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Operating Performance in Private Equity

Is Private Equity a Superior Ownership Model in Creating Operational Value in Norway?

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Abstract

While the net returns provided by Private Equity (PE) funds to its investors is a debated topic in relation to diminishing alpha and justification of fees and other fund expenses, we seek to determine if PE ownership has a positive impact on the operating performance of Norwegian portfolio companies. Additionally, we seek to identify potential operating performance differences between industry specialized and generalist PE managers and between deal types (source of entry). By applying an extensive and unique dataset consisting of 214 Norwegian buyouts occurring between 2000-2015, we find that PE in Norway generates a significantly higher growth in sales and EBITDA compared to companies not backed by PE. We also identify improvements in working capital efficiency. However, we find no evidence of improvements in operating profitability (ROA). Examining the subcomponents of ROA provides some evidence of improvements in asset turnover which are offset by a negative development in margins. Our findings do not support a positive industry specialization effect. Examining deal types, we find evidence of improvements in margins and operating profitability for public buyouts, also relative to private-to-private buyouts. In contrast, private-to-private buyouts appear to be more growth-oriented, clearly outperforming their benchmark in sales growth. The overall findings imply that revenue and EBITDA growth appears to be the main focus and driver behind value creation in Norwegian portfolio companies, rather than cutting costs and focusing on margins. Our findings also suggest that PE ownership provides advantageous differentiated support for growth and expansion buyout candidates (typically private companies) and for margin improvement buyout candidates (typically public companies).

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1. Introduction

Does Private Equity ownership have a positive impact on operating performance? After the Private Equity (PE) industry and LBOs emerged in the late 1970s in the US, the private equity model quickly developed in the UK and further into mainland Europe, including Norway, during the mid- and late-1980s (Wright et al., 1992). Since then, Private Equity in Norway has experienced substantial growth in the number of PE funds, General Partners (GPs) and assets under management (AUM). In 2001, The Norwegian Venture Capital & Private Equity Association (NVCA) and Argentum Fondsinvesteringer was founded[2]. Besides generating a high ROIC, Argentum aims to help stimulate the creation of private equity investment groups in Norway and has been an important contributor to the growth and internationalization of the Norwegian PE market (Hammerich, 2020). In 2018, around 62.500 people worked in 160 Norwegian PE-backed companies, up from 25.000 in 2001, constituting approximately 3.5% of the private sector (NVCA, 2019). In 2019, investments in Norwegian companies by both Norwegian[3] (NOK ~5.0 bn) and foreign PE funds (NOK ~27.0 bn) were NOK 31.3 bn, up from 7.1 bn in 2007 (NVCA, 2019).

While the PE industry in Norway and the Nordics has experienced significant growth since the early 1990s, the competition and committed capital have grown rapidly as well, resulting in increasing buyout multiples. In 2009 the median entry EV/EBITDA multiple for Nordic buyout deals equaled 6.1x and has since increased by 79% to 11.0x in 2019[4] (Argentum, 2020). As it is becoming more challenging to acquire underpriced assets and obtain a multiple expansion supported by leverage, the importance of utilizing operational value levers to generate competitive returns to investors is increasing in the Nordics. A trend that is broadly apparent in the western PE markets as well (Bain & Co, 2019). Thus, as the Private Equity outperformance on fund-level (in terms of gross and net returns to its Limited Partners (LPs)) is a highly debated topic, much due to the risk impact of higher multiples and leverage, the high fee levels, the weaknesses of multiple measurement metrics (such as

[2] NVCA provides comprehensive information about the private equity industry in Norway and Argentum is a Norwegian government owned asset manager that has been dedicated to private equity since it was established.

[3] NVCA defines *Norwegian private equity firm* as a firm with headquarters located in Norway. If the HQ is located outside of Norway it is categorized as a foreign PE firm.

[4] 2019 was the sixth consecutive year that the multiples were rising since 2013 (Argentum, 2020).

the IRR), and asymmetric incentives relative to LPs (see e.g. Phalippou, 2020), this thesis focuses on the underlying operating performance on portfolio company-level. As the operating performance of the portfolio companies has increasingly become a critical factor for PE firms to generate positive alpha returns, we find it interesting and relevant to study the operating performance amongst Norwegian PE-backed companies compared to non-PE backed companies. For the majority of Norwegian portfolio companies, PE capital has been reported to have a positive effect on performance and growth. From 2001-2018, the value creation in portfolio companies, as measured by Menon Economics (2020)[5], has achieved a CAGR of 13%[6]. In 2019, NVCA reported that the total value creation in portfolio companies amounted to NOK 47 bn in 2018, comprising right below 2% of Norway's mainland GDP. However, in order to determine if PE is a superior ownership form in value creation, we need to measure these returns to the returns generated in comparable companies.

Similar to Kaplan (1989), we define operating performance as referring predominately to all measures that increase the cash flow of the portfolio company, namely sales growth, operating income, EBITDA, margin expansion and streamlining of capital. Thus, we will isolate our analysis to each portfolio company's financial accounts to evaluate their performance, disregarding performance on the fund-level. Particularly, we focus on EBITDA/Total Assets (as a proxy for the Return on Assets (ROA)) to measure the change in operating profitability. A further breakdown of ROA will be conducted including metrics depicting the operational efficiency and growth. Furthermore, we analyze the reported accounts between the year prior to PE-entry and the five subsequent years post-buyout, and also include the year prior to exit to assess the changes during the holding period. The development in performance will be benchmarked against a carefully constructed group of companies operating in the same industry at the same time, as well as sharing similarities in terms of size, sales, margins and asset turnover. This is conducted by applying a statistical method called propensity score matching. Additionally, we attempt to address some caveats in the previous research on PE operating performance of reverse causality issues where PE

[5] Measured by Menon Economics as EBITDA plus personnel expenses as a proxy for contribution to GDP.

[6] To make a coarse comparison, the OSE benchmark index shows a CAGR of approximately 8.8% over the same period.

portfolio companies are not randomly chosen, as well as the length of the holding period involved (see e.g. Phalippou (2019) who raises some of these issues).

As there has been conducted limited research on private equity in Norway, our objective with this thesis is to determine whether PE is a superior ownership model in creating operational value. We will do so by applying an extensive dataset comprising 214 portfolio companies acquired between 2000-2015. We will further segment the results to test and understand the relative importance of sector specialization of the GPs and certain deal types. Thus, with our novel and unique dataset, our objective is to explore the relationship between these variables and performance in the Norwegian PE industry.

The paper is organized as follows, we will start by describing the Private Equity market and business model, and important changes since the start of the PE industry in the late 1970s. More specifically, we will explain how a PE fund is usually structured and operates, certain PE deal types, as well as present the main value levers and success factors in PE, and how these levers have developed in importance. Additionally, we will describe the difference between *specialized* and *generalized* fund managers seen in relation to the operating performance. In section 3, we will review the academic literature on value creation in PE by applying a value creation framework similar to Kaplan (1989). Moreover, we will present the empirical research on important structural changes in the PE market related to specific deal types and specialization effects, all in relation to the operating performance. Based on the previous literature we formulate three hypotheses which we present in the beginning of section 4. Further, we present the applied data as well as the empirical method we use in section 4, before we provide the results with a corresponding discussion in section 5, and how the results should be interpreted. Finally, in section 6 we conclude and provide suggestions for further research.

2. The Private Equity Market and Business Model

In this section we will describe the private equity market and provide a brief overview of how the market has changed over time. Further, we assess certain key elements of the PE business model and key levers for value creation. Additionally, we outline the categorization of PE deal types as a part of the business model in terms of company selection upon entry and exit strategy. Lastly, we will provide a discussion of specialized vs. generalized fund managers and how this impacts the level of value creation.

2.1 The Private Equity Market

The private equity market consists of different segments or sub-asset classes that differ depending on the types of companies the GPs invest in. These companies are classified based on the company development stage. More specifically the private equity industry invests in venture capital, (i.e., early stage firms), growth capital, which involves sizable and growing businesses in need of capital, direction and professional ownership and management in order to expand, buyouts, which is referring to mature companies typically with potential to improve their business model and/or competitiveness (commonly referred to as Leveraged Buyouts (LBOs)), and distressed companies, which refers to mature, but unprofitable companies. In our thesis we focus on buyouts and growth capital PE investments, while venture capital is excluded from the analysis as there are very different drivers defining investments in and development of such companies. Hence, we will use the terms buyouts and PE interchangeably when referring to either buyouts (or LBOs) or growth capital investments.

2.1.1 The Global Market Development

Since Private Equity emerged in the late 1970's by the establishment of US and UK PE firms like KKR, Thomas H. Lee Partners, Candover, Forstmann Little, Clayton, Dubilier & Rice and Cinven, the PE market has experienced significant growth in size and scope. Current global AUM in the buyout and growth capital segment has reached $2.8 trillion or nearly 2.7x more than in 2010 (Preqin, 2019). It represents the largest alternative asset segment with 32% dedicated to buyout capital and 11% to growth capital or a total of 43% of total alternative assets, followed by 28% in real assets, 17% in Venture capital/other, and

13% in private debt (Preqin, 2019). Historically, PE has generated high returns, both in absolute terms and relative to public markets which manifests itself in the growth and capital inflows to the asset class. Yet, as the private equity has matured, the degree of outperformance relative to public indices has declined (Harris et al., 2016). It has also become increasingly correlated with public equities (Welsch, 2017). As such, we can observe a declining relative performance in the PE industry as the spread in returns between private and public equities have started to converge, closing a three-decade gap in performance. Moreover, the initial PE boom dominated by so-called public-to-private transactions have fallen out of favor compared to previous levels, replaced by private-to-private buyouts (Næss-Schmidt et al., 2017). At the same time, the relative importance of value levers has changed over the past 40 years. While optimizing the financial structure in portfolio companies and multiple expansion was previously a significant part of PE firms' value creation, this has gradually become less relevant (Harris et al., 2014; Næss-Schmidt et al., 2017). Meanwhile, operating performance and more specifically top line growth levers have increased in importance. This is related to the increasing share of PE investments going into growth industries and a longer PE holding period on average than the earlier buyouts (Døskeland & Strömberg, 2018).

The PE industry has transformed substantially since its introduction in the late 1970s. Similar to other industries generating super profit, more competition will follow, leading to increasing amounts of capital and talent competing for a limited number of high-quality assets. Effectively, the GPs value creation mandate has become more challenging as they depend on finding and exploiting new levers to create value. In particular, finding profitable investments at an attractive price has become a difficult task. A survey by Preqin (2018) shows that the No. 1 source of concern among 70% of GP respondents across the world, is the concern for overheated asset valuation. Over the past two decades, the increased multiples have accentuated the importance of having a more growth and operationally oriented investment thesis for each deal, i.e. a more systematic and operationally focused approach to value creation (Ketels et al., 2019). BCG reports that, on average, around 70% to 80% of value creation from prominent PE firms now stems from EBITDA growth, whereas only 10% to 15% comes from multiples and financial engineering (Ketels et al., 2019). According to Heel & Kehoe (2005), the increasing and intense competition has forced private equity firms to start focusing on creating value in their portfolio firms' operations in order to stay competitive.

In sum, Private equity firms have evolved from focusing on improving the capital structure, increasing the leverage and identifying underpriced deals to encompass enhancements in the operational efficiency (von Laskowski, 2012). The eras of private equity can as such be classified into financial restructuring (exemplified by KKR's famous barbarians at the gate attack on N.J.R Nabisco) to financial engineering powered by high leverage ratios and multiple expansions, to the more operational efficiency focused era (pioneered by PE firms such as Clayton, Dubilier & Rice) to the more growth-oriented type strategies (pioneered by PE firms like General Atlantic). Throughout these eras, enhanced corporate governance has become a key factor as the interplay between the owners, the board and management are critical to effectively execute an operational and growth focused investment thesis.

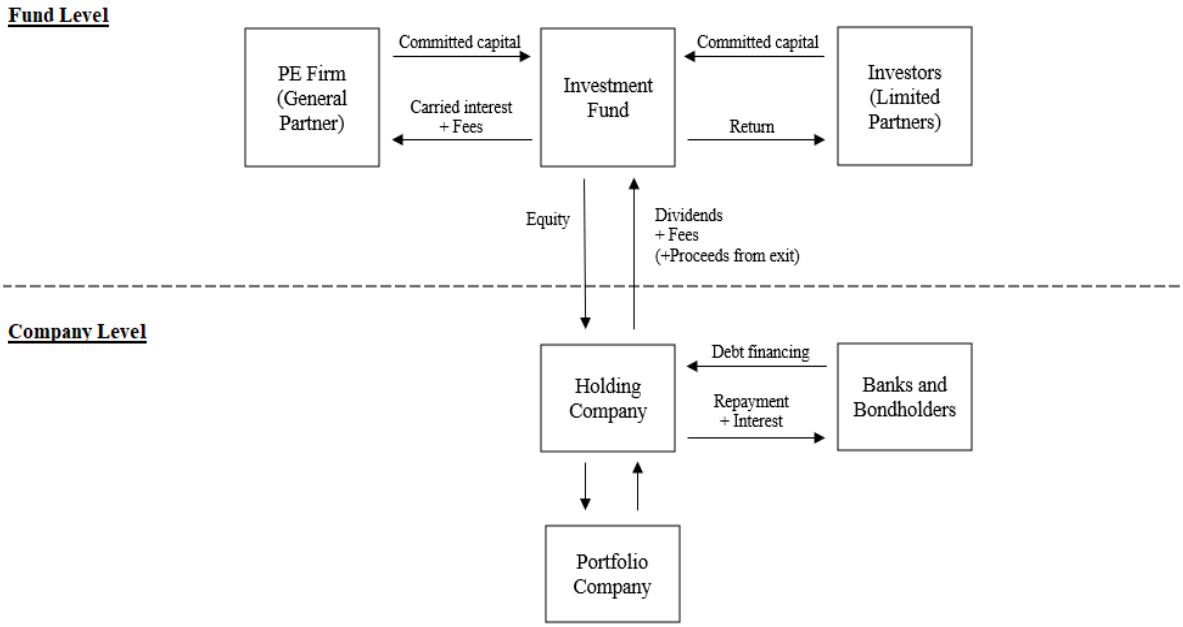
2.2 The Private Equity Business Model

Most PE funds are organized as limited partnerships where the PE fund manager acts as a general partner and manages the fund with full discretion, while the limited partners are the investors providing most of the equity capital[7] (Døskeland & Strömberg, 2018). Typically, each individual fund has a lifespan of 10 years with an option to extend for an additional two to three year upon LPs approval.

Over the first six years (the investment period) after having closed the fund, PE firms invest directly in portfolio companies through the fund (Døskeland & Strömberg, 2018) based on an overall investment thesis, and typically exits the same investments after a two till six year active ownership holding period. As such, the PE model value chain consists of four main steps: (1) fundraising from investors, also referred to as Limited Partners (LPs), (2) screening opportunities and investing by acquiring a large stake of the portfolio companies, (3) managing the portfolio company through active ownership, and lastly, (4) realizing capital gains by exiting (selling) the investment (Gilligan & Wright 2008). Hence, PE investments include elements that would make it difficult to replicate in a public setting (Døskeland & Strömberg, 2018).

[7] Notably, in order to achieve the limited partnership status, the GPs have to provide at least 1 percent of the total capital commitment to the fund, and often invest even more (Døskeland & Strömberg, 2018).

Figure I - PE Firm Structure

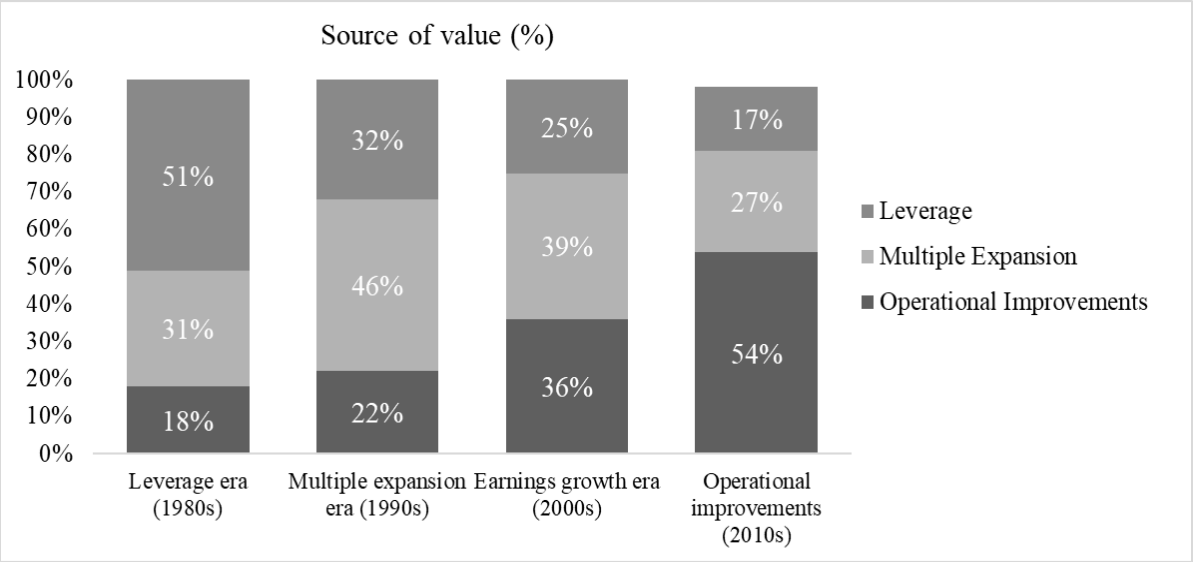


In Figure I we can see a typical overview of how PE firms are usually structured. Before any acquisitions are made by a new fund, a holding company is usually created and funded with equity from the fund, as well as outside debt from banks or debt funds. Thus, on the company level, which we focus on in this thesis, we have the different portfolio companies that have been acquired by the PE fund. The holding company subsequently acquires and holds the portfolio company.

The PE firms target three overall value levers during this process: multiple arbitrage, leverage and operating performance improvements, where the latter lever has become increasingly important over the last two decades (see Figure II).

Reflecting these levers, empirical studies highlight *company selection*, favorable *price to intrinsic value*, *deal structuring* (leverage, shareholder agreements, etc.), *a well prepared and executed exit strategy* and *improving the portfolio company's operating performance* as the critical success factors of the PE business model. These are introduced below. We note that the focus of this thesis is on operational improvements, however, we provide a brief introduction to the other value levers as well (which often are referred to as value *capturing*) for contexture of the anatomy of a typical PE deal and overall value framework.

