Private Equity Financing of Technology Firms: A Literature Review

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1. Introduction

"The publicly held corporation has outlived its usefulness in many sectors of the economy. [...]Active investors are creating a new model of general management. These investors include LBO partnerships such as Kohlberg Kravis Roberts and Clayton & Dubalier."

—Michael C. Jensen, The eclipse of the public corporation, Harvard Business Review, 1989

"The big private equity funds have proven to be a menace to healthy companies, to workers' rights, and to the European Union's Lisbon Agenda […] These LBOs leave the company saddled with debt and interest payments, its workers are laid off, and its assets are sold. A once profitable and healthy company is milked for short-term profits, benefiting neither workers nor the real economy."

—Poul Nyrup Rasmussen, "Taming the Private Equity Locusts" Project Syndicate/Europe's World, 2008.

Private equity (PE) investment activity and more specifically the perceived economic impacts of the investment activity have received considerable attention in academic literature as well as in popular media. Since the early 1980s, and arguably even before that, scholars have analyzed the characteristics of PE investment behavior from many different angles and contributed to a broad body of literature. This work aims to give an overview of the current status of research that relates to PE financing of technology firms. Specifically, it focuses on the branch of literature that primarily addresses the impact of PE investments on firms in technology intensive industries, by influencing the firm's innovative capabilities, its entrepreneurial orientation (EO), its productivity, and its ability to make long term investments. In this process, two main streams of literature are provided. First, the paper covers literature concerned with agency theory and moral hazard (Bergemann & Hege, 1998; Eisenhardt, 1989; Jensen & Meckling, 1976) to interpret the role of PE firms as financial intermediaries in general, and PE firms investing in the technology sector in particular. Second, it covers the body of literature that addresses PE transactions before the background of innovation theory (Schumpeter, 1912, 1942), EO (Lumpkin & Dess, 1996), and the resource-based view of the firm as a source of competitive advantage (Ireland, Hitt, & Sirmon, 2003). Similar to work produced by other researchers which has integrated agency and resource based theories (Castanias & Helfat, 1991; Mahoney & Pandian, 1992), this work summarizes findings covering the PE business model and the behavior of PE firms and integrates these findings with studies that have investigated PE transactions in the context of innovation and entrepreneurship. By gathering evidence from several different studies, it is possible to shed light on aspects that have been both praised and criticized in the context of PE investments in technology companies (Zahra, 1995).

During the past 30 years, the PE industry itself has evolved. Empirical evidence indicates that the focus has shifted away from financial leverage as a main source of value creation to operational improvement and value generation through product development, innovation, and commercialization among others (Kaplan & Strömberg, 2009; Lerner, Sorensen, & Strömberg, 2011; Wright, Hoskisson, & Busenitz, 2001; Wright, Hoskisson, Busenitz, & Dial, 2000). The shift in PE investment behavior has implications on the competitiveness of technology companies which obtain capital from PE firms. Still, a large portion of academic research relates to PE transaction conducted in the 80s (Wright, Gilligan, & Amess, 2009). Therefore, a second goal of this paper is to investigate if academic research covering PE investments during different periods of time provides evidence of changes in behavior.

The terminology in PE is not always used unambiguously. In order to clarify the scope of this paper more precisely, I define the areas covered under the topic of this paper, specifically PE finance as well as technology firm, as follows: When addressing the concept of PE finance, I follow the rationale that venture capital (VC) investments in the earlier stages of the corporate life cycle and (leveraged) buyout (BO or LBO) investments in the more later stages are both members of the same PE asset class which share many of the same basic characteristics (Diller & Kaserer, 2009; Koryak & Smolarski, 2008; Metrick & Yasuda, 2011). In that sense, I also emphasize the role of VC as a provider of growth capital as opposed to start-up capital (Bruining & Wright, 2008). Still, the differences between VC and BO remain pronounced in many aspects of their investment activity. For instance, whereas around 80-90% of VC investments in the U.S. are made in the technology sector (Cumming, 2007; Gompers, Kovner, & Lerner, 2009), BO firms have a more broad industry coverage (NVCA, 2012). In the following chapters, I will use the term VC to refer to findings from literature that are specific to

early stage investments and the term BO or LBO to refer to later stage investments. Moreover, I will use the term PE to refer to aspects that relate to both VC and BO irrespective of the stage within the corporate life cycle that investments are made in. Similarly to PE, the terminology with respect to technology firms is almost defined equally wide and captures a continuum from business services/software to classical manufacturing/production. In the PE context, this continuum is often referred to as "asset light" (i.e. business services/software) and "asset heavy" (i.e. manufacturing/production). In this analysis, I will include the whole continuum of business that can be categorized as technology firm. Still, I will strive to emphasize differences in the findings in literature as they relate to PE investments in asset light and asset heavy technology firms.

The remainder of the paper is structured to follow the PE investment life cycle and present findings from literature that relate to the individual phases within the investment life cycle: From market screening and investment decision making, to the operative management of PE portfolio companies, and to exiting from a portfolio company. First, I review the screening process through which PE firms identify and assess portfolio companies. In this context, I present evidence on the firm specific criteria that influence the investment decision by PE firms to provide technology firms with capital and include information on the fit of certain markets and/or industries with the PE business model. Second, I elaborate on the impacts of PE investment activity on the portfolio company's competitive capabilities. Specifically, I focus on the impact of PE ownership on the target firm's innovative capabilities, on its strategies to commercialize new products, and on the EO, productivity and asset utilization within the firm. Moreover, I will present findings that address the effect of PE ownership on a firm's ability to make long term investments in R&D and its tangible asset base. Third, research covering the possible exit routes for technology firms in PE portfolios is presented along with the implications of the different exit routes for the PE firm as well as for the portfolio company. Last, I present conclusions to be drawn from literature with respect to PE investments in technology firms and identify future areas of research in this specific field.

2. Screening & Selection

Preceding a capital commitment, PE firms apply very specific screens and evaluation procedures in order to minimize risk and maximize returns from their investments. The topic has attracted significant interest from academics and consequently a broad body of literature exists that covers screening criteria and decision making by VC and/or BO firms (Kaplan & Strömberg, 2001; MacMillan, Siegel, & Narasimha, 1985; Muzyka & Birley, 1996; Petty & Gruber, 2011; Tyebjee & Bruno, 1984a). The interest in this topic stems not only from a theoretical perspective, but also from its implications for the PE investment community. For instance, Hege et al. (2009) compare the performance of US VCs with the performance of European VCs using firm level data of 146 European and 233 US VC backed companies. The results of their analysis suggest that the outperformance of U.S. VC relative to their European counterparts is partly explained by superior screening abilities of U.S.-based VCs. Moreover, research conducted by Nielsen (2011) for the Danish market provides evidence that the screening and selection skills by PE firms are not easily replicated. Specifically, Nielsen shows that albeit being sophisticated investors, pension funds making direct investment in private companies have underperformed the PE market with their investments by at least 3.9% per year during the period from 1995 to 2004. Overall, the results yielded by Nielsen are similar to evidence on institutional investment activity in private companies for the U.S. market (Lerner, Schoar, & Wongsunwai, 2007).

When analyzing screening and selection criteria of PE firms, academics frequently group individual criteria into categories. For instance, in their paper on VC decision making, Petty and Gruber (2011) cluster their analysis according to the following five major categories: (1) market, (2) management team, (3) product, (4) financials, and (5) investor specific criteria. Other studies include categories such as competitive environment, strategic orientation, or similar criteria. Still, the categories (1)-(4) are virtually always included in some variant that mirrors their relevance in the screening and investment phase. Interestingly, the relative importance of each of these categories varies widely, even across experienced and successful investors. According to Gompers and Lerner (2001), some VCs (such as Tom Kleiner of Kleiner Perkins) focused on a company's proprietary technology/product, some VCs (such as Don Valentine of Sequoia) emphasized the importance of the market and again others (such as Arthur Rock of Davis & Rock) viewed the management team as being the most decisive factor.

In the following chapter, I will focus on the findings from literature attributable to the 4 broad categories (1) market, (2) management team, (3) product, and (4) financials that are most frequently addressed in the context of PE investment decision making and which are subject to a controversial debate among academics and professionals.

2.1 Market

At its core, the PE business model is based on investing in companies and selling their stake at a profit to another acquirer (through trade-sale or IPO) at some point in the future. In order to follow this business model, it is first necessary to identify potential investment targets or "deals". The process to identify and generate deals can either be driven by the PE firm itself (active deal sourcing), or by parties outside of the PE firm (passive deal sourcing), such as firms seeking funding, or M&A advisors mandated with the sale of a company or a business division. Early evidence on VC deal origination during the 1980s shows that VCs rarely follow an active deal sourcing approach (Tyebjee & Bruno, 1984a). Instead, most deals are referred to the VCs by third parties and/or VCs are invited by other VCs to participate in a deal as a syndication partner. A decade later, analyses initially conducted in the UK suggest that VC behavior with respect to active deal sourcing might have changed (Sweeting, 1991). UK VCs interviewed by Sweeting responded that they preferred seeking out investments proactively. Specifically, the VCs examined markets which experienced a high degree of fragmentation, but at the same time exhibited good growth prospects. These markets were screened for companies with a relevant technology, but were underfunded and/or poorly managed. Further evidence towards a more active deal sourcing stance, as compared to the early '80s, was collected by the author through follow-up interviews with VCs in the U.S.

As evidenced by responses from VC professionals in Sweeting's study, the nature of the deal sourcing process is often closely connected with the type of analysis – top-down vs. bottom-up – performed to evaluate a deal opportunity. Active deal sourcing, in which PE firms take the initiative to approach a company is typically performed through a top-down analysis (i.e. searching for attractive industries and markets first before targeting individual companies), whereas a bottom-up analysis is conducted when PE professionals are presented with a deal opportunity through a passive deal sourcing channel such as an M&A advisor. Since the majority of PE deals comprise of private-to-private transactions (Strömberg, 2008), information on products, financials, and management teams of these private, non-listed firms is often scarce and/or exhibits significant limitations. In order to identify attractive deal opportunities, PE firms applying an active deal sourcing approach often resort to the performance of individual industries or markets to prescreen for potential investment targets.

