund Types, Risks, Returns, and Regulation.* pp. 359–393. Hoboken, NJ: Wiley.

Meehan, Caroline (2003). Phoenix Equity Buys 3i's Stake in Vehicle Check Company. *Financial News*. June 30, 2003.

Metrick, Andrew and Ayako Yasuda (2010). The Economics of Private Equity Funds. *The Review of Financial Studies*. 23.6: 2303–2341.

Meyers, Lawrence S., Glenn Gamst and A. J. Guarino (2006). *Applied Multivariate Research: Design and Interpretation.* Thousand Oaks, Calif.: SAGE Publ.

Mikkelson, Wayne H., M. M. Partch and Kshitij Shah (1997). Ownership and Operating Performance of Companies that Go Public. *Journal of Financial Economics*. 44.3: 281–307.

Miller, Merton H. and Kevin Rock (1985). Dividend Policy under Asymmetric Information. *The Journal of Finance*. 40.4: 1031–1051.

Minsky, Hyman P. (1992). *The Financial Instability Hypothesis.* The Jerome Levy Economics Institute Working Paper No. 74.

Minsky, Hyman P. (1993). *Finance and Stability: The Limits of Capitalism.* The Jerome Levy Economics Institute Working Paper No. 93.

Mitchell, Mark L. and Harold J. Mulherin (1996). The Impact of Industry Shocks on Takeover and Restructuring Activity. *Journal of Financial Economics*. 41.3: 193–229.

Modigliani, Franco and Merton H. Miller (1958). The Cost of Capital, Corporation Finance and the Theory of Investment. *The American Economic Review*. 48.3: 261–297.

Müller, Kay (2008). *Investing in Private Equity Partnerships. The Role of Monitoring and Reporting.* 1. Aufl. Wiesbaden: Gabler.

Munari, Federico, Robert Cressy and Alessandro Malipiero (2006). *The Heterogeneity of Private Equity Firms and its Impact on Post-buyout Performance: Evidence from the UK.* Working Paper.

Myers, Steward C. (1984). The Capital Structure Puzzle. *The Journal of Finance*. 39.4: 575–592.

Myers, Stewart C. and Nicholas S. Majluf (1984). Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have. *Journal of Financial Economics*. 13.1: 187–221.

Neher, Darwin V. (1999). Staged Financing: An Agency Perspective. *The Review of Economic Studies*. 66.2: 225–274.

Newey, Whitney K. and Kenneth D. West (1987). A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix. *Econometrica*. 55.3: 703–708.

Officer, Micah S., Oguzhan Ozbas and Berk A. Sensoy (2010). Club Deals in Leveraged Buyouts. *Journal of Financial Economics*. 98.2: 214–240.

Owen, Sian (2006). *The History and Mystery of Merger Waves: A UK and US Perspective.* Working Paper.

Oxman, Jeffrey and Yildiray Yildirim (2006). *Evidence of Competition in the Leveraged Buyout Market.* Working Paper.

Pástor, Ľuboš and Pietro Veronesi (2005). Rational IPO Waves. *The Journal of Finance*. 60.4: 1713–1757.

Persaud, Avinash D. (2008). *Regulation, Valuation and Systemic Liquidity.* Working Paper Banque de France.

Phalippou, Ludovic (2010a). *Private Equity Funds' Performance, Risk and Selection.* Working Paper.

Phalippou, Ludovic (2010b). Risk and Return of Private Equity: An Overview of Data, Methods, and Results. Douglas Cumming (Ed.). *Private Equity: Fund Types, Risks, Returns, and Regulation.* Hoboken, NJ: Wiley.

Phillips, Peter C. B. and Pierre Perron (1988). Testing for a Unit Root in Time Series Regression. *Biometrika*. 75.2: 335–346.

Phoenix Equity (2003). *Phoenix Acquires HPI for £70 Million.* Company news release.

Pindur, Daniel (2007). *Value Creation in Successful LBOs.* 1st ed. Wiesbaden: Deutscher Universitätsverlag.

Popov, Alexander and Peter Roosenboom (2009). *Does Private Equity Investment Spur Innovation. Evidence from Europe.* Working Paper ECB.

Povaly, Stefan (2007). *Private Equity Exits. Divestment Process Management for Leveraged Buyouts.* Berlin, Heidelberg: Springer.

Prais, S. J. and C. B. Winsten (1954). *Trend Estimation and Serial Correlation.* Cowles Commision Discussion Paper No. 383, Chicago.

Punch, Keith F. (2005). *Introduction to Social Research. Quantitative and Qualitative Approaches.* 2. ed. London: SAGE Publ.

Quinn, Carl and Dylan Schulz (1992). Banking in the 1990s: Challenge and Change: Carl Quinn and Dylan Schulz. *Chicago Fed Letter*. 62.