Figure II – Value Levers: Sources of Value Contribution (%)



(Source: Goldman Sachs, BCG-IESE estimate)

2.2.1 Company Selection

Davis et al. (2019) divides buyouts into four sourcing categories: *public-to-private,* where a quoted company is taken private, *divisional*, which refers to the situation when a division of a company is acquired, *private-to-private*, where an unquoted company is acquired by a private equity firm, and *secondary buyout (SBO)*, where an existing PE portfolio company is bought by another private equity firm. For the PE investment to become a success, the target must be a suitable candidate for PE ownership. PE firms usually identify the portfolio company «candidate» based on specific firm characteristics, driven by the PE manager's strategy and focus. Typical LBO-driven PE firms seek targets with additional borrowing capacity and undervalued assets. Research finds that PE firms select targets that have growing assets, higher return on assets, higher liquidity, but lower market-to-book and leverage ratios (Aslan & Kumar, 2011). Additionally, cash in excess of working capital needs and a strong performance record further increases the capacity for debt. In sum, these factors create leverage opportunities and potential tax benefits from goodwill write-offs and interest payments (DePamphilis, 2014). Furthermore, PE firms prefer targets with a strong and highly motivated management team.

Finally, the business fundamentals of the niche and the target, such as high barriers to entry, stability, limited competition and solid growth and scalability potential of proven and innovative business concepts are important factors assessed in the selection process.

Additionally, the company's financial robustness is a critical factor for success (Oppler & Titman, 1993; Acharya et al., 2009). Moreover, for growth strategies, which have increased in importance over the past two decades, the fragmentation and the presence of scale and skill in an industry niche are defining characteristics.

2.2.2 Price to Intrinsic Value

A second critical success factor to buyouts is paying a price which is favorable to intrinsic value. Empirical research suggests that, whether it's a buyout or another form of acquisition, the acquirer needs to be careful with paying too high of a price for the deal. Overpaying implies that less value is created from the deal (Koller et al., 2010). Additionally, high transaction prices are associated with higher deal leverage and lower buyout fund returns and suggest that acquirers tend to overpay when access to credit is easier (Axelson et al., 2013). This can violate loan covenant restrictions and lead to time consuming and costly renegotiations with the lenders on loan agreement terms (DePamphilis, 2014), and in worst case defaults.

2.2.3 Deal Structuring

Typically, PE funds raise equity at the time they are formed, and raise additional capital when investments are made. This additional capital is usually raised in the form of debt from third parties such as banks (Axelson et al., 2009). The use of debt normally has a lower cost of capital than equity which combined with tax shields reduces the overall capital cost of financing the buyout. The reduction in the weighted average cost of capital (WACC) by incurring a larger amount of debt results in a higher yield to equity. As the debt is paid down, usually with the cash flow from the portfolio company, the value of the equity increases and healthy returns are generated.

Moreover, the LP and GP relationship usually involves full discretion (within the fund mandate often limiting the GP to specific sectors, size, geographic focus, etc.) for the GP to act without consoling with the LP. Normally, any distributions are only made as investments are converted into cash and the LP has no right to demand the GP to sell their investment(s) (Demaria, C., 2015).

2.2.4 The Exit Strategy

Phalippou (2019) lists four possible exit routes (besides bankruptcy). The most prevalent is *trade/strategic sale*, which is a sale to another company (corporate acquirer) in a similar or related industry, mainly motivated by synergies and scale, competition and regulation. Another exit route is a *secondary*, i.e., a sale of the portfolio company to another PE firm[8]. A third exit route is a *dividend recapitalization*, described as a partial exit by having the company borrowing money to pay a large dividend to its shareholders, and the fourth route is an initial public offering, or *IPO*. The latter is also a partial sale because the PE firm retains a meaningful share ownership and control after the IPO before a full sell out is executed (Phalippou, 2019). As of 2009, strategic exits or so-called trade sales, represent 38% of all exits, followed by secondaries occurring in 24% of all exits. The latter has increased considerably over time, while IPOs have decreased (Kaplan & Strömberg, 2009). Moreover, when the economic outlook is uncertain, PE firms prefer strategic exits to IPOs as they can sell their entire stake, whereas IPOs imply lockups that restrict how much and how quickly they can sell (Døskeland & Strömberg, 2018). Additionally, strategic sales imply lower costs than IPOs, which is a costly and time-consuming exit route implying roadshows and considerable underwriting fees (Phalippou, 2019).

Schwienbacher (2005) suggests that there is a positive relationship between the profitability of portfolio companies and the likelihood of going public as these companies are characterized by a convincing equity story and high growth prospects. Giot and Schwienbacher (2007), also identifies IPOs as the exit route with most attractive investment returns. By contrast, secondary buyouts and buybacks are regarded as less preferred as these are correlated with lower investment returns (Schmidt et al., 2010).

In addition to finding the right exit route strategy, an exit requires careful preparation and execution to yield the best results. Typically, the exit process starts two to three years before exit, to position and develop the portfolio company as favorable as possible for the exit itself. Combined, acquiring a company at a favorable price with a later successful exit can result in what is referred to as multiple arbitrage (if the company is sold at a higher multiple on the same income metric as acquired). Hence, by taking advantage of asymmetric

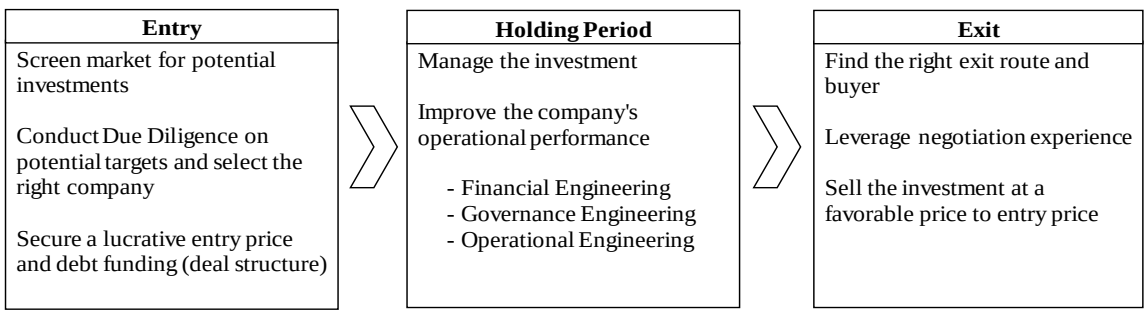
[8] Can also be tertiary and even quaternary buyouts.

information, superior bargaining skills, market timing abilities and an efficient allocation of resources (selling to the right buyer), PE can capture a substantial amount of value. However, as the market has become gradually more competitive and higher-priced, PE has responded by focusing more on the operating performance, i.e. growing the value of the underlying business, as the main value lever (Gompers et al., 2015).

2.2.5 Improving The Portfolio Company's Operating Performance

Improving the portfolio company's operating performance is the fifth critical success factor of successful PE investments and is increasing in importance as the entry and exit markets are becoming increasingly competitive and transparent, reducing the potential for expanding the difference between the exit and entry multiple. PE funds typically employ external or in-house full-time experts who implement a dedicated playbook with initiatives that improve the performance, broadly by applying three overarching sets of changes to the portfolio companies in which they invest. These can be categorized as *financial engineering* (i.e. optimization of the capital structure by improving net working capital levels, moving balance sheet items off the balance sheet such as real estate, capital goods through leasing, outsourcing of fixed asset operations), *governance engineering* (i.e., board composition, focus, management incentives, management team composition), and *operational engineering* (i.e. improving operational efficiency). These mechanisms typically trigger a process leading to significant and rapid changes in the firm's capital structure, assets, organizational structure and the corporate governance regime (Berg & Gottschalg, 2005), and their contribution to value creation are assessed in detail in the literature review. Figure III provides a simplified summary of the value levers in the PE deal process. The entry and exit stages can be described as value-capturing while the ownership is the stage where value is created through improving the operating performance of the company.

Figure III – Value Levers in The PE Deal Process



2.3 Specialized vs Generalist PE Funds

Cressy et al. (2007) argues that there are advantages of being specialized in particular industries or industry stages. A specialist refers to a GP who possesses a high degree of knowledge, experience and networks in an industry at level with, or even superior to, respected industry «insiders». As a result, specialists experience reduced information asymmetries and are expected to know the individual companies' strengths and weaknesses, providing a competitive edge in identifying the most attractive investment candidates (Cressy et al., 2007). In addition, specialists are expected to provide more effective active ownership, thereby adding more value to the portfolio company compared to diversified PE firms. These advantages are in line with research done by Lossen (2007). He finds that specialized PE firms have at least three advantages compared to non-specialized PE firms.

Firstly, specialized PE firms have an information advantage in the screening and pre-investment process, as this process is typically run as a tight and multi-staged selection process, particularly in auction-like processes. During this selection process, more generalist PE managers typically face substantial information asymmetry compared to the management team or the current owner despite extensive use of external strategy, operations, accounting and legal advisors. However, if PE firms are specialized in the technology and business of the potential portfolio company, they may have a significant competitive advantage both relative to other bidders, the sellers and management (Lossen, 2007).

The second advantage is related to the leveraging of the portfolio company. Lossen (2007) argues that the more knowledge PE firms have about the industry and markets of the portfolio company, the more effectively it is able to raise debt financing from financial institutions, including exerting performance pressure on management through leverage. In addition, specialized PE firms will be able to execute control rights more effectively (Kaplan & Strömberg, 2009).

Thirdly, specialized PE firms will be better equipped to set direction, establish the right management team and incentivize and monitor the team. Lossen (2007) further argues that deeper industry knowledge is closely linked to a PE firm's value added to a portfolio company. In summary, a specialized PE firm should therefore be able to apply more

effective financial, governance, and operational engineering compared to generalized PE firms resulting in higher returns than comparable generalist transactions.

Counterarguments to specialization focus on the ability of generalists to leverage outside expertise, building on strong management teams and the value of portfolio diversification. Berg & Gottschalg (2005) state that PE firms add value to portfolio companies by leveraging their extensive network of contacts in various industries and advisory firms who can support them during the investment process. This includes identifying and attracting business partners, finding new managers or identifying attractive platforms and add-on acquisitions for buy-and-build strategies. In addition, syndication indicates that financial risk will be spread between two or more investors, thereby increasing the gains of portfolio diversification (Manigart et al., 2006). Furthermore, Acharya et al. (2009) suggests that PE firms select targets where there is already a strong management team in place. Strong management teams typically possess solid technological, market and product expertise, as well as networks comprising experts and investors with relevant knowhow. This might offset the advantage that specialized PE firms have compared to generalized PE firms.

3. Literature Review

Since the emergence of buyouts in the late 1970s private equity have grown from constituting a minor share of the capital market to becoming an important global force (Jensen, 2007). In parallel, the private equity industry has gained increasing attention from academics on various issues - including performance (relative to risk adjusted equity returns), how private equity creates value, the costs of the PE model, and the impact on society including employment, innovation and banking market exposures.

In this section we will present and elaborate on relevant existing literature. We will look at the performance in the industry and how private equity has developed over time on value creation levers, deal types and strategies typical to private equity today and specialist versus generalist PE funds. Most of the studies and research on PE stems from abroad and is conducted in larger markets, but we will include relevant literature on PE in Norway.

3.1 Value Creation Framework

In the wake of the LBO-wave during the 1980's, Harvard Business Review published an article entitled *Eclipse of the Public Corporation* (Jensen, 1989[9]) predicting that the private equity model would become the dominant corporate organizational form. The main argument is that the model reduces the value loss caused by the inherent conflict between the owners and managers over the control and use of corporate resources, or more specifically to ensure that the free cash flow finance projects with positive net present value (Jensen, 1989). The foundation of the PE model is built on concentrated ownership stakes, highly leveraged financial structures, and powerful long-term performance-based incentives including symmetric (to owners) management share ownership. Additionally, the private equity firm applies active governance to the companies by being actively involved in strategic direction setting, monitoring management, and sometimes even managing the company themselves (Jensen, 1989). These structures enhance the alignment between the risk carriers and managers of risk, resulting in higher operating efficiency, profitability, employee productivity, and shareholder value creation, thus appearing superior to the typical

[9] Revised in 1997.

public corporation (see e.g., Jensen (1989); Kaplan (1990); Smith et al. (1990); Lichtenberg & Siegel (1990)). As such, prior research argues that private equity is a higher performing ownership structure in mature as well as growth industries.

Since the scope of this thesis is to research underlying performance, we will look further into the academic research on company level performance. We will do so by applying the theoretical framework by Kaplan & Strömberg (2009) inspired by Jensen (1989), namely dissecting the operational value creation into three separate categories being; *financial*, *governance* and *operational*[10]. As such, value creation can be defined as mechanisms that affect the bottom line either directly through for example altering revenues, margins and capital requirements, or indirectly via agency costs and parenting effects (von Laskowski, 2012)[11]. Hence, the three components for increasing value are neither all-encompassing nor mutually exclusive, whereas improved operating performance is often a result of better financial structures and corporate governance, monitoring and control (Jenkinson & Sousa, 2011). For that reason, we include relevant research on all three sources and their role and impact on overall value creation.

3.1.1 Financial Engineering

Financial engineering has been most comprehensively defined by Finnerty (1988) as design, development and implementation of innovative financial instruments and processes, and formulation of solutions to the problems in finance. In an LBO-context, it mainly refers to the capital structure that PE investors implement in their portfolio companies based on their experience, and knowledge about the capital market in order to optimize it, while reducing its tax obligations (Anders, 1992; Berg & Gottshcalg, 2005). Additionally, it refers to the structure of the equity incentives they provide to the management teams of their portfolio companies (Gompers et al., 2015).

[10] Similar frameworks have been applied to evaluate how PE ownership creates value by Berg & Gottschalg, 2005; Bergström et al., 2007; Hahn & Kehoe, 2012; Døskeland & Strömberg, 2018; Phalippou, 2019 and Biesinger et al., 2020.

[11] The other common term to mention here is *value capturing*, which can be defined as mechanisms that occur without any changes in the underlying asset's performance, i.e. primarily related to the entry- and exit-phase of the investment, e.g. multiple arbitrage (Berg & Gottschalg, 2005). However, this paper does not focus on this aspect and will not elaborate further than what is provided in section 2.2.2 and 2.2.4.

The major element of financial engineering in LBOs is the role of debt used in the transaction (Kaplan & Strömberg, 2009). According to Jensen (1989), debt carries two separate advantages: the benefit of corporate tax reductions due to the deductibility of interest payments and the incentive benefits of debt. Since debt is transferred to the portfolio company's balance sheet it becomes the management's responsibility to serve the debt through interest and principal payments. As such, it creates pressure on managers not to waste money on projects with negative NPV or dissipate cash flows that could rather be paid out as dividends to the investor (Jensen, 1989; Kaplan & Strömberg, 2009; Gompers et al., 2015). Guo et al. (2011) finds a positive correlation between cash flow performance and pre-buyout leverage and the increase in leverage as a result of the buyout for LBOs in the US between 1990 and 2006. Additionally, the extensive expertise of the capital market combined with vast networks enables PE firms to negotiate better financing terms than the portfolio company could do standalone, as well as better utilization of low credit rates and spreads (Magowan, 1989; Cotter & Peck, 2001; Axelson et al., 2014). Further, DeAngelo (1986) emphasizes that PE funds' awareness of the importance of long-term relationships and reputation dependency greatly diminishes the buyout firms' incentives to transfer wealth from its lenders, which PE has been accused for (see e.g., Shleifer & Summers, 1988).

On the other side, high levels of debt can also be negative as the company's resilience to unexpected external developments or internal developments and potential to make strategic investments and responses to increased competition, as well as overall financial flexibility, is reduced (Singh, 1990; Kaplan & Strömberg, 2009). While the early studies insinuated that debt mitigates free cash flow problems, several recent studies find that the benefits of debt are optimally traded off against the increased risk of costly financial distress and are thus priced into the transaction (Jenkinson & Stucke, 2011; Axelson et al, 2013; Døskeland & Strömberg, 2018). Moreover, Phalippou (2019) argues that the disciplining effect of debt, i.e. incentive benefits, is superficial as the management already should be fully incentivized to focus on cash generation via their compensation packages PE is known for providing.

In Norway, Bienz (2017) proposes three features which private equity firms usually find interesting in potential targets: 1) firms are underlevered, 2) firms are underperforming and/or 3) firms lack capital or managerial expertise. From conversations with Norwegian GPs, feature 3) appeared to be the most relevant and attractive (Bienz, 2017). This coincides with Friedrich (2015) who shows that the level of leverage in 105 Norwegian buyouts is not

substantially different from comparable companies that have not received PE funding. Also, Bienz et al., (2016) document that the change in leverage from the year before the buyout to the buyout year is not statistically significant. Meanwhile, it is worth noting that historically Norwegian buyout funds have been constrained in using the acquired firm's assets as collateral for debt (Bienz et al., 2016).

Another important aspect of financial engineering is related to the structure of incentivization systems (Gompers et al., 2015). The incentive system is enhanced by structuring both large equity upside potential but also downside risk. The upside is provided through stock and options and bonus programs, whereas the downside risk arises due to requiring management to make a meaningful investment in the company from their own personal wealth (Døskeland & Strömberg, 2018; Biesinger et al., 2020). This mid-to-long-term upside and downside versus short term risk symmetry was hardly existent in public firms in the early 1980s (Jensen & Murphy, 1990). As management cannot sell its equity nor exercise its options until after exit, it mitigates biases towards short-term performance, and ensures focus on long term objectives, substantially lowering agency costs (Kaplan & Strömberg, 2009).

Overall, while the impact of debt on performance is debated, there seems to be academic consensus on the positive relationship between management actions and the incentive benefits. Even though public companies have introduced somewhat stronger incentives to managers, the incentives introduced by PE investors appear more forceful and better structured to help mitigate the agency cost between owners and management post-buyout, which is further associated with increased performance (Kaplan & Strömberg, 2009). Lastly, as leverage has a pejorative connotation, most practitioners argue that most of the value creation is achieved through operational transformation. Nonetheless, LBOs occur more often when debt cost is low, and conversely, fewer LBOs when debt costs are high, which advocates that the debt-part of financial engineering is an important lever in the private equity business model (Phalippou, 2019; Loualiche et al., 2016). Yet, overall, there has been a substantial decrease in leverage in buyouts, especially compared to the leverage ratios in the 1980s and 1990s (Guo et al., 2011; Gompers et al., 2016). Lastly, Guo et al. (2011) argues that the more certain you are that what you are buying is cheap, the more leverage you should use. Hence, since buying cheap has become more difficult, the degree of leverage in buyouts has decreased (Guo et al., 2011).