Early evidence of the importance of market characteristics in the VC decision process is provided by Wells (1974), and Tyebjee and Bruno (1984a). In the two studies, the importance of specific decision criteria is assessed by VC professionals; Wells personally interviews eight VCs whereas Tyebjee and Bruno conduct telephone interviews with 46 VCs. Wells ranks the attractiveness of the market at number three of twelve, Tyebjee and Bruno record market growth/size at number two of twelve and market niche/position and number four of twelve.

MacMillan et al. (1985) were also among the early researchers who systematically examined determinants of VC investment behavior. In their paper, the authors conducted a survey with 102 U.S. VC principals which identified and weighted their decision criteria of whether to invest in a firm or not according to six categories: (1) the personality of the entrepreneur, (2) the experience of the entrepreneur, (3) characteristics of the product or service, (4) characteristics of the market, (5) financial considerations, and (6) the composition of the venture team. Among the characteristics of the market, market growth was considered to be the single most important criterion. However, in a follow on study by MacMillan et al. (1987) aimed at identifying successful and unsuccessful ventures, relatively more importance was attributed to market dynamics and market-product criteria, such as competitive threat and market acceptance of the product as opposed to market growth. The study was conducted as a survey in which 67 U.S. VC principals were asked to assess several successful and unsuccessful ventures. The results of this survey were used in a regression analysis to identify criteria with predictive power on venture success as measured by performance criteria such as profit, ROI, sales, and market share.

The importance of the market, specifically for growth PE investments, is emphasized in a study by Siegel et al. (1993). In order to examine which criteria define a high growth venture, the authors analyze two distinct data-

bases consisting of (a) early stage ventures (1,600 firms in the state of Pennsylvania with an average revenue of approximately $1.4m) and of (b) later stage ventures (105 U.S. firms with an average revenue of approximately $10.7m). For their samples, the authors gathered information on firm characteristics such as experience of management team in the same industry, strategy, utilization of new technology, leanness of operations, market growth, diversification, customer contracts, and funding relationships. These characteristics were then tested for their power to predict high-growth firms in the model developed by the authors. Especially for sample (b), containing larger firms in terms of revenue, market growth proved to be the most important criteria to distinguish low-growth from high-growth firms.

In a study of 149 U.S. VCs, Elango et al (1995) examine criteria that distinguish individual VC firms including the preference for ventures in certain stages of the corporate life cycle. The authors then examine the implications of the distinguishing factors on VC behavior. Among other results, the analysis provides evidence that VC firms with a preference for investments in early stage ventures value high market growth. Conversely, VC firms with a preference in later stage ventures put relatively more emphasis on demonstrated market acceptance than on high market growth. Going beyond the characteristics of the market in the VC decision making process, Gompers et al. (2009) examine the importance of market/industry know-how for the VC firm itself. In their analysis building on 24,331 U.S. VC investments during the period from 1975 to 2003, the authors compare the performance of VC specialists with focused industry/market know-how vs. VC generalists. Gompers et al. measure the difference between specialists and generalists by applying a variation of the Herfindahl-Hirschman index, usually used to assess market concentration, on individual VC managers. That is, a VC investment professional with a Herfindahl score of 1 has only invested in a single industry, whereas investment in several industries lower the professionals Herfindahl score. The authors calculate Herfindahl scores on a VC investment professional as well as on a VC firm level. Results of the analysis provide evidence for a positive relation between the specialization of individual VC professionals and the profitability of the VC firm. They conclude that "the poorer performance by generalists appears to be due to both an inefficient allocation of funding across industries and poor selection of investments within industries."

In a similar context, Dimov et al. (2012) find that the characteristics of the VC as well as their learning patterns also influence the type of markets that are entered. In a study of 4,446 U.S. VC firms during the time period from 1962 to 2004, Dimov and Martin de Holan (2010) analyze the market entry decision by VCs based on the three dimensions: Depth of investment experience, breadth of investment experience, and distance from the subject market. The authors distinguish between First-Round Entries, in which the VC is the first to invest in a firm positioned in a new market, and Later-Round Entries, in which the VC invests in a firm positioned in a new market that has already received VC. The researchers find that VCs are not likely to invest in distant markets. They also find that VC with the greatest breadth of investment experience are the most likely to invest in First-Round Entries and that VC with a large depth of investment experience are likely to invest in First-Round Entries in proximate markets.

Attributable to the comparatively greater uncertainty associated with VC investments as opposed to later stage BO investments, the boundary conditions of the markets play an important role in determining the success of VC backed firms (Hargadon & Kenney, 2012). Specifically, the later identify three conditions that have to be met in order for a market to be suitable for VC investment: (1) The market has to be large and growing rapidly, (2) the technology has to be scalable, and (3) buyer behavior in the exit market should have a high likelihood of large and rapid payoffs. In addition, findings from Lerner (2009) suggest that the stage of the market in the business life cycle influences the suitability of certain high-technology ventures; Lerner argues that ventures centered around disruptive innovations are most suitable in less mature markets whereas ventures with a lower degree of innovation face lower barriers to enter more mature markets with established incumbents. Overall, the growth characteristics of the market are relatively more important for venture capital and growth PE firms and less vital for BO firms investing in more mature stages. Instead of focusing on market growth, the latter put relatively more focus on free cash flow (Bull, 1989). Consequently, investments in high technology industries with high R&D exposure have not been very common for LBOs in the past (Hall, 1990; Opler & Titman, 1993). However, recent studies report a gradual shift of PE investment activity into more high-tech industries (Lerner et al., 2011; Strömberg, 2008).

2.2 Management Team

According to early research on VC decision making, management team related criteria are unanimously ranked as the single most important criteria in the VC selection process. In the rankings compiled by Wells (Wells, 1974), Tyebjee and Bruno (1984a), and Poindexter (1976), who utilized responses from 97 VCs to a mailed questionnaire, the most important criteria are management commitment, the quality of management, and management skills and history, respectively. In their work, Tyebjee and Bruno (1984a) show that the expected return of an investments is determined by market attractiveness and product differentiation, whereas the perceived riskiness of the investment in the view of the VC is determined by management capabilities and environmental threat resistance. In this view, the relative high importance of management team can be interpreted that risk aversion and mitigation is valued higher than expected return by the majority of VCs taking part in the authors' analysis. Similar observations in this regard have been made by (Lerner, 2012; Taeube, Migendt, Schock, & von Flotow, 2014).

A study conducted by MacMillan et al. (1985) finds that five of the ten most important criteria to evaluate an investment target involve the entrepreneur's capabilities. The was conducted by questioning 102 U.S. VC principals which identified and weighted their decision criteria of whether to invest in a firm or not according to 6 categories: (1) the personality of the entrepreneur, (2) the experience of the entrepreneur, (3) characteristics of the product or service, (4) characteristics of the market, (5) financial considerations, and (6) the composition of the venture team. Overall, evidence of staying power and the ability to mitigate risk by the entrepreneur were the most highly weighted criteria. In the words of Tyebjee and Bruno (1981), "There is no question that irrespective of the horse (product), horse race (market), or odds (financial criteria), it is the jockey (entrepreneur) who fundamentally determines whether the venture capitalist will place a bet at all." Analyzing the results of the study by factor analysis, the authors find that VCs evaluate deals based on several categories of risk to be managed. In line with arguments brought forth by Tyebjee and Bruno (1984a) in a later study, the emphasis on risk (as opposed to return) in the assessment concurs with the entrepreneur's capabilities as most important selection criteria. The importance of the management team in connection with the perceived risk of the venture is confirmed by a survey of 49 U.S. VC firms in 1984 conducted by Gorman and Sahlman (1989). They find that weak senior management is perceived as the most important cause for failure of a venture by the VCs participating in the survey.

Similarly, through surveying 73 European VCs involving 53 pairwise trade-off decisions, Muzyka et al. (1996) find that among a number of VC decision criteria including, (1) financial criteria, (2) product-market criteria, (3) strategic-competitive criteria, (4) management team criteria, (5) management competence criteria, (6) fund criteria, and (7) deal criteria, management team criteria are regarded as the most important. The authors conclude that "venture capitalists interviewed would, as a group, prefer to select an opportunity that offers a good management team and reasonable financial and product-market characteristics, even if the opportunity does not meet the overall fund and deal requirements."

In the context of their study on the effects of changing management and ownership on corporate restructuring, Robbie and Wright (1995) provide evidence on the importance of the management team in the eyes of the VC firm. Specifically, Robbie and Wright point to the considerable effort that is made by the VC to assess the entrepreneurial skills of the managers taking part in a buy-out or buy-in. Evidence from industries such as local area networking and biotechnology also suggests, that in the early stages of yet opaque, emerging high-technology industries, VC investors place comparatively greater emphasis on the perceived competencies of the management team (von Burg & Kenney, 2000).

More recently, Kaplan et al. (2009) analyzed 50 VC financed firms in the period from 1975 to 2006 and followed them throughout their life cycle from the early business plan to IPO to three years as a public company. Firms in their sample were mostly comprised of high-technology firms (around 90%), with a strong weight on biotechnology and information technology. Among other goals, the authors follow up on the question of whether the management team or the business/market is more influential on the success prospects of an individual firm. Notwithstanding the anecdote from VCs that a great management team can eventually seize a good opportunity "even if they have to make a huge leap from the market they currently occupy," Kaplan et al. find that firms in their sample rarely change their initial business proposition or line of business. However, the

authors also find that firms frequently exhibit changes in top management. At the time of the IPO, only 72% of the CEOs stated in the business plans were still present whereas only 50% of the next four top managers were still present. At the time of the annual report, only 44% of the CEOs stated in the business plans along with only 25% of the next four top managers. The authors conclude that although it is important for VCs to select both good managers and good businesses/markets, the selection of the business/market should be given relatively more weight. According to Kaplan et al. "poor or inappropriate management is much more likely to be remedied by new management than a poor or inappropriate business idea is to be remedied by a new idea."