Ramón, Marina B. and José M. Pellón (2003). *Characterisation of the Reputation of Private Equity Managers: Evidence in Spain.* Working Paper.

Rau, P. R. and Aris Stouraitis (2010). Patterns in the Timing of Corporate Event Waves. *Journal of Financial and Quantitative Analysis*. Forthcoming.

Reuters (2008). *U.S. Loan Market Review: 2008 Ends with Lending Grinding to a Halt.* <http://www.loanpricing.com/newsroom_files/press_release_4Q08.htm>.

Rhodes-Kropf, Matthew and S. Viswnathan (2004). Market Valuation and Merger Waves. *The Journal of Finance*. 59.6: 2685–2718.

Ritter, Jay R. (1984). The "Hot Issue" Market of 1980. *The Journal of Business*. 57.2: 215–240.

Robinson, Thomas, Greuning, Hennie van, Henry, Elaine and Michael Broihahn. (2009). *International Financial Statement Analysis.* Hoboken, NJ: Wiley.

Rosenbaum, Joshua and Joshua Pearl (2009). *Investment Banking. Valuation, Leveraged Buyouts, and Mergers & Acquisitions.* Hoboken, NJ: Wiley.

Ross, Stephan A. (1973). The Economic Theory of Agency: The Principal's Problem. *The American Economic Review*. 63.2: 134–139.

Rossa, Jennifer June 05; 2008). PE Fund-Raising: Shades of the Tech Bust? *The Wall Street Journal*.

Ruud, Paul A. (2000). *An Introduction to Classical Econometric Theory.* Oxford New York: Oxford University Press, USA.

Sahlmann, William A. (1990). The Structure and Governance of Venture-Capital Organizations. *Journal of Financial Economics*. 27.2: 473–521.

Savin, N. E. and Kenneth J. White (1977). The Durbin-Watson Test for Serial Correlation with Extreme Sample Sizes or Many Regressors. *Econometrica*. 45.8: 1989–1996.

Schertler, Andrea and Tereza Tykvová (2010). *What Lures Cross-Border Venture Capital Inflows?* Working Paper.

Scheurle, Patrick and Klaus Spremann (2010). Size, Book-to-market, and Momentum During the Business Cycle. *Review of Managerial Science*. 4.3: 201–215.

Schmidt, Daniel, Eric Nowak and Alexander Knigge (2004). *On the Performance of Private Equity Investments: Does Market Timing Matter?* Working Paper.

Sekaran, Uma and Roger Bougie (2010). *Research Methods for Business. A skill-building Approach.* 5th ed. Chichester: Wiley.

Shleifer, Andrei and Robert W. Vishny (1992). Liquidation Values and Debt Capacity: A Market Equilibrium Approach. *The Journal of Finance*. 47.4: 1343–1366.

Shleifer, Andrei and Robert W. Vishny (2003). Stock Market Driven Acquisitions. *Journal of Financial Economics*. 70.3: 295–311.

Shleifer, Andrei and Rovert W. Vishny (1990). The Takeover Wave of the 1980s. *Sience*. 249.4970: 745–749.

Sims, Christopher (1989) A. *Modeling Trends.* Discussion paper 22, Institute for Empirical Macroeconomics, Federal Reserve Bank of Minneapolis.

Smith, Abbie J. (1990). Corporate Ownership Structure and Performance: The Case of Management Buyouts. *Journal of Financial Economics*. 27.1: 143–164.

Spremann, Klaus (1989). Agent and Principal. Günter Bamberg, and Klaus Spremann (Ed.). *Agency Theory, Information, and Incentives:* 3–37. Berlin: Springer.

Spremann, Klaus (2006). *Portfoliomanagement.* 3rd ed. München: Oldenbourg.

Spremann, Klaus and Patrick Scheurle (2009). Kapitalkosten bei zyklischen Risiken. Gerhard Seicht (Ed.). *Jahrbuch für Controlling und Rechnungswesen 2009.* Wien: LexisNexis.

StataCorp LP (2009). *Stata Time-Series Reference Manual ; release 11.* College Station, Tex: Stata Press.

Stewart, Chris (2011). A Note on Spurious Significance in Regressions Involving I(0) and I(1) Variables. *Empirical Economics*. Forthcoming.

Stock, James H. and Mark W. Watson (2007). *Introduction to Econometrics.* 2nd ed. Boston, Mass.: Pearson Education.

Strömberg, Per J. (2007). *The New Demography of Private Equity.* Working Paper Swedish Institute for Financial Research.

Strömberg, Per J. (2009). *The Economic and Social Impact of Private Equity in Europe: Summary of Research Findings.* Working Paper.

Sudarsanam, Sudi (2003). *Creating Value From Mergers And Acquisitions. The Challenges: An Integrated and International Perspective.* Harlow: Prentice Hall/Financial Times [u.a.].