3.1.2 Governance Engineering

Since PE investors usually buy a large stake in their portfolio companies, they often obtain voting control. This allows PE firms to conduct governance engineering (Døskeland & Strömberg, 2018). Governance engineering refers to how the private equity firms impact the portfolio companies' corporate governance processes, including the role, composition, and priorities of the boards, the management team, and focus and design of strategic and operational management processes (Døskeland & Strömberg, 2018). In comparison, in a public company, there are numbers of issues that a board of a company cannot resolve upon at all, or only with the prior authorization of the general meeting where all shareholders exercise their governance rights over the company (BVCA, 2016).

Kaplan & Strömberg (2009) find that PE investors are more actively involved in the governance than public company boards, where several studies conclude that active monitoring and involvement contribute to enhanced performance (Cotter & Peck, 2001; Cornelli & Karakas, 2008; Guo et al., 2011). Furthermore, according to Gertner & Kaplan (1996), Acharya & Kehoe (2008) and Cornelli & Karakas (2012), private equity-owned companies have smaller boards than comparable public companies and meet more frequently, which is found to be more efficient than larger boards[12]. Moreover, the boards are composed of directors with a mix of former executives, PE investors, and outsiders with deep industry and/or functional knowledge and experience. Typically, all board members, including the external board members, are invested in the company (Kaplan & Strömberg, 2004, Cornelli et al., 2015). Additionally, PE firms do not only provide high-powered equity-linked incentives to management and the board, but often key employees as well. In Norway, (Bienz, et al., 2016) studies how the requirement of co-investment among PE fund managers affects the acquisition strategy of LBO funds. They show that the co-investment induces managers to choose less risky firms and use more leverage. Moreover, if the required co-investment is relatively high, the funds become more conservative and tend to diversify their capital over a larger number of portfolio firms compared to funds with lower co-investment requirements. Hence, we can observe an apparently stringent alignment between the agent (GPs) and the principals (LPs).

[12] Interestingly, a survey by Kehoe et al. (2008) shows that around 20 UK-based directors who have served on the boards of both private and public companies find PE boards overall more effective.

Even though corporate governance mechanisms were implemented in the early buyouts as well, the mechanisms have evolved and become more operationally focused (Schenkel & Strömberg, 2017). The boards are structured and run to effectively deliver on the investment thesis, focusing on management's implementation of structured improvement processes, detailed business plans and operational KPIs that are continuously monitored and communicated throughout the organization (Schenkel & Strömberg, 2017). Moreover, these corporate governance mechanisms mitigate the risk of free cash flow being reinvested in a suboptimal manner (Nikoskelainen & Wright, 2007). Furthermore, private equity firms replace around one-third of chief executive officers of acquired firms during the first 100 days, and two-thirds over a four-year period (Acharya & Kehoe, 2008). In particular, the CFO is often replaced as it is a key role to assist the PE fund in its governance and financial engineering (Døskeland & Strömberg, 2018).

In sum, although governance mechanisms for public companies have improved relative to many firms of the 1980s (Kaplan, 1997), PE firms are found to be more actively involved in governance than public company directors and public shareholders. Additionally, PE-backed companies show a higher ownership share among board members, managers and key employees, of which both are associated with higher performance relative to comparable benchmarks (Kaplan & Strömberg, 2009; Acharya & Kehoe, 2008; Gompers, et al., 2015).

3.1.3 Operational Engineering

Operational engineering involves actively applying industry and operating expertise to improve the value of the firm's operations (e.g., enhancing productivity, functional expertise on lean manufacturing, marketing/sales, strategic repositioning, IT, pricing, supply chain management, and working capital management), leading to improved cash flow (Berg & Gottschalg, 2005; Kaplan & Strömberg, 2009; Acharya & Kehoe, 2008; von Laskowski, 2012; Phalippou, 2019).

The empirical evidence on the operating performance of companies' post-buyout is largely positive. A study of 76 large management buyouts of public companies during the 1980s in the US finds that the ratio of operating income to sales increased by 10 to 20 percent, both absolute and relative to industry (Kaplan, 1989). The ratio of cash flow[13] to sales increased

[13] Calculated as operating income less capital expenditures.

by approximately 40 percent. These findings are also coincident with large increases in firm value, in absolute and relative terms, and is, according to Jensen (1989), achieved without massive layoffs or cuts in R&D expenditures. Other studies covering the first buyout wave document significant operating improvements measured in profit margins, sales per employee and net working capital (see e.g., Kaplan, 1989; Smith, 1990; Lichtenberg & Siegel, 1989; Smart & Waldfogel, 1994).

More recent studies, such as Harris et al. (2005) and Cressy et al. (2007)[14] in the UK, Boucly et al. (2011)[15] in France, and Bergström et al. (2007)[16] in Sweden, document that LBOs are associated with significant improvements in profitability and revenue growth after buyouts. Additionally, Acharya et al. (2013) studied 395 deals exited during the period 1991 to 2007 in Western Europe made by 37 mature PE houses, documenting higher sales growth and operating margins. Lee & Lou (2017)[17] find that PE managers successfully cut excessive operating working capital in firms taken private. This is mainly achieved through reduced cash tied up to inventory, increased inventory turnover, and reduced accounts receivables. Additionally, the effect of improved working capital is found more significant when PE firms have replaced the CEO or when the firm has lower liquidity (Lee & Lou, 2017). In Norway, Friedrich (2015) studies the Norwegian PE market by investigating the changes firms undergo during the time they are PE-backed relative to non-PE-backed firms. Overall, he finds that PE improves the operating performance relative to control firms over the three-year period, although not all results are statistically significant. Asset turnover and ROA (EBITDA/Assets) improves by 50% and 23%, respectively, over three years post PE-acquisition.

Moreover, in 2009, Kaplan & Strömberg stated that, while financial and governance engineering were common PE practice by the late 1980s, PE has recently introduced operational engineering. This is reflected in most top private equity funds being increasingly organized around industries and hiring of professionals with operating backgrounds from the

[14] 122 private and public LBO deals from 1995 - 2005. Measure: EBIT/assets.

[15] 839 buyouts between 1994 - 2004. 36 public-to-private, rest is private-to-private.

[16] 69 Private-to-private LBOs. Measure: sales growth, EBITDA growth and return on invested capital.

[17] 117 LBOs in the US between 1990 - 2015.

relevant industry. According to recent studies, the financial crisis sparked the focus on operational engineering, where a UK study found that PE-backed portfolio companies relative to non-PE backed peers gained 8% higher market share during the crisis and attracted 6% more in investments (normalized to assets) in the post-crisis period (Gianfrate & Loewenthal, 2015; Bernstein et al., 2017; Jordaan, 2018). Moreover, the intensified industry and operational focus often comprise specific value creation plans (Cressy et al., 2007; Kaplan & Strömberg, 2009; Biesinger et al., 2020). These plans may for example include top-line growth, cost-cutting opportunities, strategic changes or repositioning, and acquisition opportunities, thus covering both organic and inorganic initiatives to boost operating performance. Similar to Kaplan & Strömberg (2009), Hammer et al. (2020)[18] also finds that value creation has increasingly turned towards operational focus and growth-related measures. Besides, a survey of GPs by Gompers et al. (2016) reveals that 97% of the PE firms report operational improvement as a major driver for their investment returns.

Research documents that private equity achieves a positive effect on operating performance. Nevertheless, recent studies by Guo et al. (2011)[19] and Cohn et al. (2014)[20], find that gains in operating performance are either comparable or slightly exceed those observed for benchmark firms matched on industry and pre-buyout characteristics. Hence, the relative differences in cash flow gains are significantly reduced compared to the deals documented from the 1980s buyout wave by Kaplan (1989). Moreover, a comprehensive study of 183 US public-to-private LBOs finds no robust evidence of post-buyout improvements after adjusting for accounting-induced distortions in empirical measures of operating performance (Ayash & Schütt, 2016)[21]. In the UK, Acharya & Kehoe (2008) and Weir et al. (2007) find similar results in operating performance during the same period. Meanwhile, Weir et al.

[18] Based on a sample of 788 PE-backed firms and a matched control group of 6.652 non-PE-backed peers between 1997-2015 in Europe.

[19] 94 public-to-private LBOs between 1990 - 2006. Measures: EBITDA scaled by assets or sales, and operating cash flow minus capex scaled by assets or sales.

[20] 317 US LBOs between 1995 - 2007. Measures: tax EBIT scaled by sales, assets or adjusted by a cost of capital charge.

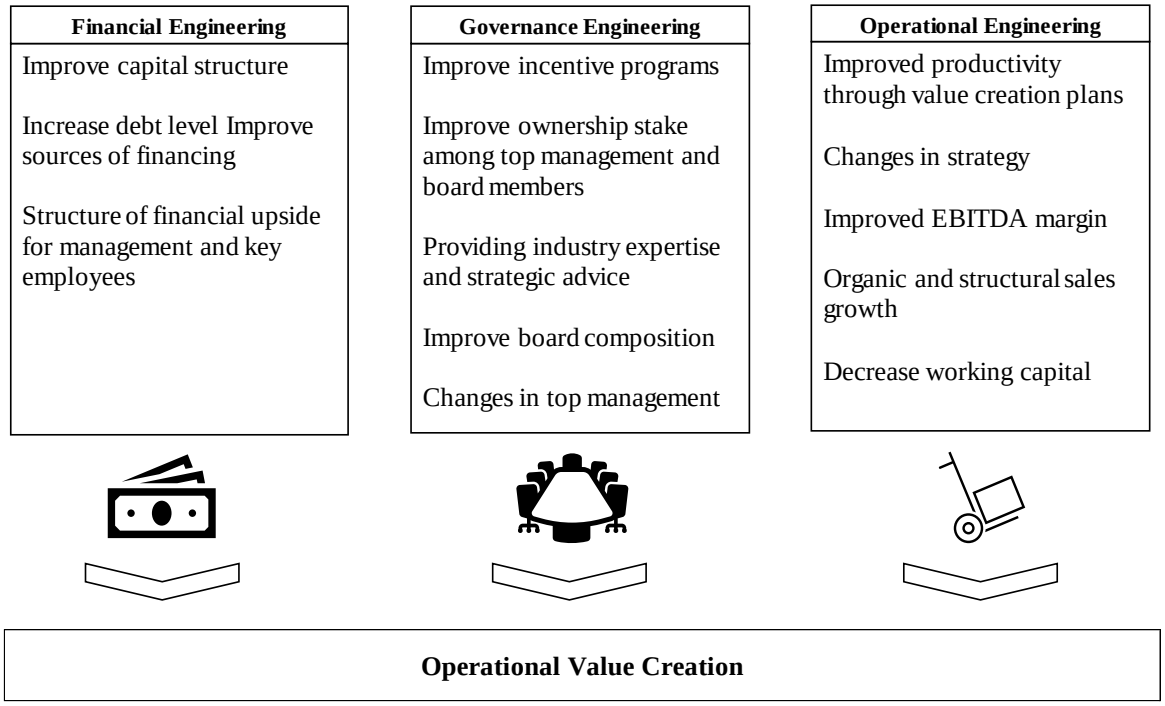
[21] Use EBITDA adjusted for restructuring charges and scaled by tangible assets to deal with the premium paid which affects the balance sheet of the target firm's assets - which otherwise, mechanically, creates an upward bias into LBO targets' performance measures. More specifically, they use a return-on-tangible-assets measure instead of return on assets (ROA), and compare both measures to a propensity score matched control group. For ROA they find some evidence of improvements, while no improvements with their more unbiased and conservative measure.

(2015)[22] document a significant decline in operating performance. The combination of modest operating improvements and high investor returns coincides with Døskeland & Strömberg (2018) stating that (more recent) buyouts are usually not about turning unprofitable companies around, but rather about a "good-to-great" or "small-to-large" model and improving already profitable companies through efficiency improvements. This appears to leave less room for improved performance. In essence, this is also suggested by Acharya & Kehoe (2008), Weir et al. (2007) and Guo et al. (2008).

Additionally, an interesting micro study of the operational consequences of private equity in the restaurant industry in Florida finds that restaurants become cleaner, safer, and better maintained once they are PE-held (Bernstein & Sheen, 2013). Without observing store-level financial information following the PE-buyout, this study finds that store closure risk declines after PE-entry. These findings are consistent with a large study by Bloom et al., (2009) who surveyed over 4,000 firms in the US, Europe and Asia and found that PE-backed firms are on average the best managed group in the sample. Moreover, Agrawal & Tambe (2016) document that PE-held companies train their employees more by tracking the long-run career paths of individual workers who are employed by PE targets during an acquisition in the US.

[22] 138 public-to-private LBOs from 1998 - 2004. Measure: EBITDA/Assets (ROA).

Figure IV – Levers to Value Creation



To summarize, a large literature, starting with Jensen (1986, 1989), Kaplan (1989) and Smith (1990), documents how PE ownership impacts the performance of portfolio companies. Over various time periods, empirical research shows that the interplay and overlap between financial, governance and operational engineering (see Figure IV for overview) have all been important levers to operational value creation in PE. Meanwhile, we can find some mixed and somewhat conflicting results when it comes to operating improvements in more recent research, showing that the operating and efficiency improvements are marginally higher, or broadly in line with, or even worse than industry peers (Guo et al., 2011; Acharya, 2013; Cohn et al., 2014; Weir et al., 2015; Ayash & Schütt, 2016). The majority of the same literature suggests that the time-inconsistent results are due to a decline in value creation opportunities over time. A possible explanation to this is that better governance mechanisms have become more widely used, thus diminishing the impact of the initial buyout innovation by reducing high agency costs (Lerner & Cao, 2009; Guo et al., 2011; Weir et al., 2015). Similarly, Jensen (2007) was puzzled by the fact that all of the techniques that PE uses to accomplish value creation can be adopted by most public companies, yet it does not happen. Seemingly, the market has gradually responded to what Jensen (2007) remarks. As the market has matured and become more competitive, the

financial and governance engineering have simultaneously become more or less common practice and broadly commoditized (Guo et al., 2011; Kaplan, 1997). Meanwhile, operational engineering is more difficult to imitate and acquire as it requires skills, capabilities and resources of which many are time-extensive, such as industry-expertise, experience and networks (Døskeland & Strömberg, 2018). Hence, operational engineering has become a key skill for PE investors to continue to add value to their investments and over the long run manage to generate positive relative returns to their investors.

3.2 PE Deal Types, Strategic Focus and Specialization Effects

In this section, we review literature on some of the structural changes in the PE industry related to value creation. More specifically within deal types, the increasingly popular *buy-and-build* strategy as well as describing the strategic focus, and lastly the specialization effect.

Private-to-Private vs. Public-to-Private

The previously popular delisting of mature and large companies, i.e., public-to-private transactions, have fallen out of favor relative to private-to-private buyouts. Private-to-private buyouts and particularly Secondaries have increased significantly over the last two decades and typically actively pursue and engage in growth opportunities (Hammer et al., 2017).

A large body of research has been focused on this industry shift. For instance, in France, Boucly et al. (2011) find that private-to-private buyouts generate a greater improvement in ROA than public-to-private buyouts. Cohn et al. (2016; 2014), and Bansraj et al. (2019) also find evidence of superior relative performance of private-to-private buyouts in the US (1995-2009) and Europe (1997-2016) compared to public-to-private buyouts. Morris & Phalippou (2020) suggest that the shift from public to private buyouts could reflect the fact that private equity applies different levers in a private-to-private buyout, such as access to capital and management skills and experience, compared to the public-to-private buyouts that Jensen (1989) researched. Additionally, it may reflect the fact that private equity is focusing more on growth capital and less on mature companies compared to the initial

buyout wave. This is in line with Hammer et al.'s (2017) and Boucly et al.'s (2011) findings, showing that public-to-private buyouts are not driven by growth opportunities.

Secondaries

Moreover, increasing from 2% of global transaction value during the late 1980s to 25% in 2005, the surge of secondary buyouts has been a distinct part of the worldwide PE market development (Kaplan & Strömberg, 2009). Firstly, it has resulted in an increase of the total time period in which portfolio companies are owned by private equity funds. As such, the individual holding periods underestimate the total holding period in private ownership. When accounting for this, Strömberg (2008) shows that the median PE ownership period is nine years after the original buyout transaction. In a study by Kaplan (1991), he found that the median LBO ownership period was slightly below seven years.

Jenkinson & Sousa (2011) and Achleitner & Figge (2011) study the economic value-added activities of private equity firms in secondaries. By comparing 308 European firms exited through a secondary or an IPO between 2000-2007, they find that the operating performance of IPO firms clearly outperform secondary firms in terms of sales and EBITDA during the first (full) three years post exit. However, they find that secondary firms increase their net cash flow[23] significantly more than IPO firms, mainly due to a reduction in capex. Similarly, Bonini (2010) finds that the operating performance of the companies is only slightly improved in the SBO compared to industry benchmarks, whereas the first buyout shows significant improvement[24]. Furthermore, Jenkinson & Sousa (2011) identify a negative relationship between the holding period in the first PE holding period and the secondary deal performance, and also suggest the secondary PE firm's lesser experience as possible explanations for underperformance compared to IPO firms. Overall, Jenkinson & Sousa (2011) find it premature to conclude that the increase in secondary buyouts, i.e., lengthened total PE ownership period, implies that PE is a superior long-term organizational form. Achleitner & Figge (2011) on the other hand, find no robust evidence that SBOs generate lower equity returns or offer lower operational value creation potential in their sample of 910 realized buyouts transactions, including 115 SBOs between 1985 and 2006. But they

[23] Calculated as EBITDA minus CAPEX.

[24] Bonini's analysis focuses on a very short performance window of one year prior and post transaction. Thus, it likely captures low hanging fruit, but does not adequately assess the actual realized performance over the total holding period.

document that SBOs acquire more leverage than primary buyouts (even after controlling for debt market conditions), which they suggest can be driven by lower informational asymmetries in an SBO. Similar to Wang (2010), they also find evidence of SBOs being more expensive than other buyouts. Contrary to Jenkinson & Sousa (2011), Achleitner & Figge (2011) concludes that SBOs are no second-rate deals, documenting equity returns and operating improvements comparable to primary buyouts. Lastly, secondary buyouts frequently exploit unused inorganic growth potential through add-on acquisitions, commonly referred to as *Buy-and-Builds*, which will be discussed below, implying that the strategy is a key value creation lever in secondary buyouts (Jansen et al., 2016, Hammer et al., 2017).

Buy-and-Builds and Strategic Focus

The development of the buyout industry includes the development of several value creation strategies since the Classic LBO during the 1980s (Ayash & Bartlett, 2017). In a study of 92 fully monetized LBOs occurring between 1995 and 2008 in the US, Ayash & Bartlett (2017) suggest that PE firms have developed transaction strategies that aim to produce equity returns through aggressively growing revenues, often through multiple acquisitions. Moreover, The Boston Consulting Groups suggests that the use of mergers and acquisitions (M&A) has become the single most important way to improve operation in PE buyouts (BCG, 2012).