2.3 Product and Technology

Despite many entrepreneurs, especially in the high-technology sector, placing a lot of emphasis on product or technology related criteria, early research on VC decision making does not provide evidence for an equal emphasis on the side of the investors. Among the three studies conducted by Wells (1974), Poindexter (1976), and Tyebjee and Bruno (1984a), only Wells places the criterion "product" at number three of his ranking. Neither VCs surveyed by Poindexter nor VCs questioned by Tyebjee and Bruno explicitly rank product related criteria among the top decision criteria. However, in a follow-up on a study by Tyebjee and Bruno, several product differentiation related criteria such as profit margins determined by the product, uniqueness of the product, and patentability of the product were used by VCs to evaluate a potential investment target. The authors conclude that together with market attractiveness, product differentiation determines the expected return of an investment in a target company although its impact on the expected returns and consequently the investment decision is considered weaker than market attractiveness.

Taking on a more aggregate view on VC investment activity, Florida and Kenney (1988) examine the relation between characteristics of regional VC complexes and investments in high-technology firms by VC. In their study focusing on seven large U.S. VC complexes, namely Silicon Valley/San Francisco, Boston, New York, Chicago, Minneapolis, and Texas, the authors provide insight on the relationship between VC and high-technology entrepreneurship. The results show that technology based complexes characterized by the presence of a large number of technology intense firms attract VC investors which then invest in local technology companies. Conversely, finance based complexes characterized by the presence of financial institutions and their VC subsidiaries tend to export their investment funds to other regions. The authors conclude that "despite its importance in premier high-technology regions, the availability of VC does not necessarily translate into high technology entrepreneurship." Instead, innovative high technology companies seem to attract VC from other regions.

The results by Florida and Kenney find support by analyses conducted by Engel and Keilbach (2007). Studying firm-level evidence of VC investments on growth and patent output for a sample of 142 VC funded German firms founded between 1995 to 1998, the authors find that VC funded companies exhibit significantly more patent issues than their industry peers. However, the authors show that patent issues at target firms were surpassing their industry competitors even before the VC investment. They therefore conclude that innovative capabilities of technology firms serve as selection criteria for VC in their investment decision process. The findings are in line with Hellmann and Puri (2000), who find that imitators are less likely to obtain VC than the initial innovators.

In an analysis on UK VCs, Sweeting (1991) studies the VC deal creation model developed in the U.S. market by Tyebjee and Bruno (1985) to examine the applicability of the model in the UK. His sample include in depth analyses of four VC firms accompanied by the evaluation of broad VC industry data. Among other evidence, Sweeting finds a "slackening of interest in innovative, technology-based businesses, particularly those in their early stages of development." Still, all managers at VC firms interviewed for his study expressed interest and experience in investing in high-technology companies. Moreover, the author also finds evidence that performance characteristics of technology heavy investments can have a significant impact on future activity in high-technology areas. Specifically, after experiencing poor performance from investing in new technology based companies, one VC fund pulled out from these type of technology investments altogether. Recent research on VC activity in the clean technology sector also provides evidence for this behavior (Taeube et al., 2014).

In addition, the investment stage focus of VC firms has been shown to impact the relative importance of prod-

uct and technology. In their study on differences among VC firms, Elango et al (1995) find that VC firms which prefer to invest in early stage ventures emphasize product related criteria such as proprietary product features and product uniqueness. Compared to early stage investors, VC investors with a focus on later stages ventures examined by Elango et al. place more relevance on demonstrated market acceptance.

2.4 Financials

Unsurprisingly, research focused on early stage PE investments as evidenced by studies on VC decision making hardly attribute particular emphasis of VCs on target firm financial data. Among the three early studies conducted by Wells (1974), Poindexter (1976), and Tyebjee and Bruno (1984a) only the latter report that the financial history of a firm is taken into account by VCs in their decision making process. Even then, the criteria "financial history" is ranked at number five, behind management skills, market size/growth, rate of return, and market niche/position. The lacking emphasis on a company's financial data in this stage of investment can mostly be attributed to the fact that the majority of companies at this stage simply do not have any meaningful financial history. Above that, the anticipated financials presented in the business plan frequently exhibit a considerable degree of uncertainty and/or are often overly optimistic. As a response, VCs stage their investments in order to manage risk, incentivize management, and gain a better understanding of the target company and its ultimate success prospects (Bergemann & Hege, 1998; Gompers, 1995; Tykvová, 2007). Nevertheless, Wright and Robbie (1997) provide evidence that accounting information is an important part of the VC's decision making process. In order to analyze the implications of financial expertise and focus on the part of the VC on investment behavior, Dimov et al. (2007) examine the investment decision of 108 US VCs in the wireless communications industry in the period from 1997 to 2002. The authors find that VCs with higher financial expertise make fewer investments in early stage ventures. Again, this result implicates that VC professionals with a focus on a target company's financials are comparatively uncomfortable with making investments in early stage ventures, in which financial data is hardly suited to serve as a basis for an investment decision. Still, Dimov et al. also find that high VC reputation weakens the aversion of VC firms with higher financial expertise to invest in early stage ventures, whereas high VC status strengthens the aversion.

In comparison to early stage VC investments, target financials play a much more prominent role in BO investment in the later stages of the corporate life cycle. In their analysis of manufacturing LBOs during the period from 1980 to 1990, Opler and Titman 1993 (1993) capture the determinants of LBO activity using a sample of 180 LBO transactions. The firms included in the sample are then compared to a control group of all manufacturing companies in the same period of time. The authors find that firms targeted by an LBO exhibit both low growth prospects (as measured by Tobin's q) and high free cash-flow (CF) illustrating the relatively high importance that PE investor attribute to FCF. In addition, the authors provide evidence that LBO investors during the '80s shunned companies with high expected cost of financial distress such as companies with high R&D expenses. As Titman and Wessels (1988) have shown, R&D intensive companies are frequently high growth companies with unique products which are associated with high costs of financial distress. Moreover, the regression results also show that firms in the machinery and equipment industry are not usually targeted by LBOs for the same reason.

3. Operative Management

As mentioned in the introductory chapter, the PE industry has evolved and over time put more emphasis on operational improvement of portfolio companies and less emphasis on financial leverage to generate value in the course of their transactions. At least in part, this development has been driven by institutional investors, which have included operational value-adding criteria in their selection process to allocate capital to individual PE firms (Taeube et al., 2014). In a study analyzing the impact of VC value-adding measures on fundraising, Cumming et al. (2005) identify specific criteria that influence the success of VC firms to attract capital from institutional investors. His sample includes data on the Australian VC market during the period from 1999-2000. In their analysis, the authors distinguish between the following value-adding measures: (1) financial, (2) administrative, (3) marketing, (4) strategic/management. Their results show that VC funds which provide relatively more financial and strategic/management assistance to their portfolio firms receive more capital commitments. This is in contrast to funds that provide relatively more administrative and marketing assistance, while controlling for VC performance, risk, investment activity as well as management and perfor-

mance fees. Naturally, VC firms that exhibit higher internal rates of return (IRR), higher performance fees, lower management fees and a higher portion of exited investments also receive larger commitments.

But even without this recent push from institutional investors, value-adding activities have always been an important criterion that has distinguished PE from other sources of capital, such as bank loans and public equity (Gompers & Lerner, 2001; Jensen, 1989; Sahlman, 1990). Still, especially in the case of later stage BOs, the recent shift in the investment focus from mature, slow-growing CF driven businesses towards younger, faster-growing businesses demands different angles towards operational management. Whereas a classical LBO model as described by Jensen (1989) exhibits a focus on corporate restructuring and the alignment of interest, many BO investments in the late '90s and '00s exhibit a focus on growth and operational improvement (Alvarez & Jenkins, 2007). An analysis conducted by Achleitner et al. (2010) examines value generation drivers in European BOs in the period from 1991 to 2005. Their sample includes data on 206 BOs in the UK, France, Sweden, Germany, and the Netherlands. They find that leverage contributes around one-third of returns with two-thirds stemming from operational management and market driven valuation effects. In addition the relevance of the leverage effect seems to be more pronounced for large transactions above €100m, whereas in smaller transactions operational management and revenue growth is at the center of attention. As the research presented above indicates, many different drivers influence if, to which extent, and by which measures PE firms engage in operational management at the portfolio company level. Consequently, the following discussion is limited to areas which are particularly important for technology companies under PE ownership. Specifically, the following chapters summarize research on the impact of PE on (1) R&D and innovation, (2) commercialization and entrepreneurial orientation, (3) productivity, efficiency, and asset utilization, and (4) investments in physical assets.

3.1 R&D and Innovation

Both R&D and innovative capabilities are widely regarded as important factors influencing firm competitiveness in the world market. For the purpose of scientific analyses, the R&D effort can be approximated by looking at R&D expenses. Their economic relevance can be characterized by two main features. First, R&D expenses exhibit characteristics of long-run investments (Meulbroek & Mitchell, 1990). Initially they represent expenses whereas the benefits are typically not earned in the near future. Second, R&D expenses are generally associated with a positive contribution to the market value of a firm (Griliches, 1984; Hall & Oriani, 2006; Oriani & Sobrero, 2003).

Closely linked with R&D efforts, innovation is typically assessed by examining the number of new patents issued, as well as the citations received by each patent. The use of patent citations as a proxy for the economic importance of the subject patents is wide-spread in academic research. The use of patent citations is founded, among others, on Hall et al. (2005), who investigated the impact of patent citations on the market value of a firm's intangible assets. Their analysis measures the impact of R&D expenses, patents, and patent citations in the US during the period from 1963 to 1995. Specifically, the authors test the impact on three ratios, R&D expenses to book value of assets (R&D Input), the number of patents to R&D expenses (R&D Output), and patent citations to the number of patents (Quality of R&D Output) on Tobin's q. The results of the analysis support the positive impact of all three ratios on the market value of a firm, thereby confirming that the market acknowledges the importance of R&D expenses, the number of patents and patent citations on the future performance of companies. Moreover, the authors find that on average, an additional citation per patent increases the market value by 3%. Overall, despite having shortcomings (e.g. due to the protection of innovations through trade secrets instead of patents), several publications have shown that the number of new patents issued combined with the number of citations as a proxy for patent quality represents a good indication of a firm's innovative and technological capabilities (Bottazzi & Peri, 2007; Hall et al., 2005; Trajtenberg, 2001).