Tobin, James (1959). On the Predictive Value of Consumer Intentions and Attitudes. *The Review of Economics and Statistics*. 41.1: 1–11.

Treanor, Jill (2003). Davis Offloads HSS Tool Hire to 3i. *The Guardian*. December 17, 2003.

Van Ness, Bonnie F., Robert A. Van Ness and Richard S. Warr (2001). How Well Do Adverse Selection Components Measure Adverse Selection? *Financial Management*. 30.3: 77–98.

Väre, Minna, Christoph R. Weiss and Kyösti Pietola (2005). *On the Intention-Behaviour Discrepancy: Empirical Evidence From Succession on Farms in Finland.* Working Paper.

Verbeek, Marno (2008). *A Guide to Modern Econometrics.* 3. ed., reprinted. Chichester: Wiley.

Vogelwang, Ben (2005). *Econometrics: Theory & Applications With Eviews.* Harlow: Pearson Education.

Wagner, Hannes F. (2008). *Public Equity Issues and the Scope for Market Timing.* Working Paper.

Waters, C D. J. (1998). *Essential Quantitative Methods. A Guide for Business.* Harlow: Addison-Wesley.

Weber, Axel A. (2005). Bank Relationships, Financial Integration, and Monetary Policy. DIW-Conference Bank Relationships, Credit Extension, and the Macroeconomy. Berlin June 03, 2005.

Weintraub, E. R. (1993). Neoclassical Economics. Library of Economics and Liberty (Ed.). *The Concise Encyclopedia of Economics.*

Weston, John F., Mark L. Mitchell and Harold J. Mulherin (2004). *Takeovers, Restructuring, and Corporate Governance.* 4. ed., internat. ed. Upper Saddle River, NJ: Pearson/Prentice-Hall.

Whalen, R. C. (2008). *The Subprime Crisis: Cause, Effect and Consequences.* Networks Financial Institute Policy Brief No. 2008-PB-04.

Williams, Joseph and Kose John (1985). Dividends, Dilution, and Taxes: A Signalling Equilibrium. *The Journal of Finance*. 40.4: 1053–1070.

Wooldridge, Jeffrey M. (1991). On the Application of Robust, Regression-Based Diagnostics to Models of Conditional Means and Conditional Variances. *Journal of Econometrics*. 47.1: 5–46.

Wooldridge, Jeffrey M. (2006). *Introductory Econometrics. A Modern Approach.* 3rd ed. Mason, Ohio: Thomson South-Western.

Wright, Mike, Luc Renneboog, Tomas Simons and Louise Scholes (2006). Leveraged Buyouts in the U.K. and Continental Europe: Retrospect and Prospect. *Journal of Applied Corporate Finance*. 18.3: 38–55.

Wright, Mike and Kenn Robbie (1998). Venture Capital and Private Equity: A Review and Synthesis. *Journal of Business Finance & Accounting*. 25.5-6: 521–570.

Yale School of Management (2010). *Behavioral Finance Research Initiative.* 2010. <http://icf.som.yale.edu/research/behav_finance.shtml>.

Yan, Jinghua (2006). *Merger Waves: Theory and Evidence.* Working Paper.

Zhang, Cathy (2008). *Defining, Modeling, and Measuring Investor Sentiment.* Working Paper University of California, Berkeley.

Zhao, Xinlei and Kai Li (2008). Asymmetric Information and Dividend Policy. *Financial Management*. 34.4: 673–694.

Curriculum Vitae

Personnel Details

Name:	Claudia Sommer (maiden name: Wurst)
Date/ place of birth:	13 February 1979 in Waren/ Müritz, Germany
Address:	Kegelhofstr. 12, 20251 Hamburg, Germany

Education

2009 – 2012:	**University of St. Gallen (HSG), Switzerland** Doctoral Programme
1999 – 2005:	**University of Hamburg** Diploma in Mathematics and Economics (Diplom-Wirtschaftsmathematikerin)
1997:	**Richard-Wossidlo-Gymnasium, Waren/ Müritz** Abitur

Professional Experience

Since 2012:	**Otto GmbH & Co. KG** Head of Corporate Development
2011 – 2012:	**Otto GmbH & Co. KG** Head of Planning and Controlling P4P
2007 – 2011:	**Roland Berger Strategy Consultants** Project Manager Corporate Performance
2005 – 2006:	**KMPG** Senior Consultant Restructuring/ Transation Services
2002 – 2005:	**South-East Asia Private Equity Fund, Hamburg** Assistant to Managing Director (part time)
1999 – 2000:	**Deutsche Bank, Hamburg** Corporate Analyst (part time)
1997 – 1999:	**Deutsche Bank, Hamburg** Apprenticeship