The application of "buy-and-build" strategies has increased substantially in the PE market and comprises around 30% of the overall European PE deal market (Hammer et al., 2017; Smit et al., 2020). The strategy relies on using the initial portfolio company as a platform for subsequent add-on acquisitions during the holding period to accelerate revenue growth and drive margin expansion by realizing synergies (Hammer et al., 2020). The combination of multiple companies within a single company targets skill and scale based operating efficiency improvements, provided that the acquiring firm can successfully integrate the combined firms' operations (Ayash & Bartlett, 2017). Among the sample of 788 PE-backed firms, Hammer et al. (2020) finds that PE-backed companies realize acquisitions faster and increase the expected number of acquisitions by roughly 90%. In a

sub-sample of 278 PE buyouts[25], they find that every add-on acquisition increases the EV growth rate by 3.5% p.a., expands the EV/EBITDA multiple by 15.7% and the portfolio company's operating margin by 1.6%, documenting that add-on acquisitions create value on average.

A study of 818 buy-and-build strategies from seven European markets (including Norway) over 1997-2016, finds that the average holding period is more than five years longer than for a typical LBO (Smit et al., 2020). They also find that the significant synergies through higher sales materialize in year 4 and 5, while profitability increases throughout, and the impact scales over time. The buy-and-build strategy focuses more on long term growth and synergies and less on value creation from traditional LBOs, such as tax shield and restructuring (Smit et al., 2020). Interestingly, the Created Value Attribution framework developed by Duff & Phelps (2014) applied to 28 individual transactions in North America[26], finds that 62% of the enterprise value creation stems from revenue growth and almost 90% of average revenue growth across the sample was driven by industry performance or add-on acquisitions, while the remaining 10% was attributed to organic market share gains.

In another recent study, 76 private equity firms answered that the most important sources to adding value are, in ranked order; increasing revenue, improving incentives and governance, facilitating a high-value exit, making additional acquisitions, replacing management and reducing costs (Gompers et al., 2015). A comprehensive study of 1.580 emerging markets deals by 171 PE funds raised between 1992 and 2017 attempts to break down the value creation in portfolio companies into so-called *Value Creation Plans* (VCPs) (Biesinger et al., 2020). The two most popular strategies are operational improvements and top-line growth, and the three most popular combinations involve operational improvements and top-line growth, either with no other strategy or in combination with governance engineering, or with both governance and financial engineering. Interestingly, they find that the popularity of top-line growth and governance engineering strategies increases as the maturity of deals increases (Biensinger et al., 2020).

[25] Comprising deal EVs at entry and exit, sales and EBITDA.

[26] See Created Value Attribution (INSEAD) p. 11.

Specialists vs. Generalists

The relationship between PE specialization (defined by the GP's industry and stage focus) and PE portfolio company performance has been examined in several empirical studies. Cressy et al. (2007) concludes in a study of 122 UK buyouts over the period 1995 - 2002 that, in addition to portfolio companies in general outperforming comparable companies by 4.5% post-buyout, industry specialization of PE firms adds 8.5% to this premium, consistent with the industry specialization hypothesis. However, other findings related to the specialization effect are less conclusive. Aigner et al. (2008) analyzed the performance of 104 PE funds with approximately 55% US and 45% European portfolio company investments. In line with Ljungqvist & Richards (2003), Lossen (2007), and Brigl et al. (2008), Aigner et al. (2008) could not find any significant relationship between portfolio company returns and the level of specialization of the PE manager. Lossen's (2007) findings led him to the conclusion that the advantages of PE specialization in particular industries to overcome information asymmetries and principal agent problems could be limited. PE funds are often specialized within their organization (Aigner et al., 2008) suggesting there might be experts for the different financing stages and industries who, together, create specialization within GPs which are classified as generalists.

Although VC is outside the scope of this thesis, Norton & Tenenbaum (1993) examined whether VCs attempt to control risk through competing portfolio strategies. In contrast to traditional finance theory, which suggests that portfolio diversification reduces unsystematic risk, the authors argue that VCs seem to benefit from the opposite. Their research suggests that VCs control portfolio risk by specializing in certain industries and financing stages, rather than stagger their investments over different industries and stages. In addition, Norton & Tenenbaum (1993) find evidence that these firms experience higher returns than comparable non-specialized VCs due to extensive technical and product expertise in their area of specialization. These findings are supported by Gompers et al. (2008). In their sample of 2.179 U.S. VCs investing in 16.140 companies, Gompers et al. (2008) find evidence that specialized VCs with greater industry-specific experience and human capital tend to respond more quickly to new investment opportunities. In addition, these investments tend to be more successful compared to investments of less experienced VCs, measured by a greater likelihood of profitable exit (i.e. IPO, acquisition, merger). Overall,

these papers support the specialization hypothesis, which proposes a negative relationship between the level of diversification and the rate of return.

To summarize, the surge in buy-and-builds as well as increasing strategic focus on operational improvements are levers leveraged by PE managers in order to remain competitive and deliver positive returns. Thus, PE firms have developed new ways to add value to their portfolio companies involving growth strategies and holding companies for longer periods (Smit el al., 2020) in response to the significant growth of the industry since the mid-1990s, ensued by increased competition and pressure (Cressy et al., 2007). Noteworthy, some have criticized PE for simply shifting profits from other stakeholders, such as employees and customers, to its shareholders, GP short-termism and asset-stripping, negatively affecting long-term performance (see e.g. Lowenstein, 1985; Shleifer & Summers, 1988 and Elliot, 2007). Yet, there is no substantial empirical literature that finds evidence to support these claims (Døskeland & Strömberg, 2018). That is, the apparent value creation does not seem to be at the expense of other stakeholders or long-term profitability. Moreover, Døskeland & Strömberg (2018) points out that, although Jensen's (1989) prediction of the extinction of the public corporation might have been premature, his arguments help explain the dramatic growth of the PE market over the following three decades. During the same period, private equity has been a very active research field within finance, including a multitude of later empirical studies that both confirms but also refutes many of Jensen's conjectures. In sum, the substantial body of empirical research on value creation in private equity on company-level with various, but also conflicting findings, makes our paper even more interesting.

4. Empirical Research

Our research objective is to evaluate and understand the operating performance of Norwegian PE portfolio companies relative to the operating performance of similar companies. Thus, we seek to provide insights on whether PE-backed companies experience improvements in the post-buyout operating performance compared to non-PE-backed companies. We further analyze potential differences in performance between portfolio companies owned by specialized and generalist PE firms, and differences in performance among deal types. Academic research focusing on the operating performance of PE buyouts (Kaplan, 1989; Bergström et al., 2007; Cressy et al., 2007; Guo et al., 2011; Acharya et al., 2012; Alperovych et al., 2013, Ayash & Schütt, 2016) provides useful insights into setting up an appropriate research methodology which is largely reflected in this study's research design. Still, to generate valid insights we find it critical that the specifics of the local PE market, including accounting standards and data availabilities, and the characteristics of the sample itself, is reflected in our research design.

This chapter provides a detailed description of the overall research design and the research model including PE portfolio company data input, definition of the operating performance metrics, construction of the control group, empirical set-up and methodology, before the two following chapters present the results and conclusions, respectively.

4.1 Research Design

The research objective is to assess operational improvements in portfolio companies that are in excess of any general improvements in operating performance of the respective companies' industry peers. Furthermore, we attempt to identify potential underlying explanatory factors for differences in performance including degree of specialization of the PE company and deal sources. More specifically, we are testing the following three main hypotheses:

Hypothesis 1: *Private Equity ownership has a positive (relative) impact on operating performance*

Hypothesis 2: *There is a positive relationship between PE fund's degree of specialization by industry and performance post-buyout*

Hypothesis 3: *PE Portfolio company performance varies by deal type*

In order to test these hypotheses, we track performance measures on operating profitability and turnover growth from one year pre-acquisition up to five years post-acquisition and all the way to exit or last accessible accounting year for companies still private. More specifically, we measure operating profitability using return on assets (ROA, measured as EBITDA/total assets) and decompose ROA into its subcomponents; return on sales (ROS = EBITDA/sales) and asset turnover (sales/total assets). We further analyze growth in sales, EBITDA and (net) working capital improvements. When testing the main research question whether PE portfolio companies outperform non-PE backed companies, the operating performance will be benchmarked against a control group determined by applying Propensity Score Matching (PSM). The test is designed to analyze what the counterfactual performance of the PE portfolio companies would have been if they were not acquired by PE investors.

4.2 Data

As pointed out by previous research on PE in Norway, (see e.g., Bienz et al., 2016; Friedrich, 2015), private equity practices such as implementation of new holding companies, consolidation of portfolio companies, changes in organizational numbers and renaming of companies when acquiring new companies, introduce significant challenges within the research design. As a consequence, Friedrich (2015) and most of the previous research on Nordic PE portfolio companies, match the control group on the buyout year of the company, due to new ownership structures and lack of data and information. We have, however, chosen to dedicate required efforts to apply pre-buyout data in our analysis to match and construct the control group. With extensive research in several databases, we have been able to obtain company financials pre-buyout and transaction information (we provide a thorough discussion about why we have fixated on gathering data pre-buyout and the considerable limitations of matching on the year of buyout in the method section). Noteworthy, the databases on buyout activity also require considerable work to ensure a robust link between data, analyses and findings. Most of the previous research in this field is not very transparent on how these issues have been addressed. We have also chosen to dedicate significant efforts to ensure that the quality of the data which are applied generate robust findings.

4.2.1 Databases Applied

The empirical tests of this thesis require a large amount of detailed data on the PE portfolio companies. Annual accounting data for the PE portfolio companies and the control group are retrieved from a database based on data from Brønnøysundregistrene which has been created by the Centre for Applied Research at NHH (SNF) and revised by Mjøs, Berner and Olving (2016). The database contains company and consolidated accounts for all Norwegian enterprises and groups from 1992-2018.

Our dataset on PE portfolio companies is based on a database provided by the Argentum Centre for Private Equity (ACPE). ACPE is an independent research centre at NHH in collaboration with Argentum, HitecVision, Energy Ventures, PWC, Norvestor Equity, Northzone and BA-HR focused on Nordic Private Equity. The ACPE database covers most PE transactions in the Nordics from 1991 to 2015 and provides us with an initial set of 319 buyouts of Norwegian companies and 300 transactions made post 2000 which is the time period focus of this study.

These transactions include data on several parameters such as the name of the portfolio company and the corresponding organizational number, industry, PE fund manager, fund and fund ownership share, investment stage, investment date, transaction size, exit date and exit type. However, much of the information is missing or is misclassified which requires an extensive and time-consuming task in manually collecting and cross-referencing the required data for our analysis. For instance, the investment date is specified for 142 of 300 transactions, and the sample would have been reduced to only 36 transactions if we excluded those without a specified exit date underscoring the need for such extensive and manual tasks to obtain a statistically robust sample.

The ACPE database is therefore combined and complemented with a similar database provided by Menon Economics in order to extend our sample. Even though the data challenges of the ACPE database apply to this database as well, it allows us to calibrate especially data related to organizational numbers. Furthermore, the original database is complemented by a list of transactions and corresponding data received directly from Argentum. The list from Argentum is particularly useful to identify exit date and exit type for transactions exited after 2015, as the ACPE database is not updated after 2015. Buyouts occurring after 2015 are not included in the sample, since at least 3 years of post-buyout

operating performance is required to conduct a meaningful analysis, and financial statements after 2018 are not available in the SNF database. In total, 58 deals were added to the initial data from ACPE.

Missing transaction data such as entry date, exit date, entry and exit type is collected and validated through meticulous analysis of company descriptions and transaction info in databases such as Valu8, Factset, Orbis, PE manager's web pages as well as press releases.

4.2.2 Data Due Diligence

The resulting database after combining the data from the mentioned accounting and transaction database sources as well as data extracted from the latter mentioned sources, requires careful review. Firstly, we make sure that no transactions are included more than once. This is a delicate task, since quite a few transactions and corresponding organizational numbers refers to a holding company or group that includes several subsidiaries which are identified as independent PE transactions in the database. These subsidiaries are typically first acquired by the PE company and then later on incorporated into a holding company or group or merged with other portfolio companies. The database would then account for both the group of subsidiaries by providing the name and organizational number of the consolidated (holding) company and the names and organizational numbers of the subsidiaries. Hence, to avoid double sampling these transactions and the corresponding performance of these portfolio companies in our data sample, the historical holding structure of the portfolio companies must be examined. For this purpose, we use the SNF database's registry over corporations ("foretaksdata") where subsidiaries are linked to their holding company, complemented with Valu8.

Alterations to The Original Database

Steps to avoid double counting of transactions: Follow-on investments (by the same PE company) are excluded. Only the initial transaction is included and joint investments by different PE companies are treated as one transaction. Secondary transactions are included if they are not within the relevant period of measurement of the prior PE transaction. This is because secondaries are an increasingly common entry strategy and excluding these would induce risk of losing an important aspect of PE's investment activity.

Steps to ensure correct classifications of PE vs other types of investments: Some transactions reported as buyouts are venture capital investments, seed investments or passive private placements, and are therefore eliminated. Distinguishing between venture capital, private placements and PE transactions is sometimes challenging. These cases need to be evaluated on an individual basis, based on parameters such as ownership stake, transaction size and maturity of the company. Stakes in public companies that remain publicly traded (PIPES) are evaluated on the same basis and are included if they are active investments by a PE company.

Steps to exclude non-PE sponsors: Following the above-mentioned logic, transactions conducted by pure venture capital companies such as Maturo are excluded, as these are likely VC investments. Moreover, transactions conducted by family investment offices such as Kistefos are also excluded. Even though such offices are active owners, their models differ to traditional PE models regarding ownership period, exit requirement and active ownership processes. However, family offices with a clear PE model as a line of investment activity, such as Ferd, are regarded as PE, and hence their transactions are included in the sample.

Steps to exclude infrastructure-like deals: Transactions within infrastructure and asset-intensive sectors such as shipping and oil are also disregarded (suppliers to these industries are however included), since these deals are mostly not driven by operational improvement, but largely driven by external factors such as commodity prices, freight rates etc. Measuring such asset-intensive companies in terms of operational metrics such as EBITDA/assets is not purposeful and can distort the sample.

Steps to capture PE deals with robust yearly accounting time series: Our analysis is restricted to portfolio companies which have pre- and post-buyout financial statements available. Consequently, the organizational number of the target entity needs to be identified to retrieve its financial statements for the year(s) prior to acquisition as well as for the holding period. This task is complicated by the fact that many PE companies change the ownership structure of the portfolio companies upon acquisition or during the ownership. For instance, PE companies often establish a new holding company upon acquisition of a company. Hence, the organizational numbers of both the new and the old holding company have to be identified and validated so that they do not differ in terms of businesses controlled as a prerequisite for using consolidated figures on holding level to compare pre-

and post-buyout performance. Using consolidated figures for the holding company is necessary if: 1) the relevant portfolio company comprises a group, and 2) consolidated figures are not available for the group/parent company or any of its subsidiaries. Using unconsolidated figures can create distortions for several reasons. Firstly, if the portfolio company comprises a group, the unconsolidated financial statements of one subsidiary does not reflect the operational performance of the whole group, or they might be severely misleading as they can include internal transfers and payments from one subsidiary to another. Secondly, in some cases the "main operating" subsidiary of the portfolio company changes after PE entry due to changes in ownership structure, or add-on acquisitions/mergers which make the financial statements of this subsidiary no longer representative of the performance of the portfolio company. In other cases, the PE company splits the acquired portfolio company into separate companies, meaning that the pre- and post-buyout performance of the portfolio company is not comparable on an unconsolidated basis.

However, the mentioned databases often provide the organizational number of an unconsolidated subsidiary within the portfolio company. Using unconsolidated figures (for the subsidiary) is appropriate, provided that the portfolio company does not comprise a group, or that the other subsidiaries in the group are negligible. This is not always the case in the databases, as many of the organizational numbers refer to unconsolidated subsidiaries that are not representative for the operating performance of the entire portfolio company. The group or holding company is identified by matching on the organizational number of the subsidiary in the SNF database's registry of companies and corresponding parent/holding companies, which is manually verified in Valu8. Sometimes the organizational number is missing, or they refer to target companies that had changed the organizational number (and often name) upon acquisition. In such cases, the organizational number is identified manually in the SNF database by matching on company name at the time of PE entry identified through press releases and M&A databases such as Factset, Valu8 and Mergr.

In summary, tracking the performance of PE portfolio companies, and more specifically tracking the performance of the right PE portfolio companies over time is a complex task. This complexity is further enhanced by the switching between providing consolidated and

non-consolidated figures and between subsidiaries and holding companies from year to year.

The above issues lead us to the conclusion that validating the organizational numbers of the ACPE database is necessary to avoid serious distortions to the "true" performance of the PE backed portfolio companies. Furthermore, a significant number of observations would be lost to factors such as 1) the organizational number is completely missing, and 2) the relevant organizational number has changed so corresponding accounting information is not available. Identifying and validating the correct portfolio company and corresponding organizational number for each transaction is therefore crucial to conduct a statistically meaningful analysis of their performance. We approach this challenge by looking up historical ownership structures for the portfolio companies in the SNF database, Valu8 and Orbis and identifying the holding company or parent/subsidiary with consolidated figures for the group where financial statements are available for the entire period of measurement and is directly comparable to the acquired entity. If consolidated figures are not available for the relevant period of measurement, we use unconsolidated figures for the subsidiary provided it reflects the operations of the (entire) portfolio company. In order to evaluate the representativeness of using unconsolidated subsidiaries as a proxy for the group/portfolio company, we calibrate the respective accounting information with other sources such as press-releases, webpages of respective PE companies, Valu8, Factset and Orbis. This process must be conducted to identify and validate the organizational number of the target company both pre- and post-acquisition to ensure that we match the control group with the company that was de facto acquired.

This process led to the exclusion of transactions where we were not able to identify the correct organizational numbers or the organizational numbers had disappeared. The disappearance of organizational numbers can occur for various reasons. One is bankruptcy. Another is when various parts of the original company are acquired by multiple companies, and the legal entity ceases to exist and has no obvious successor (Davis et al., 2019). This makes it inherently difficult to define and measure changes in the performance of such companies (Davis et al., 2019), and they are therefore excluded from our sample. Finally, only buyouts of companies with complete accounting information for at least one year post-buyout are included in the final sample.

4.2.3 Sample Description

Our final sample consists of 214 buyouts between 2000 and 2015, out of the total sample of 358 deals gathered from the two databases from ACPE and Menon Economics (see Figure V). The sample includes 49 different private equity companies. The eight most active in the sample are Herkules (26 transactions), HitecVision (24 transactions), Norvestor and Reiten & Co. Capital Partners (both with 17 transactions), and Altor (14 transactions), followed by FSN, EQT and CapMan (all with 9 transactions).