Based on the economic relevance of patent data, Kortum and Lerner (2000) published a paper discussing the impact of VC on patented inventions in the U.S. In their work covering the time period from 1965 to 1992, the authors find that VC investment activity is associated with significant increases in patenting activity. The analysis estimates that while VC investments amount to less than 3% of the volume of capital spent by industrial (corporate) R&D, the contribution of VC to industrial innovation is around 8% for the same time period. Stated another way, one dollar of VC capital is as effective

in spurring innovation (as measured by patents granted) as three dollars spent by corporate R&D. Similarly, Tykvová (2000) also finds a positive relation between VC investments and the number of patents issued in the German market. Following a detailed case study analysis of two VC backed companies, Bruining and Wright (2008) find evidence of both increased incremental as well as strategic innovation.

Building on the work performed by Kortum and Lerner, Hirukawa and Ueda (2011) address the causality between VC investments and innovation. Specifically, they investigate whether innovations follow VC investments (VC-First) or VC investments follow innovations (Innovation-First). In their study covering U.S. data on 19 industries from 1968 to 2001, the authors measure innovation using growth in total factor productivity as well as patent counts. The rationale behind this definition being that total factor productivity growth captures the adoption of new technologies, whereas patent count captures the generation of new ideas-both of which are important factors to innovation. The authors find support for the Innovation-First thesis, constituted by a significant relation between total factor productivity growth and VC investment. They find little support for the VC-First thesis. Results from other studies also suggest that VCs invest in already innovative firms rather than the other way round (Hellmann & Puri, 2000; Engel & Keilbach, 2007; Caselli, Gatti, & Perrini, 2009).

Drawing on both the work of Kortum and Lerner as well as of Hirukawa and Ueda, Popov and Roosenboom (2012) analyze the impact of VC relative to corporate R&D on patent issues for a sample of 11 manufacturing industries in 21 European countries. Overall, their results show weaker support for the thesis that VC investments contribute comparatively more to innovative output compared to corporate R&D. In fact, the authors find significant contributions of European VCs only in countries which have a high VC propensity (measured by a VC to corporate R&D ratio of at least 3.9%). Moreover, they find the impact of VC on innovation is relatively more pronounced in countries that exhibit welcoming tax and regulatory regimes for VC as well as lower barriers to entrepreneurship.

As shown by studies mentioned above, a lot of research has been dedicated to analyzing the impact of relatively early stage VC investments on innovation, whereas research on later stage BO activity on innovation is less numerous or typically focusses on the relationship between R&D and financial leverage (see excerpt below). In one of the comparatively few studies on this topic, Green (1992) finds no support that the changes in ownership structure following a PE transaction trigger more innovative behavior and encourage owners to seek new innovative opportunities in his study of 30 UK PE investments during the '80s and early '90s. In a more recent study, Lerner et al. (2011) analyze the investment in long-run innovative capabilities by PE firms using a sample of 472 U.S. companies that were involved in a PE transaction from 1980 to 2005. In their sample, they specifically exclude any type of PE transaction that does not exhibits "textbook" BO characteristics such as early stage VC as well as private investments in public entities (PIPE) transactions, and therefore provide a very valuable assessment of BO specific investment behavior. In addition, the time period covered in the investigation stretches in the '00s and therefore includes characteristics of more recent PE transactions. In their analysis, the authors examine patenting behavior of firms three years prior and five years after being involved in a PE transaction. They find that after the PE investment, the quality of the patents and their economic impact increases as measured by the number of patent citations. They also find that the level of patenting remains unchanged following the PE transaction. In addition, their analysis shows that relatively more patents are issued in the core competencies of the firm leading to more concentrated patent and technology portfolio. Overall, their findings suggest that there is no evidence of reduced long-run investments in innovative capabilities among firms involved in a PE transaction. Instead, they argue that PE investments are more likely associated with refocusing on a firm's innovative capabilities.

Ferreira et al. (2010) provide a model to analyze, to which extent the form of equity finance (public or private) influences managers' incentive to engage in innovative projects. Their model suggests that "it is optimal to go public when firms wish to exploit the current technology and to go private when firms wish to explore new ideas." According to the authors, the option to choose an early exit in the case of bad news in private firms makes insiders more tolerant for failures. In contrast, in public firms, bad news are quickly reflected in the market value of the firm, making an early exit by insiders unprofitable. These circumstances result in private firm managers pursuing innovative but riskier projects, whereas public firm managers are more likely to pur-

sue conventional projects to cash in early once the good news spreads out. Implications that can be derived from the model are: (1) Through the decision to take a company private, PE investments can have a direct impact on innovative behavior, and (2) the optimal structure of ownership should evolve with the corporate life cycle from private in the early and growth phases to public in the later phases of the life cycle, and/or returning private during a restructuring phase.

There is also evidence that some governmental programs of establishing a VC and BO environment to fund high-technology firms in countries that don't exhibit a large PE community can be successful. Analyzing the properties of the Australian Innovation Investment Fund (IIF), Cumming (2007) finds that compared to commercial PE firms, the IIF is 34% more likely to finance companies in the biotech industry, 17% more likely to finance companies in the information technology industry, and 14% more likely to finance companies in the medical industry. He also shows that the activity in high-technology industries does not come at the cost of performance. Exit performance of the IIF is not statistically different from commercial PE firms.

3.2 Excerpt: Impact of corporate restructuring/debt/leverage on R&D and Innovation

As mentioned before, many later stage PE transactions at least in part incorporate a restructuring component that is associated with the operational improvement of the portfolio company. In this context, the question arises as to whether the restructuring is impacting investments in R&D and long-term investment projects in general. In a study of around 2,500 U.S. manufacturing firms during the period from 1959 to 1987, Hall (1990) analyzes the impact of takeovers, LBOs, and increases in debt levels on R&D spending. He finds that takeovers and LBOs cannot generally be attributed to lowering R&D spending. In this regard, Hall's results are in line with Lichtenberg and Siegel (1990), who find no evidence of reduced R&D expenses following a buyout. In their sample, R&D intensity of U.S. firms involved in a PE transaction increased at least as much as the non-PE owned peers during the time period from 1978 to 1986. However, Hall also finds that increasing debt levels can have a significant negative effect on R&D spending. In his sample, firms that exhibited a materially higher fraction of debt after the transaction than before the transaction experienced a decline of the mean R&D intensity by 0.8ppts (from a mean of 3.4% to a mean of 2.6%). In a follow-up study, Hall (1992) provides evidence that liquidity constraints are a likely contributor to the negative relationship between financial leverage and R&D expenditures. In addition, he observes that R&D intensive firms don't generally favor debt as a form of finance.

The results find support in the context of an earlier study conducted by Long and Malitz (1985). In their work, they analyze the impact of financial leverage on the investment behavior of 545 U.S. firms in a cross-sectional panel covering the years 1978-1980. The authors compare financials leverage to investment opportunities in intangible assets (as measured by R&D and advertising expenditures) and tangible assets (as measure by capital expenditures (CAPEX)). They find that investments in tangible assets – while risky (i.e. capital intensive) – are observable and therefore can support higher financial leverage. In contrast, the riskiness of investments in intangible assets is not readily assessable by outsiders, thereby limiting the availability of debt, and consequently the suitability of high financial leverage. The authors conclude that "while the availability of internal funds may be the most important determinant of whether or not a firm seeks external sources of funds, the moral hazard problem can still explain the choice of debt or equity."

Focusing specifically on small and medium sized firms in several high-technology industries, Himmelberg and Petersen (1994) examine the effects of the availability of internal finance on R&D, as well as on investments in physical assets. Their sample includes data on 179 U.S. small and medium sized companies (SMEs) in the time period from 1983 to 1987. They find that cash-flow as a measure of internal finance has a substantial effect on R&D investments for SME companies. The effect is also prevalent for investments in physical assets, but less significant in magnitude. Among the external sources of capital to finance R&D and innovation, the authors state that although VC is more suited to overcome the hurdles associated with information asymmetries and adverse selection, VC capital is expensive (Sahlman, 1990) and only available for a small fraction of SMEs (Acs & Audretsch, 1988; Barry, Muscarella, Peavy Iii, & Vetsuypens, 1990).

Drawing on the role of VC in funding R&D, Hall and Lerner (2009) examine the funding gap that presents itself when R&D projects are required to be financed

by sources of capital outside of the firm undertaking the actual R&D project. That is, the authors focus on financial market reasons for underinvestment in R&D as opposed to intellectual property reasons associated with the harvesting of gains from R&D. In their paper, the authors argue that for small innovative firms the financial market reasons for underinvestment can only partly be mitigated by the presence of VCs. Among the reasons for the limited effect of VC are: (1) VC investors tend to focus only on selective industries at one point in time, (2) In order to be able to realize certain performance targets, VC investors require a thick exit market in small and new firm stocks, (3) Establishing a new VC environment in an economy is difficult, since it requires the presence of institutional investors, experienced VC firms and functioning exit markets (e.g. IPO markets).

Analyzing a panel of 11,125 U.S. firms during the period from 1974 to 2000, Atanassov et al. (2007) investigate the impact of the type of financing on a firm's innovativeness as measured by the number and quality of patents. Controlling for R&D expenses, the measure can be interpreted as a proxy of the productivity of corporate research, depending on the sources of finance received. Their results show that capital inflows through arm's length financing (equity and public debt) lead to significantly increased innovative activities. In contrast, capital inflows through bank based financing (loans) exhibit no such impact on innovative activities. The authors argue that banks are often not able to correctly assess the potential of novel technologies and discourage investments in innovative projects. The results of the study suggest that equity based economies such as the U.S. or the UK clearly benefit from the existence of a well-developed PE community. Nevertheless, the transferability of the results to bank based economies such as Germany or Japan cannot be taken as given. Still, Acharya and Subramanian (2009) empirically demonstrate that innovation is more prevalent in countries with debtor-friendly bankruptcy codes (such as the U.S.) vs. countries with more creditor friendly bankruptcy codes (such as Germany). Using time-series changes within countries and changes across countries of patent data and bankruptcy codes, Acharya and Subramanian find that "creditor-friendly codes lead to a lower absolute level of innovation by firms, as well as relatively lower innovation by firms in technologically innovative industries."

3.3 Commercialization and Entrepreneurial Orientation

Following up on the impact of LBOs on target firms propensity to engage in innovation and new ventures, Zahra (1995) investigates the relationship between ownership chances and corporate entrepreneurship. From his sample of 47 U.S. LBOs, he concludes that although overall R&D spending did not change materially, the companies placed greater emphasis on the commercialization of technologies and on engaging in new ventures following the LBO transaction. In addition, quality and size of the R&D departments were also increased. As introduced by Zahra, the impact of PE on commercialization can be associated with the impact of PE on entrepreneurship and more specifically with EO within the target firm (Bruining & Wright, 2008). According to Lumpkin and Dess (1996), EO can be grouped into five dimensions comprised of (1) innovativeness, (2) proactiveness, (3) competitive aggressiveness, (4) risk taking, and (5) autonomy. In their paper the authors define the five dimensions. (1) Innovativeness is connected with supporting creative processes that yield novel products, services or technologies. (2) Proactiveness is defined as seizing new opportunities and introducing products ahead of the competition as well as eliminating declining business segments. (3) Competitive aggressiveness is associated with the ambition to outperform company peers in the relevant marketplace. (4) Risk taking predominately pertains to the propensity to make large and risky resource allocations. (5) Finally, autonomy represents the degree to which individuals or teams are free to act independently and implement actions based on their own ideas.

Utilizing the EO framework in a detailed case study of two VC backed transactions, Bruining and Wright (2008) find that entrepreneurial orientation of the target firm seems to progress significantly following the VC investment. In all cases, considerable focus on improving commercialization, evidenced by increased competitive aggressiveness, can be observed. Further examples that can be associated with other EO dimensions such as proactiveness and autonomy include introducing feedback loops to incorporate product ideas from customers/industry participants, actively seeking attractive niche markets for current product or variants of current products, and reducing time-to-market and competitive pricing of new product introductions. The findings can be interpreted in the light of studies conducted by Jovanovic and Rousseau (2002) which examine the influence of corporate takeovers on the diffu-

sion of new technologies. In their analysis, the authors compare to periods of the U.S. economy marked by significant technological progress: The spread of electricity and the internal combustion engine from 1890 to 1930 and the diffusion of information technologies in the period from 1971 to 2001. They find that in the periods under consideration, "takeovers have played a major role in speeding up the diffusion of new technology." In line with this finding, Hellmann and Puri (2000) provide evidence that "VC is associated with a significant reduction in the time to bring a product to market".

In a recent study, Bruining et. al (2013) investigate the impact of PE ownership on entrepreneurial activities using a framework of management practices developed by Stevenson and Gumpert (1985) and operationalized by Brown et al. (2001). In this framework, management practices are grouped into the six dimensions. (1) strategic orientation, (2) resource orientation, (3) management structure, (4) reward philosophy, (5) growth orientation, and (6) entrepreneurial culture. Differences in management practices among firms can be attributed to whether a dimension leans more towards an entrepreneurial focus or an administrative focus. Examining changes in management practices following a BO, Bruining et. al investigate a sample collected through surveying 108 CEOs of Dutch firms that were involved in a BO in the period from 1996 to 2004. They find that four of the six categories change towards an entrepreneurial focus following the BO transaction. Namely, strategic orientation, resource orientation, reward philosophy, and growth orientation. In economic terms, the change represents a shift towards a strategic direction which is driven by the recognition of opportunities in small steps with minimal commitment of resources (as opposed to driven by controlled resources in a single step), an episodic use or rent of required resources (as opposed to outright ownership), a reward philosophy that emphasizes value creation (as opposed to responsibility and seniority) as well as the acceptation of risk to realize rapid growth (as opposed to slow, safe and steady growth). Out of the two remaining dimensions, management structure exhibits no significant change following the PE transactions, whereas entrepreneurial culture evolves towards an administrative focus. That is, instead of a broad search for opportunities, the resources controlled by the firm serve as a basis for the search of opportunities. According to the authors, "buyout firms develop an administrative focus in their culture, showing that controlled resources seem to be the starting point for taking into consideration ideas about opportunities."

Moreover, it can be argued that PE firms influence commercialization through their advisory role which is especially important for investments by VCs in the earlier stages of the corporate life cycle. Analyzing the relationship between VC and their portfolio companies, Gorman and Sahlman (1989) examine the activities of 49 U.S. VCs in 1984. Strategic analysis and advice was named among the more frequent activities which incorporates the identification of new growth opportunities. The role of VC investors extends to structuring the marketing effort of new fast-growing high-technology ventures, for which a potential field of application is provided by Tyebjee et al. (1983) according to the four evolutionary phases of marketing: (1) Entrepreneurial marketing, (2) opportunistic marketing, (3) responsive marketing, and (4) diversified marketing.

3.4 Productivity and Efficiency

In a very comprehensive analysis of the impact of LBOs on total factor productivity involving over 12,000 US manufacturing firms in the period from 1981 to 1986, Lichtenberg and Siegel (1990) find significant productivity growth over a five year period at manufacturing plants involved in an LBO as opposed to non-LBO plants. On average, productivity growth rates are around 14% higher in LBO plants. In addition, the authors find statistically significant personnel reductions at manufacturing firms following the change in ownership via LBO and provide more detailed insight on the nature of the workforce reduction. Whereas white collar jobs were reduced, blue collar jobs remained unchanged, leading to the conclusion that workforce reduction predominately relate to administrative overhead. Focusing explicitly on the longer term effects of BOs, Wright, Wilson, and Robbie (1996) examine a sample of 251 BOs in the UK during the beginning of the UK BO market (1982 to 1984) using accounting information. Their analysis shows that firms involved in a BO exhibit significantly better financial ratios and productivity ratios, especially from year three onwards following the BO. Specifically, the productivity differential between BOs and the control group of non-BOs in the longer term amounts to around 9% on average.

Analyzing a sample of 78 UK MBOs in the machinery and equipment manufacturing industry against a matched sample of 156 control firms during the period

from 1986 to 1997, Amess (2002) measures the impact of MBOs on firm productivity. In his paper, the author captures the effects of MBOs on productivity using three measures: Hicks-neutral productivity, marginal productivity of labor, and marginal productivity of capital. His findings suggest that both Hicks-neutral productivity and marginal productivity of labor improve post BO. However, marginal productivity of capital as measured by fixed assets deteriorates following the BO. The author attributes the later result mainly to the poor malleability of the fixed assets and to fixed asset revaluations within the course of the BO.

Using plant level data, Harris et al. (2005) examine changes in the total factor productivity of 35,752 manufacturing facilities pre- and post-BO in the period from 1994 to 1998. Their analysis shows significant increases in total factor productivity following the BO transaction. Efficiency increases around +71% in the short run and around +90% in the long run. Representative plants under consideration experience reduced output following the BO, yet reduce their personnel comparatively stronger, achieving an overall increased labor and total factor productivity. According to Harris et al., possible explanations for this observation are measures put into place by the new owners or managers to enhance labor intensity of production through outsourcing intermediate goods, services, and materials.

In a study comprising of 5,000 (virtually all) U.S. BO transactions in the time period from 1980 to 2005, Davis et al. (2009) examine the changes in productivity, employment levels, and wages at PE targets compared to other matching firms with similar characteristics. In their sample, they specifically exclude VC investment and focus on later stage BO transactions. The authors measure the impact of the BO transactions on a firm level as well as on a facility level (i.e. plant, office). For the manufacturing subsector, the analysis includes 1,400 firms and around 14,000 facilities. Among the main findings of the study are: First, labor productivity of target firms at the time the transaction is already around 3.8% higher than at comparable firms in the same industry. Two years after the PE transaction, the lead in labor productivity at PE targets increases even further to 5.2%. The authors attribute this increase in labor productivity to the changes within facilities, as well as to changes across facilities within a company. Second, PE portfolio companies are much more likely to close down underperforming facilities as measure by labor productivity compared to their non-PE owned industry peers. Third, both PE owned firms as well as their industry peers both tend to share productivity gains with their employees through increased wages. Still, in line with Bruining et al. (2013) increases are slightly higher for firms under PE ownership.

In a response to the scrutiny of PE following the financial crisis of 2008/2009, Bernstein et al. (2010) examine the impact of PE investment on industry performance. Their sample distinguishes between 20 industries in 26 countries during the time period from 1991 to 2007. Overall, their findings suggest that industries which have received material PE funds in the past have grown more rapidly in terms of productivity and workforce. Above that, the authors find no support for increased cyclicality between industries that have received large PE funds and industries that have received comparatively less PE funds. Their results hold not only for common law countries such as the U.S. and the UK, but also for civil law countries in continental Europe. In addition, the authors find no evidence of reverse causality, i.e. the possibility that the results are driven by the fact that PE firms select to invest only in high-growth industries.

Studying performance, efficiency, and growth implications of different types of PE transactions, Meuleman et al. (2009) analyze 238 UK PE transactions in the period from 1993 to 2003. In their study, the authors distinguish between divisional BOs (i.e. spin-offs) and non-divisional BOs. They find that employee growth in divisional BOs is approximately 36% higher than in BOs that do not involve a spin-off. They also find relatively greater efficiency gains in divisional BOs, than in non-divisional BOs but do not find significant differences with respect to profitability. Independent of the type of BO, the authors find that higher PE firm experience does not generate higher profitability and efficiency at the target firm. However, PE firm experience exhibits a significant positive relationship with growth at the target firm following the transaction.

Applying a mix of qualitative and quantitative methods, Bloom et al. (2009) measure management practices of PE owned firms vs. management practices in government, family owned, privately owned, and publicly owned companies using a sample of 4,000 medium-sized manufacturing firms in Asia, Europe, and the U.S. In order to obtain unbiased data, the authors conducted double-blind interviews during which managers of the

firms in the sample are scored by the interviewers using a predefined practice score grid and open ended questions. The scoring result is then compared to performance measures such as productivity, profitability and sales growth. They find that PE-owned firms are better managed than government-owned, family-owned, and privately-owned firms, even after controlling for country, industry, size, and employee skills. PE firms also appear to be slightly better managed than publicly listed firms with dispersed owners, although the results are not statistically significant. In specific, the authors provide evidence that PE owned firms have better people management practices (such as hiring, firing, and promotions) and stronger operational management practices (such as lean manufacturing, continuous improvement, and monitoring).