Figure V – Sample PE Entries and Exits by Year

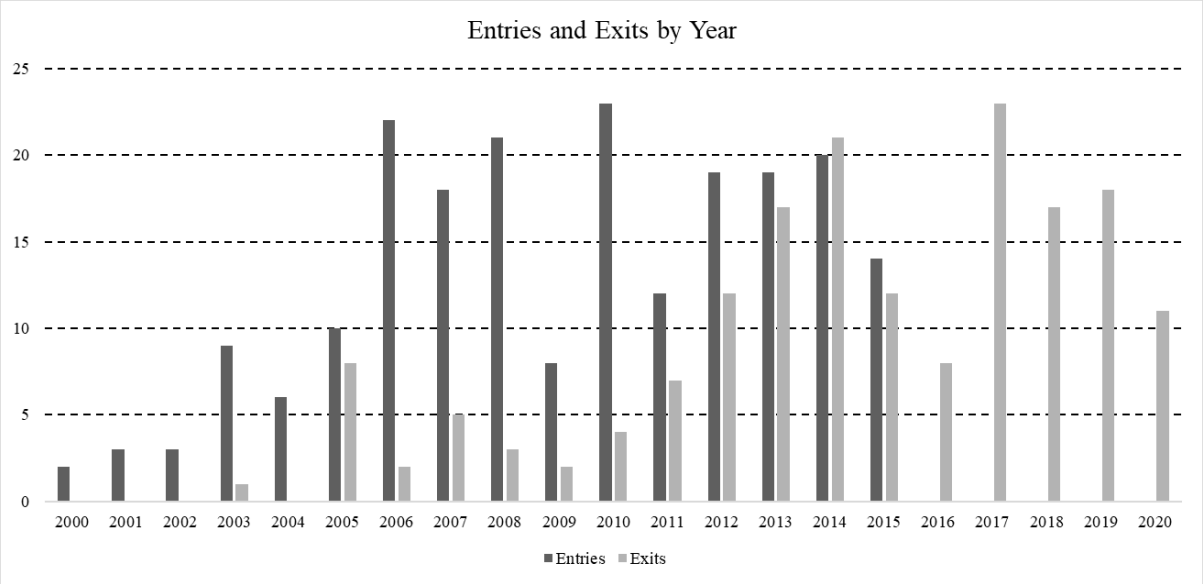


Figure V depicts sample exits and entries by year. Entries post 2015 are not included as accounting figures are limited to fiscal 2018, and minimum 3 years of post-buyout data are deemed necessary. As of February 2021, 45 investments in our sample are still private.

Like Davis et al. (2019), we sort the sample of buyouts into four main deal types: the buyout of an independent, privately held company (private-to-private), the buyout of a publicly listed company (public-to-private), the buyout of a part of a company (divisional buyout), and the sale of a portfolio company from one PE company to another (secondary buyout). Additionally, we have included private investments in public equity (PIPES). Exit type is classified based on the buyer of the portfolio company. Industry and Sector are classified according to Capital IQ's classification framework to ensure a direct link between our sample and the PE companies' distribution of investments along Industry retrieved from Capital IQ.

Table I depicts the sample distribution of buyouts along industry and investment year. The table shows that Industrials and Consumer are the two most frequent/popular industries in which the portfolio company operates, followed by Energy and Information Technology, respectively.

The distribution of buyouts along deal type and year is depicted in Table II. Importantly, we see that the distribution conveys variation both in deal type and total number of deals over time, for instance in 2009 only 8 deals occurred, arguably as a consequence of the financial crisis. This is in accordance with Kaplan & Strömberg (2009) stating that timing of investments is also an important factor in PE. Hence, expectedly, the PE industry has a cyclicality factor that likely impacts the performance post-buyout which needs to be accounted for in the analysis. Notably, we see that private-to-private buyouts, i.e., private companies being acquired by private equity investors, clearly dominates our sample, corresponding to the findings in Bienz et al. (2016).

Table III depicts the frequency of exit types and the corresponding average and median holding period to each exit. The average (median) holding period for the transactions exited in our sample is 6.3 (5.8) years. This is somewhat higher than previous findings by Kamlund & Knudsen (2018) on Nordic PE deals between 2000-2016, reporting an average holding period of 5.3 years[27]. This might suggest that the average holding period in Norway has increased. However, the longer holding period might be attributable to a skewness in the holding period of our sample compared to the population of buyout deals in Norway as the performance of some particularly early exited investments are not measurable and they are hence excluded from the final sample. Furthermore, the holding periods are calculated from entry to complete divestment.

[27] Additionally, Degorge et al. (2015) reports an average holding period of 4.4 years for 5,849 buyouts between 1986-2007. Interestingly, Jenkinson & Sousa (2015) find different holding periods for deal types, reporting an average holding period of 4.4 years for secondary buyouts and 3.7 years for IPOs in the European deal market.

Table I - Buyout Distribution by Industry and Investment Year

Table I provides an overview of the buyouts distributed by entry year and industry. The industry classifications are retrieved from Capital IQ, where Consumer Goods and Consumer Staples are merged into the category Consumer. The industry in Norway that received the most PE investments (both follow-up and initial) in 2019 was ICT (NOK 16.7 bn), followed by petroleum (NOK 7.7 bn), business related services and industry services (NOK 3.9 bn), financial services (NOK 1.4 bn), retail/consumer (NOK 610 mil), business related products and industry products (NOK 530 mil), and lastly, other energy sources, life science, construction and fishery and aquaculture, all equal to or below NOK 100 mil (NVCA, 2020). Compared to the Nordics, Norway is less diversified and relies more heavily upon offshore and energy related businesses (BVCA, 2016). However, while petroleum was the largest represented sector in PE funds combined portfolio of Norwegian companies a decade ago (in NOK), it has recently been exceeded by ICT and retail/consumer (NVCA, 2020). The three sectors combined now dominate the share of the PE funds' aggregated portfolios. Nearly all sectors have experienced growth and positive value creation since 2009, besides petroleum (-21%) and chemicals (-52%). Noteworthy, since 2009, ICT has nearly tripled its value creation contribution (NVCA, 2020). Total sample sector distribution can be seen in Figure A.I in the Appendix.

	Investment Year																
Industry	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Communication	0	0	0	0	0	0	1	2	0	0	2	0	2	0	1	1	9
Consumer	0	2	2	2	3	4	10	3	3	2	5	4	4	3	2	3	52
Energy	0	0	0	2	2	1	5	3	3	2	6	1	1	6	7	3	43
Financials	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	3
Health Care	0	1	0	2	0	1	1	3	2	0	2	1	0	1	2	0	16
Industrials	3	0	0	1	0	3	3	5	6	2	3	5	6	7	5	4	53
Information Tech.	0	0	1	1	1	2	2	2	6	2	4	1	6	2	1	3	34
Materials	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	3
Utilities	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Total	3	3	3	9	6	11	23	19	21	8	23	12	20	19	20	14	214

Table II - Buyout Distribution by Deal Type and Investment Year

This table illustrates the buyout distribution by deal types occurring between 2000 and 2015 for the final sample. Same table is provided as a figure in the Appendix (Figure A.II). When it comes to deal types in Norway, Bienz, Thorburn and Walz (2016) finds that most buyouts in Norway are indeed private-to-private transactions. In their sample of 62 Norwegian portfolio company investments made by 20 Nordic LBO funds between 2000 and 2010, only two out of the PE transactions were public-to-private (Bienz et al., 2016). For the Nordic region, trade sales and secondary transactions account for about two-thirds of the exits, whilst IPOs remain low (BVCA, 2016).

	Investment Year																
Deal type	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Divisional	0	1	1	3	1	1	3	1	2	2	4	2	2	8	2	3	36
PIPE	0	0	1	0	0	0	0	0	2	1	1	0	0	0	2	0	7
Private-to-private	3	1	0	6	3	7	14	15	15	2	14	7	13	7	9	7	123
Public-to-private	0	0	0	0	2	1	2	1	2	3	1	0	1	0	0	1	14
Secondary	0	1	1	0	0	2	4	2	0	0	3	3	4	4	7	3	34
Total	3	3	3	9	6	11	23	19	21	8	23	12	20	19	20	14	214

Table III illustrates the distribution of exit types and the corresponding holding period for each type. Total holding period is a weighted average and median based on the frequency of each exit type and adjoining holding period based on the full sample of 214 buyouts. We have distinguished Secondary from Financial exits to separate exits to other PE funds from other financial buyers. The category "Other" predominantly consists of HitecVision selling portfolio companies to their own industrial group Moreld, and also includes three other transactions where the managers or founders have bought back the company. Note that holding periods are computed from entry to complete divestment. Hence, the holding period for IPO outcomes do not correspond to the holding period from entry to IPO. For sample distribution by exits overall see Figure A.III in the Appendix.

Table III - Distribution by Outcome

Exit Type	Freq.	Percent	Years Held (avg.)	Years Held (med.)
Bankruptcy	13	6.2	7.1	6.4
IPO	16	7.7	7.2	6.8
Not exited	43	20.6	8.0	7.5
Other	11	4.8	8.1	7.2
Other Financial Buyer	16	7.2	6.5	5.4
Secondary	53	24.9	5.9	5.4
Strategic Buyer	62	28.7	5.8	5.5
Total	214	100.00	6.6	6.1

A possible bias source that could potentially affect the sample is the early exit of portfolio companies. Particularly underperforming companies might be exited early due to bankruptcy, while overperforming companies might be exited early due to an IPO or an acquisition. If accounting data is not available for at least 1 year post-buyout, the transaction is excluded. To control for the potential upward bias of early bankruptcy, we have identified the exit date and exit type for all transactions. In total, only 2 portfolio companies are bankrupt within 1 year after acquisition out of a total 14 write-offs. The remaining 12 bankruptcies/write-offs are hence included in the sample as their performance is measurable post-buyout. The potential bias of losing 2 bankruptcy transactions is considered negligible.

In sum, our sample represents PE firms across a wide spectrum of investment strategies, size, and industry specialization. Hence, the data consists of a prominent range of different firms which are considered to be very robust for capturing the overall PE-ownership effect in Norway. In total, the data significantly extends the samples used in previous research on Norwegian PE portfolio companies, and it captures a significant part of the buyout activity that has occurred in Norway since 2000.

4.3 Operating Performance Metrics

The best measure of periodic performance in an uncertain world is book yields (Vatter, 1966; Demsetz, 1997; Peasnell, 1996). Return on Equity (ROE) and Return on Net Operating Assets (RNOA = NOI/NOA) are two commonly applied book yield measures, where NOI is Net Operating Income and NOA is Net Operating Assets. RNOA would likely be the ideal measure of operating performance. This is because it allows us to isolate operating profitability from leverage effects with corresponding required risk normalization adjustments. A decomposition of return on equity, similar to Penman (2013) illustrates this point:

$$ROE = \underbrace{RNOA}_{\text{Operating Performance}} + \underbrace{(RNOA - Net\ Borrowing\ Costs)}_{\text{Spread}} * \underbrace{\frac{NFO}{Equity}}_{\text{Leverage}} \quad (1)$$

$$\underbrace{RNOA}_{\text{Operating Profitability}} = \underbrace{\frac{NOI}{Sales}}_{\text{Operating Margin}} * \underbrace{\frac{Sales}{NOA}}_{\text{Operating Turnover}} \quad (2)$$

Which can be expressed as: ROE = RNOA + [FLEV x SPREAD][28]. ROE is here decomposed into the part attributable to operating performance (RNOA) and the part attributable to financial leverage (the spread between RNOA and net borrowing costs scaled by financial leverage)[29].

However, calculating RNOA is challenging without access to detailed accounting information (typically from notes in annual reports) as many adjustments such as classification of operating versus financial items need to be made depending on the respective company's line of business. Furthermore, NOI takes taxes into account, which makes the results less comparable cross-border and to previous literature which

[28] Where FLEV is financial leverage and SPREAD is the difference between the return on net operating assets (RNOA) and net borrowing costs.

[29] Defined as net financial obligations (NFO).

predominantly use pre-tax measures (Ayash & Schütt, 2016). Therefore, there are two alternative measures that could be applied as a proxy for NOI: EBITDA and EBIT.

Earnings Before Interest, Tax, Depreciation and Amortization (EBITDA) is considered the best measure of earnings as it is not affected by changes in the capital structure and in depreciation, amortization, interest charges and tax payments potentially resulting from a levering up of the portfolio company (particularly in LBOs). Within a PE context, measures such as net income can mechanically decrease even though the underlying company's operations are unchanged (Phalippou & Morris, 2019). Therefore, PE portfolio companies' net income is not comparable to other privately held companies. EBITDA is also likely the best representation of operating cash flows (Phalippou & Morris, 2019).

As an alternative, Earnings Before Interest and Tax (EBIT) takes depreciation and amortization into account and ensures that expenses related to investments are captured. Kothari et al. (2002) argue that such investment expenses should be taken into account, since re-investments are required to sustain operating performance and growth. However, EBIT has some considerable limitations in a buyout context, as depreciation and amortization often increase post-buyout as a result of accounting-based asset write-ups of fixed tangible assets and goodwill to account for the premium paid to acquire the portfolio company (Ayash & Schütt, 2016). Thus, the EBIT/Asset ratio will, ceteris paribus, deteriorate post acquisition despite unchanged underlying operating performance. EBIT is also vulnerable to differences in accounting standards (IFRS versus Norsk Regnskapslov) and depreciation practices. Therefore, EBIT has serious shortcomings as a measure of PE operating performance and as the research objective of this thesis is to evaluate PE's operational rather than financial engineering performance, we conclude that EBITDA is the most appropriate representation of PE portfolio companies' operating earnings. This conclusion is consistent with the consensus in academic literature (see e.g., Phalippou & Morris, 2019; Ayash & Schütt, 2016).

Applying EBITDA as a measure requires, however, as outlined above, an asset denominator to capture the book yields and the dynamics of either internal (capital expenditure or current assets) or external (acquisitions and divestments) investments in PE portfolio companies (Phalippou & Morris, 2019). An increasing share of PE transactions are also based on growth or buy-and-build strategies where a company is acquired and used as a «platform» for consolidating fragmented industries through multiple add-on acquisitions or for building

positions in international markets through acquisitions. There are ways to adjust for these dynamics such as applying unconsolidated financial statements for the platform company (thereby excluding the impact of add-on acquisitions) or exclude buy-and-build strategies from the sample. However, the best methodology advocated in the majority of PE research including Phalippou & Morris (2019), is to apply assets in the denominator which is consistent with the overall value creation framework outlined in the introduction of this section. More specifically, we reflect the capital by scaling EBITDA by Total Assets to obtain a ROA measure as a proxy for RNOA.

Total Assets has, however, some challenges that need to be addressed to obtain a meaningful metric for measuring developments in operating performance. A buyout often leads to a "fair value step-up" or a "structural break" in the financial statements as the acquisition often triggers a revaluation of the portfolio company's assets from historic cost to fair value[30] (Ayash & Schütt, 2016). More specifically, the PE firm usually pays a premium over a company's net book value in a buyout, and this premium is added to the balance sheet's long-term assets as goodwill. This revaluation of assets creates a discontinuity between pre- and post-transaction Total Assets, and consequently bias post-buyout ROA downwards (Phalippou & Morris, 2019). Most studies, such as Kaplan (1989), Guo et al. (2011) and Cohn et al. (2014) address this structural break by grossing up the pre-transaction Total Assets number, and typically, goodwill associated with the buyout comprises the majority of the difference between the pre- and post-acquisition balance sheet (Ayash & Schütt, 2016). It is, however, important to note that including assets in the denominator has some disadvantages as the EBITDA/Total Assets metric can be impacted by write-offs and amortization of goodwill over time (Ayash & Schütt, 2016) and by differences in accounting standards (IFRS vs NGAAP). Methodologies which remove goodwill by applying only tangible assets in the denominator as suggested by Ayash & Schütt (2016) is one possible solution to address this issue. On the other hand, acquisitions can be considered a substitute for organic capital expenditures and not including goodwill would "punish" companies pursuing organic capital expenditures and favor acquirers. Hence, this latter approach by Ayash & Schütt (2016) introduces a bias of its own. We therefore conclude that the most

[30] According to Rskl. §§ 5—14 and 5—19 acquisitions trigger purchase accounting. There are certain exemptions for mergers of two equal sized companies where the continuity method can be applied, and the original value of balance sheet items is maintained. According to § 5--16 "small enterprises" ("små foretak") can maintain assets at balance sheet values. The same principles apply for IFRS (for consolidated accounts).

robust way to construct the metric is to gross up the pre-transaction assets to fair value for buyouts.

The portfolio companies of which the pre-transaction assets should be grossed up are identified as those that have changed organizational number from T-1 to T+0 as this legal structure buyout technique triggers fair value accounting from the buyout itself. To elaborate, a buyout fund often uses an empty holding company as an acquisition vehicle which later on merges with the portfolio company (Bienz et al., 2016). This process triggers the revaluation of the portfolio company's asset base (see Rskl. §§ 5—14 and 5--19). Therefore, the asset base in the buyout year (T+0) is scaled back to T-1 for the relevant companies. To control for the possible bias introduced by this approach, a verification analysis of EBITDA/Tangible Assets (*tan* ROA) is conducted to ensure that the pre-transaction base reflects appropriate fair value, where we have subtracted the intangible assets from the total assets.

As a further breakdown of ROA, we will also analyze its components Return on Sales (ROS), measured as EBITDA/Sales to assess the change in profitability after operating expenses, and the changes in the Asset Turnover (Sales/Assets) to assess how effectively the companies are utilizing their assets to generate sales. Furthermore, we analyze developments in sales and EBITDA to identify differences in growth between the buyouts and the control group. Turnover growth is widely used in previous research as a measure of economic performance at company level and is of high relevance as growth above cost of capital is driving value creation, and an increasing amount of PE strategies focus on this area.

We will also analyze changes in working capital in relation to sales as an additional key measure to capture drivers of asset productivity, similar to Holthausen & Larcker (1996). This ratio defines the relationship between the capital that funds and the revenue generated from operations, hence how efficiently capital is employed to run the business (Petersen et al., 2017). A standard working capital/sales ratio (WC ratio), defined as current assets - current liabilities divided by sales is applied. We also include a second measure of working capital efficiency, adjusted net working capital to sales (Adj. NWC ratio), calculated as Accounts receivable + Inventory - Accounts payable - Accrued liabilities - Taxes payable divided by sales. This measure excludes liquid and non-operational (i.e. financing) elements from consideration. Hence, this measurement relates to the purely operational aspects of a business.