In an analysis of 1,225 UK BOs covering the period 1980 to 2009, Jelic and Wright (2011) compare operating performance of PE backed firms immediately following the BO and at the point of exit to a control group of non-PE backed peers. Unlike earlier studies, the authors cannot find evidence for the outperformance of PE backed companies; however, they also find no evidence of underperformance compared to industry peers. In terms of exit channels, IPOs seem to be associated with improvements in employment and output, as well as with a lack of improvement with respect to profitability and efficiency. In the case of secondary BOs, initial performance declines in the course of the primary BO and stabilizes during the initial years of the secondary BO. Three years into the secondary BO, profitability and efficiency decreases while employment increases, similar to the development observed in the case of IPOs.

Covering 88 complete LBO investment cases which went from entry to exit during the period from 1999 to 2008, Alperovych et al. (2013) compare post BO efficiency during the first three years following the investment across different vendor sources (such as divisional BO, private BO, secondary BO). The analysis provides evidence that divisional BO and private BO exhibit greater than average efficiencies, whereas secondary BO exhibit below average efficiencies. Moreover, divisional BOs achieve greater efficiency improvements post BO than either private or secondary BOs. The authors also find a positive and significant relationship between PE firm experience and post BO efficiency with most of the efficiency gains happening in the first two years after entry of the PE firm.

3.5 Investments in physical assets

Prior research has provided evidence for a positive relationship between corporate investments (including investments in physical assets) and the availability of internal sources of capital and CF in several different countries such as the U.S. (Fazzari, Hubbard, & Petersen, 1988; Hubbard, 1998), the UK (Devereux & Schiantarelli, 1989), and Japan (Hoshi, Kashyap, & Scharfstein, 1991) among others. Analyzing 76 large U.S. LBOs of public firms conducted during the period from 1980 to 1986, Kaplan (1989) examines changes in operating results three years following the BO. Beyond the observation of increases in earnings before interest, taxes, depreciation, and amortization (EBITDA) and increases in net CF, he also observes decreases in CAPEX at the target firms as measure by the sales to CAPEX ratios. According to the FCF theory presented by Jensen (1986, 1988), public firms targeted by an LBO have been investing in negative NPV projects before the transaction. In this context, decreased CAPEX would represent a reduction in non-profitable investments and therefore improve the profitability of the target firm. More recently, evidence for the presence of overinvestment of FCF is provided by Richardson (2006). His sample includes data on 58,053 U.S. firms in the period from 1988 to 2002. For his analysis based on accounting data, Richardson decomposes total investment expenditures in 2 components: (1) replacement CAPEX, and (2) new investment CAPEX. The latter is again split up into the 2 sub-components (2a) expected investment CAPEX based on firm/industry growth opportunities and capital constraints, and (2b) overinvestment in negative NPV projects. His results show that "overinvestment is concentrated in firms with the highest levels of free CF." On average, firms with positive FCF overinvest around 20% of their FCF. The author also points out that "certain governance structures, such as the presence of activist shareholders, appear to mitigate overinvestment."

In a study of 25 U.S. PE investments in mostly asset heavy manufacturing industries during the 80s, Bull (1989) compares several accounting metrics two years before and two years after a PE transaction. He finds that average CAPEX from T-2 to T-1 decrease by around 25% and again from T-1 to T+1 by around 37%. From T+1 to T+2, average CAPEX increase by around 39%. It is likely that the decline of CAPEX before the PE investment is due to window-dressing of the target company before the transaction to present more impressive

earnings. The further reduction in CAPEX following the PE transaction could present an effort to streamline the company, whereas the following increase in CAPEX could either present (1) the reduction of maintenance backlog from underinvestment and/or (2) additional CAPEX to further growth and increase manufacturing efficiency. Additionally, Green (1992) notes in a study of 30 UK PE investments that the requirement to reduce financial leverage taken on within the scope of the transaction constrains CAPEX until leverage is reduced to industry specific levels. Still, he also finds that due to continuing replacement of CAPEX and increased project upgrades, companies were not "living off their existing capital through failing to reinvest in the business".

Analyzing the changes in accounting metrics of 72 U.S. firms that exhibited a reverse LBO in the time period from 1983 to 1990, Muscarella and Vetsuypens (1990) find a significant reduction in CAPEX compared to the control group not owned by PE. They also find increased production efficiency ratios as evidenced by operating margins, asset utilization and sales per employee. In addition, the authors provide an overview of the most frequently applied strategic and operational changes initiated by the PE firm after taking the company private. The measures include (in order of frequency): changes in product mix, product quality/pricing and customer service (44% of all cases), reorganization of production facilities and asset sales (43% of all cases), acquisitions (25% of all cases) and reductions in production cost (22% of all cases), reorganization of distribution channels (14% of all cases), reductions in personnel (14% of all cases), and productivity increases (10% of all cases). It is important to note that the sample exhibits strong characteristics typically found in restructuring/turnaround cases. This is not surprising as reverse LBOs in the U.S. often act as a form of corporate restructuring.

In a more detailed case study approach of two MBOs backed by PE firms, Bruining and Wright (2008) observe increased investment in production facilities at the expense of workforce. The reduction in workforce could also be observed in a study by Cressy et al. using a sample of 57 UK PE buyouts in the period from 1995-2000 (Cressy, Munari, & Malipiero, 2011). The authors show that during an initial period of rationalization following the buyout, PE portfolio firms exhibit statistically significant reductions in workforce compared to their industry peers. Still, the authors point to the positive relationship between post buyout profitability/ sales-growth and future employment growth, which may be a likely result of the efficiency gains through rationalization and automation.

In one of the more scarce studies using data outside of the U.S. or the UK, Boucly et al. (2011) examine a sample of 839 PE transactions in France during the period 1994 to 2004. They specifically focus on companies in financially constrained industries (Rajan & Zingales, 1998), and study the behavior of companies before and after the PE transaction using accounting data extracted from tax filings. The observations are then compared to a control group of industry peers not involved in a PE deal. With respect to investments in physical assets, their findings suggest a material increase in CAPEX in the years following the transaction which exceeds the industry peers by 24%. Assets at PE targets increase 12% more on average than at industry peers over a four year period following the transaction. In addition, the authors find statistically significant and economically large increases in profitability as well as employment growth (18% above control group) and sales growth (12% above control group).

The authors partly attribute these observations to the fact that PE investors assist target companies overcome credit restrictions observed in capital and credit markets which are smaller and less liquid than the markets in the U.S. or the UK. They also argue that monitoring activities of PE investors reassure banks to provide capital to their portfolio companies at more favorable terms. Findings from other researchers generally support the positive relation between PE involvement and bank loan terms (Citron, Robbie, & Wright, 1997; Ivashina & Kovner, 2011). In addition, reputation and financial expertise of PE investors also help portfolio companies overcome hurdles in the capital sourcing process and therefore gain access to further capital for growth investments. The findings of this study also point to the relevance of the nature of the PE transaction and its consequences. Whereas private-to-private transactions exhibit growth in employment, sales, assets, and profitability, divisional BO of large conglomerates and public-to-private BO lead to increased profitability but not to significant growth.

Similar findings with respect to private-to-private PE transactions have been observed in the UK. In a sample of 266 PE transaction in the period from 1998 to 2007 comprising of 169 private-to-private PE transac-

tions Chung (2009) analyses the impact of the change in ownership on target company characteristics following the transaction. His results implicate that after a LBO, target firms experience significant growth in firm size attributable to investments in fixed assets and to add-on acquisitions. The author concludes that "LBOs can be an important tool for private firms with large current and future growth opportunities, but with investment constraints […] imposed by highly concentrated ownership and the lack of financing."

4. Exit Routes

Ultimately, a PE company relies on profitable exits in order to achieve the returns desired by the PE firm and its investors. In the following chapter, I will therefore summarize findings from literature with respect to three main areas. First I will present research on the prominent PE exit channels and their respective importance. Second, I will elaborate on factors that have been found to determine the profitability of PE funds. Moreover, references with respect to the performance of PE relative to the public markets will be given. Third, I will present findings regarding the probability of default among PE investments and which strategies help PE firms to mitigate default risk.

4.1 Importance of Exit Channels

Among researchers as well as among PE practitioners, exits are frequently ranked according to the following scheme from most desirable to least desirable: IPO, trade sale, secondary BO by another PE firm, buyback on behalf of the entrepreneur, and write off (see for instance Ali-Yrkkö, Hyytinen, & Liukkonen, 2001; Cumming et al., 2005).

Analyzing IPOs from the perspective of IPO investors, Barry et al. (1990) examine a sample of 433 VC backed IPOs during the period from 1978 to 1987. In their paper, the authors provide a breakdown of industries most frequently experiencing IPOs backed by VC during the time period under consideration. These industries include: business services (21.8%), industrial/commercial machinery and computer equipment (18.9%), electronic equipment except computers (15.5%), and measuring, analyzing, and controlling instruments (7.6%). Among other results, the authors provide evidence that VC monitoring activities are valued by capital markets. Compared to their non-VC backed peers, VC backed IPOs exhibit significantly lower underpricings.

Although a majority of exits are conducted through a trade-sale (Kaplan & Strömberg, 2009), research suggests that for VC investors the possibility of an IPO is important when investing in a certain industry/market. Within the scope of analyzing VC financing of R&D intensive firms, Hall and Lerner (2009) note that the existence of an IPO exit route, as represented by a thick public market for high-technology stocks, limits the suitability of VCs to address the often quoted "funding gap" for innovative new companies. Similar evidence is provided by Hargadon and Kenney (2012), who provide evidence that part of the difficulties of VC investors investing in the clean technology sector are attributable to a lack of lucrative IPO exit routes.

In his analysis of 433 U.S. VC firms, Gompers (1996) underpins the importance which VC firms attribute to the IPO as an exit route. In his analysis, he finds that in order to establish a reputation among investors, young VC firms more frequently rush portfolio companies to an IPO (as measured by the age of the company at the time of the IPO and the relative IPO underpricing) compared to the more established VC firms. Examining feedback mechanisms between VC reputation, successful VC exits and future fundraising and investing, Ali-Yrkkö et al. (2001) find supporting evidence for findings yielded by Gompers. In their analysis of 30 Finnish VC firms and 630 portfolio companies, the authors confirm that IPOs and trade-sales exhibit a strong influence on future fundraising as well as on investment activity by VC in certain industries. According to responses from VC firms, the decision to exit via IPO or trade-sale in their sample is strongly affected by three factors: (1) the current condition of the public equity market, (2) the portfolio company's future profitability, and (3) the portfolio company's growth prospects. An analysis conducted by Balboa and Marti (2007) for the Spanish market extends the importance of IPOs and trade-sales to the general PE universe. Examining 101 Spanish PE firms (approximately 86% of the total population), the authors find a positive and significant relationship between PE firm reputation, future PE fundraising and the share of portfolio companies exited through an IPO or trade-sale. The value of the IPO to firm owners is also confirmed by a study conducted by Mantecon and Thistle (2011). In their study, the authors examine the IPO decision by analyzing 224 companies that filed for an IPO in the period from 1996 to 2008. Among other analyses, the authors then compare companies that withdrew their IPO before being acquired by another firm with those companies which retained

their IPO option after being acquired by another firm. The authors find that the option to go public led to an average selling price of $1.11 compared to a selling price of $0.54 of those companies which withdrew their IPO.

Despite the perceived importance of IPOs, recent research suggests that the relevance of IPOs as an exit route has decreased significantly during the last 40 years. In a very comprehensive analysis on global as well as U.S. PE investments during the period from 1970 to 2007, Kaplan and Strömberg (2009) illustrate this decline. Whereas IPOs accounted for around 28% of all exits from 1970 to 1984, their share decline to 11% from 1995 to 1999, and finally to 1% from 2006 to 2007. During the whole period under consideration, IPOs only account for around 14% of all PE exits. Unsurprisingly, the most frequently used exit route with around 38% of all exits from 1970 to 2007 is the trade-sale of a portfolio company to a strategic (corporate) investor. The share of trade-sales stays quite stable during the whole observation period and ranges from 31% (1970 to 1984) to 40% (1995 to 1999 and 2003 to 2005). Although the secondary trade-sale to another financial investor does not rank very high in the perception of many PE investors, this exit channel has gained importance over time. Secondary trade-sales have increased significantly from 5% from 1970 to 1984, to a peak of 31% from 2003 to 2005. Overall, secondary BOs account for around 24% of all exits during the time period under consideration.

4.2 Returns to Investors

One of the main areas of research in the field of PE has been concerned with the measurement of PE returns and their comparison with other asset classes such as public equity (Chen, Baierl, & Kaplan, 2002; Cochrane, 2005; Hwang, Quigley, & Woodward, 2005; Moskowitz & Vissing-Jørgensen, 2002). As indicated in the previous chapter, several researchers have confirmed that the performance of PE funds is among the most important determinants that influence the success of future fundraising activities (Black & Gilson, 1998; Gompers, 1996; Gompers & Lerner, 1998; Jeng & Wells, 2000). Notwithstanding their importance, measuring returns for PE funds is fraught with considerable difficulties due to a number of biases such as sample selection bias, survivorship bias, self-reporting bias, and self-valuation bias among others. Methods for addressing those biases and measuring returns and risks of PE funds are presented by Phalippou and Gottschalg (2009) and Driessen et al. (2012). Still, returns in the PE industry are far from uniform and differ widely depending on a number of criteria including (1) the timing of the fundraising, (2) the stage of investments, (3) the characteristics of the PE fund, (4) the type of limited partners who invest in PE funds, and (5) the exit channel.

In a study of U.S. PE investments including both VC and BO funds, Kaplan and Schoar (2005) calculate and compare fund returns to returns from the public market (as measured by the S&P500) during the period from 1980 to 2001. The authors perform their main analysis using data consisting of 746 funds that have been largely liquidated. Among other results, the authors show that performance of VC funds on aggregate underperformed the public markets during the '80s, whereas BO funds on aggregate outperformed the public markets during the same period. In the '90s, this trend reversed with VC funds outperforming the public markets on aggregate and BO funds underperforming the public markets on aggregate. More recently, Guo et al. (2011) address the performance development of LBO funds over time in their study focusing on value creation drivers in the PE industry. Their sample includes data on 192 LBOs during the period from 1990 to 2006. They find that the impact of LBOs on the profitability of target firms and consequently returns to investors have declined in the recent wave of LBOs when compared to LBOs in the '80s. In addition to the variation over time, academic literature as well as industry evidence suggests that PE performance is related to the timing of the fundraising of an individual PE firm relative to its industry peers. PE funds raised in boom times seem to be less likely to achieve above-average returns (Kaplan & Schoar, 2005; Wright et al., 2009). The effect may be attributed to the fact that in the case of multiple successful fundraisings in the industry, more money is chasing the deals available in the market which drives up prices and lowers returns to investors (Diller & Kaserer, 2009; Ljungqvist & Richardson, 2003).

In addition to the timing of the fundraising, the focus on specific stages in the corporate life cycle – VC in the early phases and BOs in the later stages – also has been shown to be an influencing factor on the performance that investors can expect from a PE fund. However, evidence from literature is mixed as to which investment model, VC or BO, outperformed the other. The relative performance strongly varies depending on the period of time under consideration, with VC outperforming BO in certain years and vice versa. Building on detailed

cash flow based data received from a large limited partner in PE funds, Ljungqvist and Richardson (2003) examine returns to U.S. VC and BO funds during the period from 1981 to 2001. In their analysis using individual cash flows to portfolio firms, management fees to PE fund managers as well as capital gains distributions to investors, the authors specifically focus on mature PE funds that exhibit a vintage year from 1981 to 1993. For this period, VC funds with an average return of 14% (25th percentile: 7%; 75th percentile 27%) underperformed BO funds with average returns of 22% (25th percentile: 10%; 75th percentile 28%). The authors also find during the average 10 year life span of a fund, the IRR of the average PE fund is negative until the 8th year at which time it turns positive.

In their analysis of 746 PE funds, Kaplan and Schoar (2005) find confirming evidence with respect to the relative outperformance of BO against VC. In the period from 1980 to 2001, VC fund returns average 17% (25th percentile: 3%; 75th percentile 19%) whereas BO fund returns average 19% (25th percentile: 6%; 75th percentile 24%). Drawing on data for US VC and BO funds during the period from 1980 to 2007, Ewens et al. (2013) find a slight outperformance of VC over BO funds, albeit at a higher risk (as measured by VC beta of 1.24 vs. BO beta of 0.72). In their sample comprising of 741 BO and 1040 VC funds, the authors calculate average VC returns at 15% and average BO returns at 14%. In addition, Ewens et al. suggest that while BO funds were able to outperform their benchmark (as measured by alpha of 4%), VC performed similar to their benchmark (as measured by alpha of 0%).

The considerable dispersion between PE funds as evidenced by the range of returns from the 25th percentile to the 75th percentile – even within the VC and BO categories – highlights the importance of the PE firm characteristics for fund performance. Unlike the situation in the public equity markets, where returns from mutual fund managers net of fees are not persistent, evidence from literature suggests that past performance is indicative of future performance in the PE market (Phalippou & Gottschalg, 2009; Wright et al., 2009). In their analysis of U.S. PE funds covering the years 1980 to 2001, Kaplan and Schoar (2005) point to the importance of individual general partners at the PE funds: "General partners whose funds outperform the industry in one fund are likely to outperform the industry in the next and vice versa." Following an approach frequently applied in the mutual fund industry in which returns are attributed to different areas such as security selection and market timing, Schmidt et al. (2006) examine a sample of 70 European PE funds in the period from 1971 to 1998. In their analysis, the authors focus on mature VC and BO funds in order to ensure an accurate performance assessment. The results provide evidence that market timing skills are important for VC funds, whereas BO fund returns are not significantly driven by market timing. Instead, in line with Kaplan and Schoar, returns from BO funds are positively related with the experience of general partners at BO funds. Moreover, in an analysis of 777 European PE funds, including both VC and BO funds, for the period 1980-2003 Diller and Kaserer (2009) suggest that both VC and BO returns are positively related with the skills of PE fund managers.

According the research conducted by Lerner et al. (2007), return characteristics of PE funds also vary according to the type of institutional investors that commit capital to PE funds. In their analysis of 838 U.S. PE funds raised during the period from 1991 to 1998 and a corresponding number of 352 limited partners (LPs), the authors find that endowments, and to a lesser extent public pension funds, are able to achieve higher returns from PE investments than other institutional investors such as banks, corporate pension funds, and insurance companies. Specifically, (university) endowments' returns from PE funds exceed the average PE return by almost 21%. Lerner et al. argue that the sophistication as well as the differing investment objectives among institutional investors can be a possible reason for the variations in returns. Other possible explanations point to the presence of "sweetheart" deals with strategically important investors, such as university endowments (Wright et al., 2009). In addition to the return variation among institutional investors, Ewens et al. (2013) show that the overall risk and return profiles with respect to target companies are influenced by the relationship between general partners (GPs) and LPs. Their analysis of U.S. PE funds from 1980 to 2007 specifically focuses on the impact of negotiations between GPs and LPs on the consequential negotiations between GP and portfolio company management. According to the authors, since the contract between the GP and LP is closed before the GP invests in any companies, the contract is based on the expected risk in the portfolio as opposed to the realized risk. Therefore, as the GP approaches a potential investment target he values not the expected average risk but the realized risk in the portfolio company, and

consequently requires the portfolio company to compensate for his personal risk. In effect, this mechanism requires the target company to reduce the price more than necessary if it just had to compensate the GP.

Finally, as indicated in chapter 4.1, the exit channels available to PE portfolio companies are often ranked according to their return hierarchy from high to low: IPO, trade sale to a strategic investor, trade sale to a secondary PE investor, trade sale via management buy-out, and write-off (Cumming et al., 2005; Wright et al., 2009). In this context, Jeng & Wells (2000) analyze VC investments in 21 countries during the period from 1986 to 1995. Their analysis shows a significant positive relationship between IPOs and VC investments. After assessing the impact of reverse causality, the regression results show that "IPOs are the strongest driver of VC investing".