Conclusively, we apply EBITDA/Total Assets to measure operating profitability and decompose this measure into Return on Sales (ROS, measured as EBITDA/Sales) and asset turnover (Sales/Assets). We also apply Working Capital/Sales and adjusted Net Working Capital/Sales to capture underlying asset-related productivity performance improvement in areas that are considered key levers targeted by PE sponsors. Overall, these operating profitability measures focus on the ability of the PE firm to improve the operating performance of the portfolio company. This includes cost reductions and margin improvements, elimination of unproductive assets, more efficient use of remaining assets, or making value-enhancing acquisitions. We also apply growth in sales and EBITDA to capture growth related performance differences.

4.4 Construction of the Control Group

In this section we will highlight why we consider propensity score matching (PSM) to be the preferred method for constructing control groups for benchmarking and testing operating performance of PE backed companies. Furthermore, applying PSM, we will outline 1) how we construct the distance measure, 2) how we choose and implement an appropriate matching method and 3) how we assess the quality of the matches and analyze the outcome and estimation of the treatment effect.

Propensity Score Matching: The Preferred Method

Identifying whether PE investors causally impact the portfolio company's operations and performance is challenging as PE firms do not select portfolio companies randomly. However, if the treatment is randomly allocated it ensures that the treatment status will not be confounded with either measured or unmeasured baseline characteristics (Austin, 2011).

Hence, the treatment effect on outcomes can be directly estimated by comparing outcomes between the treated and untreated subjects (Greenland et al., 1999). If the decision to invest is randomly assigned, this can be done by simply calculating the difference between the average outcome for portfolio companies and non-PE-backed companies, referred to as the population Average Treatment Effect (ATE), formulated as $\tau ATE = E(\tau) = E[Y(1) - Y(0)]$. The ATE parameter is the difference of the expected outcomes after treatment and no treatment on all individuals, thus the average effect in the population of moving an entire population from untreated to treated (Austin, 2011; Caliendo & Kopeinig, 2008; Stuart,

2010). As such, the ATE parameter is the expected effect on the outcome given that portfolio companies were randomly selected by PE funds.

The ATE estimate includes, however, the effect on all companies, even those who PE funds would not consider acquiring. Also, the fact that buyout targets are chosen based on certain company-specific and market characteristics makes the selection process non-random. More specifically, PE firms often specialize in certain industries making some industries more prone to buyout activity than others, and often select firms that have improvement- and growth-potential, and preferably strong financial positions (Cressy et al., 2007; Harris et al., 2005; Tykvova & Borell, 2012; Boucly et al., 2011; Gompers et al., 2016). PE activity also correlates with economic cycles (booms and busts), making timing a non-random factor as well (Kaplan & Strömberg, 2009). Hence, a more suitable evaluation parameter of the treatment effect is the Average Treatment effect for the Treated (ATT), and is given by: $\tau ATT = E(\tau|D = 1) = E[Y(1)|D = 1] - E[Y(0)|D = 1]$. ATT is defined as the difference between expected outcome values with and without treatment for those who participated in treatment (Caliendo & Kopeinig, 2008). As such, the ATT estimate compares the average outcome of the portfolio companies with PE-backing, against the counterfactual outcome where they are not backed by a PE firm, making this a much more appropriate parameter to apply. Hence, we will focus on the ATT, similarly to the majority of evaluation studies (Caliendo & Kopeinig, 2008). Nonetheless, the counterfactual - $E[Y(0)|D = 1]$ - is non-observable since the decision to invest is a dichotomous variable, thus we have to find a proper substitute.

Ideally, we would compare two identical firms where one is acquired by PE (treated) and one is not (untreated). Since we are unable to observe both the treated outcome and the untreated outcome for the same portfolio company, the standard approach in the literature is to match PE-backed companies with control firms selected using observable characteristics. Such counterfactuals will generate unbiased estimates under the assumption that these characteristics that define the untreated are exactly the ones that led PE to invest in the portfolio company in the first place. Given the lengthy due diligence and high stakes involved, this is a quite strong assumption[31]. Moreover, making the matching ceteris paribus

[31] Gompers et al.'s (2016) survey reports that out of every hundred opportunities considered by a PE investor, fewer than 24 are deeply analyzed, less than 14 involve signed letter of intent and only 6 are closed.

is difficult due to unobservable dimensions such as future prospects, level of expertise, quality of management, ability to adapt and scalability. These systematic differences challenge any determination of causal inference from receiving PE-treatment by introducing selection bias that need to be accounted for (Rosenbaum & Rubin, 1983). If not accounted for, any statistically significant relationship could potentially be attributable to PE firms repeatedly picking winners that perform well independently of receiving PE funding, and not as an effect of enhanced value creation from PE ownership. Hence, the potential superiority in operating performance could derive from superior company-selection skills rather than superior ownership attribution. Therefore, the construction of the control group, i.e., the counterfactual in the ATT estimator, needs to adjust for factors such as industry- and firm-characteristics and market timing to estimate the effect of PE-backing alone. If the counterfactual works as intended, meaning that all extraneous variables are controlled for, it assures that the only difference between the two groups is the treatment from PE-backing (Olmos & Govindasamy, 2015). A way to achieve this is by applying Propensity Score Matching which allows us to estimate the ATT (Imbens, 2004).

4.4.1 Implementation of Propensity Score Matching

PSM is a statistical technique that has proven useful to evaluate treatment effects when using observational data[32] (Austin, 2011; Rubin, 1983). Using PSM makes it possible to design a study that imitates some of the characteristics of a randomized study (Austin, 2011). The propensity score is the probability of treatment assignment (in our case being subject to a PE buyout) conditional on observed baseline characteristics (Rosenbaum & Rubin, 1983). Hence, we have: ($z = i$ |X), where z = treatment, i = treatment condition, and X = covariates. As the likelihood of receiving treatment is non-random, the probability ($z = i$ |X) is unknown. But it can be estimated from the data using a logistic regression model, where treatment assignment is regressed on the set of observed covariates (Olmos & Govindasamy, 2015; Austin, 2011). Thus, PSM involves constructing matched sets of treated and untreated subjects who share a similar value of the propensity score, i.e., same likelihood of receiving treatment (Rosenbaum & Rubin 1983, 1985; Olmos & Govindasamy, 2015). More

[32] The method has been used in several similar studies, see e.g., Cohn et al., 2014; Ayash & Schütt, 2016; Bienz et al., 2016; Friedrich, 2015; Bakke & Bull-Berg, 2016; Halvorsen & Johansen, 2017).

specifically, similar to randomization, propensity score matching aims to balance[33] the distribution of observed covariates between treated and untreated subjects (Stuart 2010; Austin, 2011). The procedure involves identifying companies that have similar observable characteristics (covariates) to the portfolio company pre-buyout to create a control group. As such, the control group will serve as the counterfactual of the portfolio companies' performance had it not been acquired by PE. Moreover, the companies in the data set are matched on the propensity score whereupon companies that share the same score are regarded as equal, even though they may vary on the specific values of the covariates (Holmes, 2014). Although PSM have some drawbacks in their approximation of randomized experiments, these are more apparent in smaller data samples (King & Nielsen, 2019). In sum, PSM is a forceful method extensively applied to balance out imbalanced data sets to provide adequate matches between the control and treatment groups and removes the effects of reciprocal interdependencies when estimating the effects of treatment on outcomes, allowing for the estimation of ATT (Austin, 2011). Therefore, we will apply PSM to construct a control group aimed at controlling for the endogeneity of the buyout decision and reducing selection bias.

However, there are two main assumptions associated with causality that need to be satisfied for the PSM method to work (Draper & Smith, 1998). The *ignorable treatment assignment assumption* (ITAA) says that treatment assignment is independent of the potential outcomes conditional on the observed baseline covariates (Caliendo & Kopeinig, 2008; Austin, 2011). The other assumption is *common support* which states that there is a positive probability of being in the untreated and treated group for each value of a covariate, also described as *overlap* between the two groups (Austin, 2011). Under random assignment these assumptions hold, and the true propensity score is known. However, why some companies receive PE-funding is not random. Hence, it is important that we can identify and control (match on) all the reasons why some companies are in the treatment or control group. If important variables that are believed to be critical in the selection process are ignored, it will increase the bias of the estimated results. This is commonly referred to as endogeneity issues, which influences the ability to determine causal relationships (Olmos & Govindasamy, 2015).

[33] Stuart (2010) defines "matching" broadly to be any method that aims to equate (or "balance") the distribution of the covariates in the treated and control groups.

Stuart (2010) provides three key steps involved for creating the PSM sample and to satisfy the two assumptions mentioned above; 1) determine the distance measure, 2) choosing and implementing an appropriate matching method and 3) assessing the quality of the matches and analyzing the outcome and estimation of the treatment effect.

Determine the Distance Measure

To construct the distance measure, one must decide which covariates to include before combining those covariates into one distance measure (Stuart, 2010). A key concept here is to satisfy the strong ignorability assumption when determining the covariates. To do so, there must not be any unobserved differences between the treatment and the control groups, conditional on the observed covariates. Consequently, all known variables that are linked to both the treatment assignment (PE's decision to invest) and the outcome (post-buyout performance) must be included in the matching procedure (Stuart, 2010; Rubin & Thomas, 2000). If such variables are omitted it can increase the bias in the estimates (Heckman, 1997). Meanwhile, Rosenbaum (1984) notes that it is important to include only variables that are not influenced or modified by participation or anticipation of treatment in the model (Austin, 2011). Measuring the variables prior to the investment (T-1) or holding them fixed over time would ensure this, and reduce the bias (Caliendo & Kopeinig, 2008; Barber & Lyon, 1996).

The previously discussed changes PE usually implements in the buyout-year implies that in the buyout year, the variables have been affected by the treatment. Therefore, matching on the buyout year (T+0) conflicts with the strong ignorability assumption. It further implies that the propensity score value (in the buyout year) will be a biased estimate of the treatment effect at that propensity score value, thus matching on T+0 leads to biased estimates (Stuart, 2010). On a more practical level, the P&L of holding companies that are registered during the year of entry often only account for profit and loss items (i.e., revenues and costs) since the actual date of registration and closing of the transaction, and not the entire year. Matching on the year of acquisition would hence bias the control group, since the P&Ls of the treated group are understated in the year of acquisition. This would result in an overstatement of the post-buyout operating performance of the treated group relative to the control group. By matching on the pre-buyout year and excluding the year of PE entry in our analysis, we ensure proper matching and avoid these pitfalls. As previously mentioned, we have therefore conducted extensive research to obtain and evaluate accounting data and other

company specific facts one year prior to the investment, in order to substantially reduce the bias without losing a significant amount of observations. The same approach is recommended and used by Kaplan (1989), Holthausen & Larcker (1996), Cao & Lerner (2006), Boucly et al., (2011) and Ayash & Schütt (2016), among others.

Further, when deciding on which variables to add, it is important to take into account that including non-significant variables in the propensity score specification can increase their variance but will not bias the propensity score estimates (Bryson et al., 2002). Additionally, an over-parameterized model may exacerbate the support problem (Bryson et al., 2002; Augurzky & Schmidt, 2001). However, Rubin & Thomas (2000) argue that a variable should only be excluded if the variable is unrelated to the outcome or not an appropriate covariate, and if in doubt their advice is to include the relevant variables in the PSM estimation. As such, there exists arguments both for and against including all the reasonable covariates available. In sum, as stated by Caliendo & Kopeinig (2008), these points imply that one should base the inclusion of the variables on economic theory and previous empirical findings. To use theoretical evidence as guidance is also suggested by Rubin (2001), Sianesi (2004), Smith & Todd (2005) and Olmos & Govindasamy (2015).

We have applied a large survey of PE investors who were asked how they select comparable companies for multiple valuation and/or exit value as well as previous research to determine the variables for matching the treatment group and the control group. Based on the empirical survey by Gompers et al. (2016), PE investors choose comparable companies based on the following characteristics and ranked order of importance; industry, firm size, growth, margin and capital intensity. Moreover, increases in sales and capital intensity tend to be some of the largest changes of companies subject to a buyout (Biesinger et al. (2020). Thus, based on Gompers et al. (2016), Biesinger et al. (2020) and previously mentioned literature such as Ayash & Schutt (2016), we match on the following variables: *industry* (to control for different industry characteristics and performance trajectories such as different industry life cycles), *year* (to control for macro-trends and other effects influencing performance), *log of Total Sales* (as a proxy for firm size to control for firm life cycle and future growth opportunities[34]), ROS (*EBITDA/Sales* to account for differences in margins), and lastly

[34] Log of sales is a widely used proxy for firm size in empirical corporate finance. See e.g., Dang & Li's Measuring Firm Size in Empirical Corporate Finance (2015).

Sales/Total Assets (as a measure of asset turnover and to account for the capital intensity, i.e., Total Assets/Sales). These are all assumed to affect the post-buyout performance as well as control for pre-event performance given that we match on the year prior to buyout and have control for industry. We regress treatment (e.g., subject to a buyout) on the covariates to determine if they are associated with treatment assignment. The results are reported in the Appendix in Table A.I and indicate that all covariates except EBITDA-margin are related to the buyout decision in our sample. This regression is conducted on various variables (of which the results are for brevity not reported), and ROA is for instance not found significant in our sample. We indirectly control for differences in profitability (ROA) by matching on its subcomponents (asset turnover and EBITDA-margins). Noteworthy, there is a trade-off between the sample size and satisfying the ignorable treatment assignment assumption. Given that the matching procedure requires complete information on all parameters included in the model, any missing variable-information will lead to reduced quality of the matched sample. Thus, we have to consider the data observations we have available to make sure we only include variables that have sufficient observations. Optimally, we would match on pre-buyout performance growth such as sales growth. However, the data lack many observations for T-2 and T-3 which are necessary to determine pre-growth leading up to the buyout[35]. Additionally, as the number of covariates increases, it becomes difficult to find good matches for companies in the treatment group.

Furthermore, determining the covariates used for matching involved testing for imbalances in covariates across the buyout group and the control sample prior to matching. We performed an omnibus test through chi-square tests to check for variables in the selection model for which the buyout and the control group are different, in line with Hansen & Bowers (2008). The results of this test on the chosen covariates indicates that at least one of these variables is creating a considerable imbalance between the buyout and the control group. The variables that were unbalanced were included in the matching process, and we selected those which best reduced the imbalance in the key variables sales, ROS (EBITDA-margin), asset turnover, ROA and EBITDA. We did not match on ROA and EBITDA as the chosen covariates for the matching process (sales, asset turnover and EBITDA-margin) together cover these variables and including them in the matching process increased the

[35] Using the growth from T-1 to T+0 will not provide a viable measure for growth due to the accounting distortions affecting the buyout year.

imbalance likely due to an over-parameterization of the model. Moreover, when there are many covariates or lots of variation, propensity scores provide the advantage of, according to Olmos & Govindasamy (2015), reducing the number of covariates needed to be controlled for, by summarizing many covariates into a single measure.

After determining which variables to include, the next step is to define the *distance*, i.e., how the covariates are summarized into one scalar given the similarity between two individuals and help to determine whether an individual is a good match for another (Rosenbaum & Rubin, 1983; Stuart, 2010). Firstly, for the matching to be meaningful it is imperative that we match exactly on industry and year[36], prior to matching on other variables. This is essential to satisfy the strong ignorability assumption. Hence, we apply exact matching on the year prior to buyout and industry, the latter by matching on the category variable *Sector* provided by the SNF database to control for industry specialization and market timing effects (see Table A.II in the Appendix for sector list). For all other variables we use propensity scores estimated by using a logit probability model, which is widely used in PSM (Olmos & Govindasamy, 2015). The estimated propensity score is the predicted probability of treatment derived from the fitted regression model. Thus, we combine both exact and propensity score matching, as proposed by Stuart (2010), which allows us to find the control company with the closest propensity from the logit estimation in the same industry and year.

Choosing and Implementing an Appropriate Matching Method

The next step after the distance measure has been selected, is to decide how the portfolio companies are matched with the control group. There are various applicable matching methods which involve the different weights individuals receive as well as the number of individuals that remain in the control group after matching (Caliendo & Kopeinig, 2008). The most conventional and easiest to implement is the so-called *k* : 1 Nearest Neighbor (NN) matching, which selects the *k* companies from the control group that has a propensity score closest to the portfolio company's score (Stuart, 2010; Rubin, 1974). NN is also described as the most effective method for settings where the goal is to select individuals for follow-up analysis, and for estimating the ATT in scenarios with many more controls than treated individuals (Stuart, 2010). The universe (the SNF database) from which the algorithm can

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select control companies consists of all Norwegian registered companies[37] (ranging from approximately 140 000 in 2000 to 300 000 in 2015), compared to 214 portfolio companies. For these reasons, we apply the NN matching method.

Further, there are different alternatives for how the NN matching method can be implemented (see Figure A.IV in the Appendix). We have chosen the alternative which allows for replacement. This implies that a control company can be used more than once as «nearest neighbor» for several portfolio companies. Allowing for replacement will decrease the bias as it increases the average quality of matching (Caliendo & Kopeinig, 2008). Meanwhile, it can reduce the number of distinct control companies used to construct the counterfactual outcome, thus increasing the variance of the estimator (Smith & Todd, 2005). Nonetheless, disallowing for replacement can lead to poor matches for several portfolio companies sharing similarity in covariates. As we believe good quality matches outweigh the disadvantages of estimator variance, we allow for replacement, but also monitor the number of controls to ensure that the treatment effect is not estimated based on a small number of controls (see Table A.III in the Appendix).

Lastly, we determine how many neighbors to include in the matching sample for each respective portfolio company. Again, this involves a trade-off between bias and variance. The variance might decrease with increasing amounts of control companies (neighbors) used, while the bias might increase due to poorer matches being included. Using fewer control companies will thus likely reduce the bias due to better matches (Smith, 1997). However, in large samples Smith (1997) and Rubin & Thomas (2000) argue that one should prefer to include more matches for each treated observation. Thus, given that the control group is substantially larger than the treatment group, including more companies from the control group matched to every portfolio company likely implies better estimates for the counterfactual in the control group (Olmos & Govindasamy, 2015). Usually, the number of controls to each treated observation is between 1 and 5 (Randolph et al., 2014). Matching on only the closest company conditioned on the propensity score, i.e. 1 : 1, leads to poorer balancing of covariates than 5 : 1 in our sample (see Table A.IV in the Appendix). In previous literature, 5 : 1 is commonly used as it is a good approach to the trade-off between

[37] The 214 PE portfolio companies are excluded from the universe of possible control companies to prevent that PE portfolio companies are selected as their own controls.

variance and bias, and we follow that construction as well. Each neighbor is equally weighted.

Notably, there might be a risk of bad matches if the closest neighbor is far away from the portfolio company in terms of propensity score. If so, we would conflict with the common support assumption. Hence, to control for potential poor matches we test with a caliper of 0.1 and 0.2 in combination with NN to restrict the control group by imposing a maximum tolerance level for the propensity score distance. However, while the caliper of 0.1 (0.2) reduces the treated sample by 9 (5) companies, the effects on bias and variance are negligible (see Table A.V in the Appendix). This is due to the vast sample size of untreated observations and that we allow for replacement. We therefore apply NN matching without a caliper to include all portfolio companies in the sample.

Assessing the Quality of the Matches

After choosing the matching method we assess the quality of the model by checking if the matching procedure is able to balance the distribution of the included variables in both the matched control companies and portfolio companies. The assessment is conducted by comparing the situation pre- and post-matching and checking for any remaining statistical differences after conditioning on the propensity score (Caliendo & Kopeinig, 2008; Austin, 2011). The quality of the matching is provided in Table IV.

To compare the similarity of treated and untreated subjects in the matched sample we calculate the standardized differences in means between the groups (Austin, 2011; Ho et al., 2007). The standardized mean difference is calculated by dividing the difference in means between the treated and untreated covariates by the standard deviation in the treated group (square root of the average sample variance of the covariates in both groups). Although no universally determined criterion threshold exists, Normand et al. (2001) states that a standard difference less than 0.1 indicates that the difference in mean between the groups is negligible, which is the case for all matched covariates in our sample. Table IV also illustrates a substantial reduction of (initially large) differences in means stipulated as percent balance improvement. Furthermore, the variance ratios are analyzed. The variance ratios should be within 0.5 and 2, and preferably close to 1 (Rubin, 2001). Even though the variance ratio of the EBITDA-margin has improved substantially as a result of the matching, it is slightly outside the preferred range.

As suggested by Rosenbaum & Rubin (1985) we also conduct a two-sample t-test to see if there are any significant differences in covariate means within the propensity score matched sample. Post-matching there should be balance in both groups, implying that no significant differences in the means of the propensity score matched groups should be found. The t-tests indicate that the groups are balanced. However, relying on statistical significance testing to detect imbalances in covariate means between treated and untreated subjects may produce misleading results since significance levels can be confounded with the reduced sample size of the matched sample compared to the original sample (Austin, 2011; Imai et al., 2008). Thus, the standardized differences in means and variance ratios are emphasized. Additionally, we assess the distribution of the propensity scores between the matched treated and control units to ensure that the individuals are within the area of common support based on overlap in the distribution of both groups (see Figure A.V in the Appendix).

Overall, the chosen propensity score matching is implemented through the three steps to satisfy the main assumptions in the PSM. Resultantly, NN 5:1 matching with replacement results in a substantial reduction of imbalances in the covariates between the buyout group and the control group. The imbalances between the buyout group and the control group were significant prior to matching, which reflects PE's tendency to carefully select buyout targets. Achieving full balance within two groups with such systematic different characteristics is practically not possible to achieve. However, although the ratio of variances between the two groups with respect to the EBITDA-margin is not as similar as we would prefer, matching quality appears to be high. The significantly more balanced data set makes parametric methods a much more reliable tool for empirical analysis and provides more confidence in the corresponding conclusions of PE's operating performance relative to a carefully constructed control group. However, even though the bias between the two groups is substantially reduced by PSM, some bias might still exist. More specifically, since it is likely to exist unobservables affecting both the treatment decision and the outcome, the model might not explain all differences between the two groups. Thus, we still have to be careful in interpreting the results casually as there are likely other effects in play that are not fully accounted for.

Table IV – Bias Reduction in Covariates

This table provides an assessment of the reduction in covariates means at the year prior to buyout between the buyout and control group, as well as the total number of observations and controls. *Unmatched* shows the balance for all the data without matching and provides the means of the buyout companies and the control companies and the standardized mean difference between the two groups and variance ratio. *Matched* shows the same after five-to-one nearest neighbor matching with replacement. We see vast improvements in reduced bias and variance ratio, and the percent balance improvement shows the percentage improvement by using the matched data relative to all data. A higher P-value indicates better matching quality.

5 : 1 Nearest Neighbor Matching

Matched Variables	*Sample*	*Buyout Group*	*Control Group*	*Standardized Mean Diff.*	*Percent Balance Improvement*	*Var.Ratio*	*T-test, P-value*
Year	Unmatched	2008.3925	2009.3131	-0.2452		0.3865	0
	Matched	2008.3925	2008.3925	0	100.00%	1.00037	1
Industry	Unmatched	6.6121	7.5135	-0.3207		1.6422	0
	Matched	6.6121	6.6121	0	100.00%	1.00037	1
Log Sales	Unmatched	12.749	7.7104	4.182		0.312	0
	Matched	12.749	12.753	-0.0031	99.90%	0.9617	0.967
EBITDA/Sales	Unmatched	0.1283	-0.7718	5.827		0	0
	Matched	0.1283	0.1161	0.0791	98.60%	0.4549	0.355
Sales/Assets	Unmatched	1.5618	2.3611	-0.9797		0.001	0
	Matched	1.5618	1.5822	-0.025	97.50%	0.5951	0.7521
Number of observations	Unmatched	214	3192017				
	Matched	214	1056				

4.5 Empirical Setup

In this section we provide the methods for measuring the overall operating performance, specialization effects and the performance of different deal types.

4.5.1 Operating Performance

We analyze performance by calculating the difference-in-difference for the previously discussed key operating performance metrics for PE backed companies relative to the control group. More specifically, the change in each metric from T-1 (the pre-buyout year) to each respective year up to 5 years post-buyout is computed for the PE portfolio companies and for the control group. This is also conducted from T-1 to the last full year prior to exit for each portfolio company (and its corresponding matched control group) or to the last available accounting year if the company is still private. Below is an example of how the Difference-in-Difference (DiD) estimator is calculated, where *i* assigns the year after the buyout, and 0 is the value in the year pre-buyout:

$$Diff - in - Diff = \left(EBITDA_{PE,i} - EBITDA_{PE,0}\right) - \left(EBITDA_{Control,i} - EBITDA_{Control,0}\right) \quad (3)$$

Hence, changes in PE portfolio companies' operating performance are measured relative to changes in each portfolio company's propensity score matched control group with similar characteristics (i.e. exact same industry and year, and similar pre-buyout performance). This allows us to estimate the effect of PE buyout on the portfolio companies (the ATT). Moreover, as the PSM methodology is designed to minimize the differences between the treatment group and control group in order to mimic a randomized assignment to treatment, we will test the differences in median and mean performance between the portfolio companies and the control companies in the matched sample in the years following the buyout. Consistent with prior literature, we provide initial evidence of the PE operating performance by testing differences in median performance using Wilcoxon signed rank tests. To formalize our tests, we subsequently perform a set of different regressions to add robustness to the results. Prior to running these regressions, the data is winsorized on the 98th and 2nd percentile to control for the effect of outliers in the data distorting the means[38]

[38] The observations below the 2nd and above the 98th percentile of the distribution are set to the values at the 2nd and 98th percentiles.

The means, however, are severely affected by extreme observations, particularly among the controls. A closer examination of these outliers indicates that the extreme values result from errors/typos in the accounting database. The outliers should therefore not convey any important information and are therefore winsorized. Since the medians do not impose the same issues as with the means, the initial analysis (prior to winsorizing) is conducted on medians in line with most of the previous literature and research (see e.g. Ayash & Schütt, 2016; Kaplan & Strömberg, 2009; Guo et al., 2011 and Boucly et al., 2011)[39].

We first analyze median percentage changes in all metrics for every year post-buyout. The percentage changes are measured relative to the level of the corresponding ratio in T-1, calculated as (same for the other variables as well):

$$\Delta ROA\ \% = \frac{(ROA_{t+n} - ROA_{t-1})}{|ROA_{t-1}|} \quad (4)$$

The reason why we use absolute value in the denominator is because some metrics are negative in T-1. Furthermore, the buyout-year (T+0) is omitted as it conveys little meaning to interpret due to the mentioned distortions to the accounting figures and we aim to only include full-year effects of PE ownership. Similarly, the exit year and corresponding accounting figures are retrieved from the year prior to exit due to several companies lacking full-year accounting data in the year they are acquired by a new entity.

Previous research on PE in Norway and the Nordics usually comprises the period from entry year (T+0) to T+3. One possible reason for this is that since exits cannot necessarily be considered exogenous, the assumption might be that 3 years will capture the PE-effect as the majority of all buyouts comprise a holding period of at least 3 years. Hence, they attempt to mitigate time- or exit-dependent factors which create biased results of underlying performance comparisons, given that good investments are on average exited early while bad investments are often exited later (Phalippou & Gottschalg, 2009). However, in addition to the three years post-buyout, we track performance changes post-buyout to T+5. This is due to the possibility of a "hockey-stick"-development in operating performance metrics under PE-ownership stemming from a lag-effect of implemented measures, especially on top-line. As discussed, the average holding period has gradually increased over time together with an

[39] We have also performed unreported t-tests on winsorized means which provided roughly the same results as the medians. However, we focus on medians similar to previous research.

increased amount of growth capital and higher frequency of buy-and-builds. SVCAs (2017) reported findings in Sweden of significant improvements from T+5 and onwards supports this view. Hence, analyzing only the three years subsequent to a buyout might not capture the *true* or complete value creation imposed by PE ownership. Consequently, the analysed period is extended to include not only the T+3-effect, but until T+5 as well. We argue that the years after T+3 are necessary to include in order to test whether PE-backed companies outperform its matched peer group.

As mentioned, one endogeneity problem with exits is that there might be a bias stemming from the most successful companies leaving the sample early (and prior to T+4 or T+5). GPs have strong incentives to exit particularly successful investments early due to the structure of the incentives, i.e., as carried interests are tied to measures such as IRR that favor early realizations of high performing investments. This can potentially downward bias the results since the organizational number identificatory in our database can change post-exit with new owners, and as such no longer be included. Meanwhile, if companies are exited early due to bankruptcy or restructuring, this will create an upward bias. If these biases are present, returns from T-1 to the last post-buyout fiscal year available prior to the exit, or the last available fiscal year for deals still private, may be most informative (Guo et al., 2008)[40]. We therefore analyze performance changes from T-1 to the last post-buyout fiscal year available prior to the exit, or the last available fiscal year for deals still private. We argue that this measure might yield the most relevant and informative picture of PE's operating performance. The performance of the investment over a certain period of time is not particularly relevant compared to the end result as this is what determines the investment outcome. Thus, in our opinion PE should be evaluated on their ability to create value over the entire ownership period. Consequently, the regression analyses are based on changes in operating performance from T-1 to exit.

4.5.2 Specialization Effect

In order to test the second hypothesis of whether there is a positive relationship between PE companies' degree of specialization by industry and performance, we construct a specialization dummy. This dummy is based on a constructed measure that captures the

[40] We have, however, controlled for the latter potential bias, as only 4 companies are bankrupt within 5 years post-buyout.

different PE firm's degree of specialization by industry, similar to (Cressy et al., 2007). This measure, called "the Index of Competitive Advantage" or "ICA index" is adapted from the literature on international trade and technological specialization (Archibugi & Pianta, 1994). We follow the method applied by Cressy et al. (2007) to compute the ICA index for each PE company over the same period by using each PE company's distribution of historical investments sorted on sector.

$$ICA_{ij} = (C_{ij} / C_{.j}) / (C_{i.} / C_{..}) \quad (5)$$

where the dot indicates summation over the relevant subscript and

C_{ij} is the number of portfolio companies of PE firm *i* in industry/stage *j*

$C_{.j}$ is the total number of companies invested in industry/stage *j* by all PE firms

$C_{i.}$ is the total number of portfolio companies of PE firm *i*

$C_{..}$ is the total number of companies invested by all PE firms (i.e. across all industries/stages)

The numerator in this measure ($C_{ij} / C_{.j}$) represents PE firm *i's* share of all investments in industry/stage *j* and the denominator ($C_{i.} / C_{..}$) represents its share in all investments across all industries.

The different PE companies' distributions of historical investments sorted on sector are retrieved from Capital IQ, in line with the sector of each transaction. Since our sample consists of 49 different PE companies of which many are foreign and have not conducted more than a few transactions in Norway, using their distribution of transactions conducted in Norway as a basis for determining their degree of relative specialization would not make sense. We therefore use each PE company's distribution of investments by sector in Europe as a basis for the calculation. However, the distinct characteristics of the Norwegian PE market, which is relatively skewed towards Energy, introduces a challenge. As the index is constructed to measure relative specialization among PE companies, transactions within less common sectors (such as Energy) relative to the entire population of transactions conducted by the respective PE companies (such as Consumer) are assigned more weight. Hence, PE companies with only a few investments within Energy are deemed specialized by the ICA index. We therefore apply a filter that requires a PE company to have conducted more than five transactions within any sector to be deemed specialized.

This index is used to generate an “Industry-Specialized” dummy that takes the value 1 for companies that are acquired by a PE company specialized in the respective company’s sector, (i.e., the ICA index>1 for the PE company). Applying this measure yields 140 specialized transactions out of 214. We first analyze how specialized PE investors perform relative to their constructed control group by examining changes in medians from T-1 to T+5 and exit. Similarly, we run a regression on the performance of specialized PE transactions relative to its controls from entry to exit to add robustness to our results. In a second regression, we analyze how specialized transactions perform relative to non-specialized PE transactions (generalists), to see if we are able to find any outperformance between the two groups relative to their respective control groups.

4.5.3 Deal Type

To test whether the deal types differ in performance, we include the following dummy variables: “Public-to-private”, “Private-to-private”, “Secondary”, “Divisional Buyout” and “PIPE”. Each buyout is assigned to one of these categories, based on collected transaction information from Factset, Valu8, Capital IQ, press releases and PE companies web pages. We run two regressions in a similar manner as the regressions testing for specialization effects. Hence, we run one regression where each deal type (except PIPE) is tested against its respective benchmark, and a second regression where the performance of each deal type relative to its respective benchmark is tested against the performance of private-to-private buyouts relative to its benchmark.

5. Empirical Results

In this section we present our findings and examine the (relative) impact of PE ownership on operating performance based on the described operating performance measures. In subsections 5.2 and 5.3 we test the hypothesis of advantages to specialization and whether performance varies by deal type.

5.1 Operating Performance

We first test the main hypothesis: *Does Private Equity have a positive (relative) impact on operating performance?* As mentioned, we have performed Wilcoxon signed rank tests on median performance changes and regressions on means. Table V below presents test results on median percentage changes in the first five years after the buyout (T+1, T+2, T+3, T+4, T+5) and the year prior to exit or the last available fiscal year if still private (Exit), all compared to the last year prior to buyout (T-1).

Examining the median levels in Table V of the operating metrics at the year prior to buyout (T-1), we note that these are quite balanced between the portfolio companies and the control group as a result of the propensity score matching procedure. However, while the return on sales is initially three percentage points higher for the portfolio companies than for the control group, the asset turnover is approximately twenty percentage points lower for the buyout group than the control group. Conversely, the median ROA is the same in both groups. The initial differences in *tan* ROA and working capital ratios are quite similar as well. In sum, we argue that these differences are acceptable as obtaining exact similar ratios across all metrics between the two groups is unattainable.

Table V – Post-Buyout Performance of All Buyouts

Panel A: Median Differences

	Values at T - 1		Difference Relative to T - 1											
	T - 1		T + 1				T + 2				T + 3			
	Buyouts Level	Controls Level	Buyouts % Change	Controls % Change	DiD	P-value	Buyouts % Change	Controls % Change	DiD	P-value	Buyouts % Change	Controls % Change	DiD	P-value
Sales	-	-	25%	10%	15%	**0.00*** **	41%	11%	30%	**0.00*** **	43%	13%	31%	**0.00*** **
EBITDA	-	-	21%	8%	13%	**0.04** **	34%	1%	32%	**0.01** **	41%	-3%	44%	**0.02** **
ROS	0.109	0.083	-10%	0%	-10%	0.71	-10%	-6%	-4%	0.77	-11%	-17%	6%	0.95
Asset turnover	1.238	1.434	9%	1%	7%	**0.07***	8%	-3%	10%	**0.04** **	4%	-2%	6%	0.16
ROA	0.111	0.112	-4%	0%	-4%	0.89	-9%	-19%	10%	0.30	-10%	-12%	2%	0.76
tan ROA	0.158	0.126	6%	-1%	7%	**0.09***	4%	-20%	23%	**0.02** **	2%	-9%	10%	0.15
WC ratio	0.075	0.079	-25%	-4%	-21%	**0.02** **	-38%	-10%	-28%	**0.05***	-33%	5%	-38%	**0.01** **
Adj. NWC ratio	-0.001	-0.024	-8%	-12%	4%	0.63	-13%	-2%	-10%	0.63	-21%	7%	-28%	0.15
Number of Obs.	214	1051												

			Difference Relative to T - 1											
			T + 4				T + 5				Exit			
			Buyouts % Change	Controls % Change	DiD	P-value	Buyouts % Change	Controls % Change	DiD	P-value	Buyouts % Change	Controls % Change	DiD	P-value
Sales	-	-	52%	22%	30%	**0.00*** **	57%	30%	27%	**0.00*** **	50%	20%	31%	**0.00*** **
EBITDA	-	-	46%	12%	34%	**0.02** **	44%	23%	21%	0.15	51%	18%	33%	**0.07***
ROS	-	-	-12%	-10%	-2%	0.95	-15%	-12%	-3%	0.93	-5%	-14%	9%	0.39
Asset turnover	-	-	5%	-2%	7%	0.20	6%	-1%	7%	0.35	4%	0%	4%	**0.05** **
ROA	-	-	-1%	-9%	8%	0.50	-10%	-18%	8%	0.58	0%	-16%	15%	0.27
tan ROA	-	-	9%	-11%	19%	**0.04** **	5%	-19%	24%	**0.08***	12%	-18%	30%	**0.03** **
WC ratio	-	-	-39%	18%	-57%	**0.00*** **	-40%	51%	-90%	**0.00*** **	-38%	13%	-51%	**0.00*** **
Adj. NWC ratio	-	-	-24%	0%	-24%	0.15	-40%	-4%	-36%	**0.02** **	-23%	-9%	-14%	0.53

The effect of PE ownership is estimated by testing the differences in the percentage changes of the metrics between the portfolio companies and the control group from one year prior to the buyout (T-1) to T+5, and from T-1 to the last full year prior to exit to capture the full holding period development. T-1 is the starting point of which the relative changes in the medians reflect (see equation (4)). Hence, -12% in T+4 for ROS is interpreted as a 12% lower median ROS than in T-1 (11%), corresponding to a median ROS of 9.6% for the buyout group in T+4. Wilcoxon signed rank tests are used to test for significance of the median changes in relative performance over time (the DiD estimate). The tests are two-tailed. Significance levels of 1%, 5% and 10% are denoted as ***, **, and *, respectively.