Conversely, Black and Gilson (1998) analyze IPOs from the viewpoint of the portfolio company within the scope of comparing bank- and stock market-centered financial markets. In their analysis, they link the comparatively greater presence of VC in a stock market centered financial market to the market for corporate control associated with IPOs. The latter provides the VC and its LPs with a lucrative exit opportunity, which enables the portfolio company entrepreneur to regain control over her company. Still, analysis conducted by Hege et al. (2009) suggest that the performance gap observed between U.S. and European VCs cannot be fully explained by the differences in public equity market vitality between the two regions. Instead, the authors attribute the relatively worse performance of European VC mostly to the share of poorly performing companies. Studying performance drivers of PE transactions in the UK during the period from 1995 to 2004, Valkama, Maula, Nikoskelainen, and Wright (2013) examine the influence of deal- and industry-factors and macroeconomic factors on PE returns. The authors show that on a deal level, the use of leverage has a positive and significant impact on PE returns. In addition, other deal specific factors, such as transaction size and add-on acquisitions, impact PE performance. Moreover, the authors find that industry growth is a particular strong driver of PE returns from a macroeconomic perspective.

4.3 Defaults

Dimov and Sheperd (2005) examine the relationship between human capital at the VC firm level and the performance at the portfolio company level. Specifically, Dimov and Sheperd examine to which degree general human capital (as measured by education and experience in science and humanities) and specific human capital (as measured by education and experience in economics, law, finance, and consulting) at the VC firm impact the share of portfolio companies that go public (home run) and the share of portfolio companies that go bankrupt (strike out). They measure the effects with a sample of 112 U.S. VC firms and 749 VC firm top management members that have made investments in the wireless communication industry. Among other results, the authors find that VC firms with higher proportions of specific human capital have a lower share of companies in their portfolio that go bankrupt. Conversely, VC firms with a higher proportion of general human capital have a higher share of companies in their portfolio that go bankrupt.

Empirical research also suggests that a more diverse VC universe reduces the failure rate of VC portfolio companies. Studying the failure rate of 200 U.S. VC portfolio firms during the period from 1990-2001, Dimov and de Clercq (2006) find that specialization of VC in a certain development stage as well as syndication among VC firms significantly reduce the probability of default among portfolio companies. Since both specialization and syndication of VCs are more likely to occur if the number of active VCs in a certain region is higher, a diverse and thick VC environment strengthens the overall resilience of VC portfolio companies. Apart from the management team at the VC firm and the VC landscape, the overall performance of the public equity market has also been observed to impact the probability write-offs at the portfolio company level. In his analysis of 280 Australian PE firms and 845 portfolio companies during the period from 1982 to 2005, Cumming (2007) finds that the probability of write-offs at the portfolio company level are reduced by 2.5% if the overall capital market (as measured by the Australian MSCI Index) increases by 50% over the holding period. Additionally, the likelihood of an IPO increases by 4% given the same 50% increase of the MSCI.

In their analysis of global PE activity in the period from 1970 to 2007, Kaplan and Strömberg (2009) address the question of whether the high levels of debt associated with many PE transactions result in a higher frequency of bankruptcies among PE portfolio companies. The authors approximate the average default rate among

PE portfolio companies at 1.2% per annum compared to a slightly higher annual default rate of 1.6% for all U.S. corporate bond issuers in the same period. However, evidence from research on large public-to-private PE transactions suggests that the default rate among this specific type of transactions might be higher. For instance, building on data comprising of public-to-private LBOs during the '80s and early '90s, Andrade and Kaplan find that 31 of the 136 LBOs went bankrupt - a default rate of 23%. Still, on aggregate, the default rate of all PE transaction in the almost 40 years covered by Kaplan and Strömberg amounts to 6%. Moreover, the default rate has generally been declining over time; from 7% in the period from 1970 to 1984 to 3% in the period from 2003 to 2007, with a slight setback in the period from 1995 to 1999 (8%).

Similarly, Tykvová and Borell (2012) examine the question of whether the financial distress risk of a portfolio company increases following a BO. In their analysis, the authors build on data covering 1,842 BOs in 15 European countries during the period from 2000 to 2008. Tykvová and Borell find that PE firms specifically target companies which are less financially distressed than their industry peers. They also find that after the BO transaction, financial distress risk at the target firm increases. Still, default rates among BO targets are not significantly different from the control group of non-BO firms. Moreover, when the BO is conducted by an experienced PE fund (as measured by the number of transactions prior to the subject BO), default rates are in fact lower than those experienced at the control group.

5. Conclusions

The evidence presented by the body of literature mentioned above indicates that significant aspects of the PE business model went through a dynamic development during the last 30 years. The adaptation of PE firm behavior to the business environment and macroeconomic developments affects all stages of the PE investment cycle, from screening and selection, operational management of portfolio companies to targeting specific exit routes. When screening for potential investment in entrepreneurial firms, literature suggest that VC often put relatively more emphasis on reducing risk than they put on return opportunities. In practice, the risk weighted approach is characterized by the strong influence attributed to the entrepreneur and the management team in the decision making process of the VC as opposed to market and product specific factors. Moreover, literature shows that VCs with a technology and product centered investment approach are frequently associated with more early stage heavy investments which in turn are more risky than investments in later stages of the business life cycle. Put another way, the earlier the focus of the VC company in the business life cycle, the more likely it is that the VC emphasizes technology/product related criteria in their selection process. Still, evidence from literature suggests that despite being sophisticated investors, new high tech and asset heavy industries are challenging for VCs. Historically, VCs have been successful by investing in software and IT related business models which are particularly well suited for the VC business model due to the low capital requirements and short holding periods. Asset and technology heavy business models demand for larger amounts of capital, specific market/technology know-how, and longer holding periods, which typically exceed the capacity of a single VC. Consequently, syndication and co-investments are important methods for VCs to overcome some of these limitations.

The dynamic development of the PE investment model is probably most prominent with respect to the operational management of portfolio companies and here specifically for later stage BOs. Whereas in the '80s, financial leverage and changes in corporate governance and incentive structure were the most important operational value drivers, the situation has changed. Successively, relatively more importance is attributed to operational improvements of the portfolio companies regarding strategic development, productivity, and distributions/sales among others. This shift is partly attributable to a more mature PE industry in which more PE firms are searching for investment opportunities and competition among PE firms for attractive deals is strong. Overall, the typical (L)BO model experienced a gradual shift towards more growth PE oriented investment and management criteria. The evidence from literature is supported by the fact that many large BO firms, such as KKR, Carlyle, and Blackstone, have established management consulting branches within their organization which are specifically occupied with leveraging operational potential within the portfolio companies.

Nevertheless, there are also indications that some of the prejudices which have been attributed to PE firms are in fact warranted, although the context in which these developments occur is highly important. In particular, it is important to distinguish between PE investments

in profitable, growing companies on the one hand and investments in companies that experience difficulties and/or are in financial distress on the other hand. Many of the prejudices associated with PE investors, such as laying off workers and reducing CAPEX, are frequently associated with restructuring portfolio companies that have previously experienced difficulties. This also pertains to public-to-private BOs, which have been the early focus of researchers. Often, applying much needed changes to the business model (which are hardly possible as a public entity) is the reason behind taking a public company private and making it profitable again in the long term.

In terms of exits routes, evidence from literature shows that the number of IPOs and thus their relevance for PE companies has diminished quite substantially over time, although IPOs are generally considered to be the most profitable exit channel for PE investors. Consequently, the lack of IPOs among PE portfolio companies can be attributed to an increasingly smaller window of opportunity to bring private companies public. This development has implications for policy makers which try to recreate the U.S. VC model and use it as a tool to strengthen innovation and growth of high technology companies. In order for the VC investment model to be successful, several prerequisites are required such as a sufficiently large body of innovative high technology companies as well as local VC firms. According to evidence from research, VC firms are less drivers of innovation but investors in companies which are already innovative. A major contribution of VC lies in the focused approach to drive the commercialization of innovative products into new and existing markets. Ultimately, the performance of VC (and BO) firms is dependent on the presence of accessible exit markets in the form of IPO and trade sale opportunities. As the literature suggests, successful exits are among the most important factors that determine the positive outcome of VC fundraising activities among institutional investors. Consequently, policy measures aimed at establishing a VC culture in countries outside of the US frequently fall short of their goal due to the complexity of the interrelations of the participants in the VC investment model.

A possible avenue for future research in this context could focus on successful PE clusters outside of the U.S. and analyze whether local policy measures and regulatory frameworks contributed to the establishment of a PE industry. Moreover, although some studies in extant literature relate to specific industries or to manufacturing companies in general, relatively little evidence is available that analyses the specific characteristics of PE investments on a more detailed industry level. In this regard, research could provide further insight as to why PE firms frequently focus their investment activity on narrow industrial sectors, and what determines the decision to get active in specific industries.

Moreover, research on PE investments in general and PE investments in technology companies in specific points to the existence of several interrelations between different types of capital along the PE investment model. Specifically, public and private R&D and angel finance contribute to the development of new technologies and consequently to the establishment of companies based on new technologies. The availability of debt determines the amount of capital that can be deployed to leverage a transaction and enhance PE returns, and the activity of the public equity and M&A markets determines exit performance of portfolio companies which in turn influences future PE fundraising. Future research could elaborate on these interrelations in order to provide a better understanding of the consequences associated with shifts in supply and demand among different types of capital.

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Endnotes

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ii. Investor specific criteria include factors such as VC industry focus, VC regional focus, VC company lifecycle, and funding status and/or portfolio related issues among others.

iii. Quote attributed to Arthur Rock, a successful U.S. VC

iv. Tobin's q measures the ratio of the market value of a company's assets to the replacement value of the same assets. It is often referred to as follows: Tobin^' s q= ((Market Value of Equity+Market Value of Liabilities))/

((Book Value of Equity+Book Value of Liabilities))

v. In their study, Cumming et al. used the number of days per month spent with sharing financial, administrative, marketing, and strategic/management expertise by the VC as a proxy of the magnitude of value-adding efforts.

vi. Industries included in this study were comprised of: chemicals and drugs, machinery, electrical equipment and communications, and instruments

vii. Double-blind interviews incorporate two main aspects. First, interviewers are not told anything about the performance of the firm they are interviewing (i.e. interviewers are performance-blind). Second, managers that are interviewed are not told they are being scored (i.e. managers are scoring-blind).

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