5.1.1 Development in Return on Assets

The development in median ROA is favorable relative to the control group for all years after T+1. However, the results are not statistically significant. On an absolute basis, ROA is unchanged by exit year, but decreases every year compared to T-1 until exit year. Over the same period, the controls experience a negative development in ROA of 16%.

These results contrast some of the previous research on PE in the Nordics[41] which find tendencies of negative relative ROA-performance in portfolio companies compared to their respective benchmarks although the overall results lack statistical significance. On the contrary, Friedrich (2015) finds a positive development in ROA in all years (up to T+3) for portfolio companies in Norway relative to benchmarks. From year T+0 to T+1 the differential effect is 44.30% at a 5%-level of significance, and 23.60% from T+0 to T+3 although the latter is not statistically significant.

The mentioned research measures ROA as EBITDA to total assets but matches the control companies to the portfolio companies in the same year as the buyout occurs as a reference point for the analysis. As discussed, this imposes a risk of upward bias in performance in the final results as the P&L statement of portfolio companies is often understated in the buyout year. Hence, all else equal, we would expect to find less positive ROA developments than these papers. In summary, the medians provide no statistically significant evidence of PE outperformance with respect to ROA. We can however observe tendencies of positive developments relative to the benchmark and flat absolute development upon exit.

Additionally, we have analyzed the developments of EBITDA to tangible assets (*tan* ROA). Thus, by removing the intangible assets which include the goodwill (acquisition premium paid), we attempt to control for the effect of amortization and impairments of goodwill on the asset base and hence ROA (EBITDA/total assets), and the potential bias of scaling the assets in T+0 to the pre-transaction asset base. This measure is immune to the changes in impairments and amortization of goodwill often triggered by buyouts, and hence avoids this potential bias. However, by taking intangible assets out of the denominator but not adjusting for the possible benefits from intangibles in the numerator, this adjustment biases the measure positively in relation to finding operating improvements. Especially in cases of

[41] See Halvorsen & Johansen, 2017 and Bakke & Bull-Berg, 2016.

buy-and-build strategies or roll-ups, the portfolio companies will benefit from an increased EBITDA in the numerator. As such, we would expect to find an outperformance in the *tan* ROA measure, which also turns out to be the case. In every year post-buyout, the median change in *tan* ROA exceeds the control group at statistically significant levels. From T-1 to exit, the median change in *tan* ROA for the buyouts is 30% higher than the median change for the controls. These findings sharply contrast the research of Ayash & Schütt (2016) who find evidence of increased ROA, but when applying this adjusted measure (EBITDA/tangible assets) find no evidence of operating improvements on US LBOs.

A further inspection of the subcomponents of ROA, namely return on sales (or ROS calculated as EBITDA/Sales) and the asset turnover (Sales/Assets) is conducted to understand why PE backed companies apparently do not outperform the control group with respect to ROA.

5.1.2 Development in Return on Sales

Examining return on sales (ROS, measured as EBITDA/sales) we find no evidence of improvements. Relative to the benchmark there are marginal improvements in year 3 and the exit year, but these are not statistically significant. For the rest of the years (and for all years on a stand-alone basis) the changes in ROS are negative, but not statistically significant. Thus, our findings might indicate that PE focuses on enhancing the top-line (as will be elaborated below), but with no change in margins. These findings contradict the belief that PE commonly initiates cost reduction programs after a buyout which leads to improved margins and enhancement in asset productivity (Muscarella & Vetsuypens 1990; Harris et al., 2005). Moreover, the findings are not in line with older research suggesting that margin improvement is an essential value creation lever in portfolio companies (Gulliksen et al., 2008). On the other hand, our findings are consistent with the outlined structural changes in section 3.2. More specifically, the PE industry's traditional value levers like cost cutting and aligning management incentives have become more commoditized post-2000 where "low hanging fruit" initiatives have already been implemented by previous owners.

5.1.3 Development in Asset Turnover

The median changes in asset turnover are positive for all years and the difference between buyouts and the control group is found statistically significant in T+1, T+2 and the exit year. These results indicate that PE is able to increase sales in relation to assets over the holding

period and outperforms the control group by approximately 4%. This corresponds to research by Friedrich (2015) who finds a significant higher increase in asset turnover for buyouts than for the peer companies in Norway. Considering the increase in subsequent M&A activity conducted by the buyouts, the improvement in the asset turnover indicates that the PE-backed companies are able to grow sales at a higher pace than the growth in assets stemming from potential add-ons. As elaborated below, the improved asset turnover is supported by a statistically significant positive improvement in sales over the five years subsequent to the buyout year.

5.1.4 Development in Sales

We see that the portfolio companies quickly grow their top line relative to the year prior to the buyout, resulting in a 15% outperformance in T+1, and 30% in T+2. The revenue growth is positive for all years, and from T-1 to the year prior to exit (or the last available year for portfolio companies still private), the median PE portfolio company has increased sales by 50% and outperformed the benchmark by 31%. Overall, compared to the benchmark, PE demonstrates an outperformance of 15%, 30%, 31%, 30% and 27%, in the 5 years following the buyout-year, respectively. Between entry to exit we find a median (mean) sales CAGR of approximately 8.8% (10.8%) for the portfolio companies and 3.9% (1.9%) for the controls. All DiD estimates are found statistically significant at 1%-level. Moreover, the results indicate that the improvement stems from the growth in the first 3 years post buyout, as we see that sales grow rapidly in the first years, before it flattens at around 50% in T+4.

Our findings are in line with previous findings in the Nordics (Grubb & Johansen, 2007; Gulliksen et al., 2008; Friedrich, 2015; Bakke & Bull-Berg, 2016; Halvorsen & Johansen, 2017), who all find statistically significant growth in sales for portfolio companies relative to their matched peer groups in all three years post-buyout. Increase in sales can be achieved either organically by improving the pricing, volume (marketing and sales strategies) and product mix or services, or inorganically by making add-on acquisitions. Particularly relevant is Friedrich (2015) findings on Norwegian portfolio companies, where he finds a median sales increase of 62.31% and an outperformance of 64.7% at year two post-buyout. Surprisingly, the sales decreased by 2.34% in his control group over the same period, raising the question of the quality of his control group and the estimated outperformance. In addition, the stand-alone sales increase is likely upward biased as a consequence of Friedrich (2015) using the buyout year (generally implying an understated revenue) as the reference

point. NVCA (2020) also finds that the growth in sales flattens and stabilizes around the third year post-buyout, where NVCA (2020) suggests that the portfolio company is maturing and much of the short-term growth potential is utilized during the first years of the holding period.

In summary, our research documents clear PE outperformance on sales growth. In addition, it documents high growth in the first three years post-buyout before growth flattens. These findings are consistent with other research on Norwegian PE, despite some biases in the latter methodologies.

5.1.5 Development in EBITDA

We find that EBITDA follows the same development pattern as sales. From entry to the year prior to exit (or the last available fiscal year if not exited), the median EBITDA increases by 51% and outperforms the benchmark by 33%. The EBITDA growth from the buyout year to each respective year is significantly higher than the control group for each year at a 5%-level, except in year 5 (10%-level of confidence). The EBITDA growth appears to peak in T+4, as the EBITDA actually declines from T+4 to T+5. This might indicate that either the (short-term) growth potential is realized after four years, or that the most favorable investments are realized within 4 years, similar to what is suggested by NVCA (2020).

5.1.6 Development of Working Capital

The WC ratio (calculated as current assets minus current liabilities divided by sales) provides evidence of a favorable and strong development in working capital management for buyouts, in line with Lee and Lou´s (2017) findings. Working capital relative to sales declines in each subsequent year compared to the level in T-1, both on a stand-alone basis and relative to the controls. For the first three post-buyout years, the changes in the WC ratio are statistically significantly different from the controls at 5%-level (T+1 and T+3) and 10%-level (T+2). For the latter years (T+4 and T+5), and all the way to exit, the differences are significant at the 1%-level. During the holding period, the WC ratio has declined by 38%, while the controls have increased the WC ratio by 13%. Controlling for the fact that the reductions in the WC ratio might be attributable to PE holding less cash in their portfolio companies than their peers, and thereby increased liquidity risk, generate results pointing in the same direction, (although only statistically significant in T+5). The adjusted net working capital ratio (Adj. NWC ratio) which excludes liquid and non-operational (i.e. financing)

elements from consideration might be better suited to capture operational improvements as it relates to the purely operational aspects of a business. The adj. NWC steadily decreases during the holding period until T+5, both in absolute figures and relative to the control group. Until exit, the adjusted net working capital relative to sales is reduced by 23% and 14% relative to the control group although only statistically significant in year 5. The gradual reduction in adjusted net working capital relative to sales each year from T-1 to T+5 indicates that working capital management on an operational level (apart from "quick fixes" such as reducing cash), takes time which is consistent with that changes in invoicing, inventory and supplier procedures and terms typically takes years to implement.

Overall, the results indicate that working capital management is a continuous focus for PE. Thus, PE appears superior in freeing up cash to support growth, finance investments, reduce leverage or distribute dividends.

5.1.7 Regression Analysis

To formalize our statistical tests, we run the following regression analysis on all buyouts and controls from entry to exit:

$$\Delta Y = \alpha + \beta_1 * PE_D + \beta_2 * Holding\ period + \beta_3 * Y_0 + \sum_{i=1}^{10} \gamma_i * Sector_i + \sum_{i=2000}^{2018} \delta_i * Year_i \quad (6)$$

where Y is the dependent variable. This regression is conducted on all performance measures[42] and is depicted in Table VI. An explanation of the variables included in the regressions is provided in Appendix Table A.VI along with specifications for all regression models used. Given that the initial levels often serve as predictors for future growth, we control for the initial level of the dependent variable of interest, in line with previous research (see e.g., Cressy et al., 2007). The initial value of the dependent variable is also likely to capture effects of other variables that are assumed to have an effect on both the dependent variable and the treatment decision (i.e., being acquired by PE). Controlling for the initial value is also particularly important since the regression depicts changes in ratios, and not percentage changes relative to the initial level as depicted for medians in Table V. Hence, by controlling for the initial level we account for the fact that it might be more challenging to improve an initially high ROA than an initially low ROA. The highly

[42] Note that for CAGR sales the dependent variable is not delta (change) but the Continuous Annual Growth Rate for the relevant period as is.

significant and negative coefficients for the initial levels of ROA, asset turnover, ROS and tan ROA supports this view. We also control for the holding period. Note that the "holding period" of each control company corresponds to the holding period of its matched PE company. In other words, if a PE company is included in the sample from for instance 2010-2015, its control group is included in the sample in the same period (i.e., it enters the sample in 2010 and leaves the sample after 2015). All observations without complete financial statements from entry to exit are excluded. Thus, if a PE company is excluded from the sample for this reason, so are its controls. We run two regressions; one including year and sector fixed effects as additional controls, and one without (see Table A.VII in the Appendix). The results do not differ among the two regressions, confirming that our matching approach has successfully accounted for year and sector effects.

The regression confirms most of the findings on medians from Table V. More specifically, PE portfolio companies clearly outperform the benchmark with respect to sales growth. In our model, the effect of private equity on CAGR sales is 7 percentage points. In other words, if we were to interpret these results casually, being acquired by PE leads to an increase of 7 percentage points in CAGR sales relative to the counterfactual outcome where the company was not acquired by PE. Furthermore, the effect of PE on EBITDA is a 51% increase relative to non-PE companies over the holding period. Similar to the analysis of medians, the regression analysis provides no evidence of improvements in return on assets (ROA) nor return on sales (ROS) relative to the control group. However, in contrast to medians, the regression does not provide statistical evidence in favor of PE outperformance with respect to asset turnover. Even though the coefficient is pointing in the same direction where PE is associated with a three-percentage point increase in asset turnover relative to the controls, this effect is not statistically significant. Meanwhile, the PE outperformance with respect to return on intangible assets (*tan* ROA) and working capital relative to sales is confirmed. Companies acquired by PE increase their return on tangible assets with five percentage points relative to the controls and reduce the working capital over sales by 11 percentage points relative to the controls.

Table VI – Regression Analysis for All Buyouts

Panel A: Post-Buyout Performance - Entry to Exit

Independent Variables	Dependent Variables							
	CAGR sales	Delta EBITDA %	Delta ROS	Delta asset turnover	Delta ROA	Delta tan ROA	Delta WC	Delta adj. NWC
PE dummy	**0.07*** **	**0.51*** **	0.01	0.03	0.01	**0.05** **	**-0.11*** **	-0.01
	(0.0102)	(0.2468)	(0.0107)	(0.0500)	(0.0115)	(0.0203)	(0.0217)	(0.0149)
Holding period	**0.00***	0.02	-0.00	0.00	**0.00** **	**-0.01*** **	0.00	0.00
	(0.0020)	(0.0421)	(0.0022)	(0.0104)	(0.0019)	(0.0030)	(0.0058)	(0.0031)
Initial sales	-3.44E-09							
	(3.03E-9)							
Initial EBITDA		**0.00** **						
		(158.00E-9)						
Initial ROS			**-0.20*** **					
			(0.0358)					
Initial asset turnover				**-0.21*** **				
				(0.0285)				
Initial ROA					**-0.45*** **			
					(0.0053)			
Initial tan ROA						**-0.45*** **		
						(0.1111)		
Initial WC/sales							0.03	
							(0.0183)	
Initial adj. NWC/sales								**-0.01*** **
								(0.0035)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.07	0.75	0.09	0.01	0.04	0.07	0.03	0.00
	(0.0502)	(1.0882)	(0.0604)	(0.1851)	(0.0526)	(0.0896)	(0.0984)	(0.0915)
N	858	858	858	858	858	858	858	858
R-squared	0.11	0.06	0.16	0.13	0.32	0.28	0.04	0.05
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table depicts the post-buyout performance for all buyouts from entry (T-1) to exit (exit year-1) compared to the matched control group. This means that N (858) includes both PE-backed companies and the control companies. The regressions are OLS regressions. In total the table shows eight separate regressions ran on eight different dependent variables. Besides controlling for the initial value of the relevant dependent variable, all regressions have the same controls. A description of all variables included in the model is given in Table A.VI in the Appendix. The significance levels 10%, 5% and 1% are denoted by asterisk *, ** and ***, respectively.

To summarize, PE appears to significantly improve sales growth which translates into a median 33% (mean 51%) improvement in EBITDA from entry to exit. We do, however, not find improvements in operating profitability measured by ROA. Decomposing ROA, we find evidence indicating that the operating profitability among the portfolio companies appears to be driven by improvements in asset turnover, counteracted by stable margins. The asset turnover improvements are, however, only statistically significant for medians. We also find improvements in working capital although the evidence is less clear when excluding cash and interest-bearing short-term liabilities.

Given that ROA is more or less unchanged during the period until exit, it indicates that the growth in assets corresponds to the growth in EBITDA. Also, while sales and EBITDA grow significantly, ROS remains relatively unchanged. Again, this implies that revenue growth appears to be the main focus and driver behind value creation in portfolio companies, rather than cutting costs and focusing on margins. This conclusion corresponds to other research focused on Norway (see Friedrich, 2015), but not in Sweden where Grubb & Jonsson (2007) find significant improvement in margins as well.

The clear outperformance in *tan* ROA and no clear outperformance in ROA indicates that PE in Norway substantially increases the intangible asset base by performing add-on acquisitions. This increased asset base translates into neutral ROA developments as PE is apparently not able to capitalize on the increased asset base resulting from acquisitions. One explanation might be that growth is the primary objective, without necessarily targeting improvements in margins or return on assets. In addition, the growth investments may require indirect costs resulting from resources, infrastructure, and systems to enable top line growth (Cambridge Associates, 2019). This may result in decreasing margins and ROA in the years post-buyout. Thereafter, cost-cutting and operational efficiencies captured from a larger revenue platform may explain the unchanged ROA from T-1-levels to the last year prior to the actual exit. Thus, it seems like PE has focused on creating a revenue-engine and a scalable platform with potential from further growth post-exit. The need to demonstrate strong growth in the portfolio company can also be explained by the increasing entry valuations, particularly at the growth stage where increases have been most pronounced (Cambridge Associates, 2019).

The value creating rationale in terms of investment returns might be that operational returns from marginal acquisitions or organic growth investments exceed the cost of capital. In other

words, if marginal ROA from an investment exceeds cost of capital, the investment should be made. The ROA levels and developments indicate that this is likely the case in our sample[43]. In addition, value creating growth is likely to impact exit multiples positively, creating a multiple expansion from entry to exit for the PE firm. The general increase in multiples over the last decades also imply that these growth investments have benefited from this in terms of investment returns.

5.2 The Effect of PE Specialization

We furthermore explore if there is a relationship between PE companies' degree of specialization by industry and performance post-buyout, to test the hypothesis of any additional positive effects stemming from specialization. Following the same approach as with all portfolio companies, Table VII presents median changes in the performance of specialized PE buyouts relative to the control group of these specialized buyouts from T-1 to T+5 and Exit.

From Table VII we observe that the median performance of specialized PE buyouts mainly follows the same trends as with all buyouts. The DiD estimates are in general similar in sign and magnitude to all buyouts. However, the improvements in asset turnover relative to the controls are only significant (at 10%-level) in the first year. This can be partly due to fewer observations.

[43] The portfolio companies' median (mean) ROA of 11% (15%) is likely above their (pre-tax) WACC. As long as it is plausible to assume a (pre-tax) WACC below 11% (15%) the median (mean) PE portfolio company does indeed grow at returns above their cost of capital which implies value creation.

Table VII – Performance by Specialized PE

Panel A: Median Differences

	Values at T - 1		Difference Relative to T - 1											
	T - 1		T + 1				T + 2				T + 3			
	Buyouts Level	Controls Level	Buyouts % Change	Controls % Change	DiD	P-value	Buyouts % Change	Controls % Change	DiD	P-value	Buyouts % Change	Controls % Change	DiD	P-value
Sales	-	-	24%	9%	14%	**0.00*** **	40%	10%	30%	**0.00*** **	35%	12%	23%	**0.00*** **
EBITDA	-	-	22%	8%	14%	**0.06***	35%	2%	33%	**0.01*** **	47%	-2%	48%	**0.04****
ROS	0.123	0.085	-8%	0%	-8%	0.84	-7%	-2%	-5%	0.21	-1%	-17%	16%	0.63
Asset turnover	1.253	1.450	10%	3%	7%	**0.07***	4%	-3%	7%	0.18	0%	-6%	6%	0.35
ROA	0.111	0.113	0%	-2%	3%	0.41	2%	-20%	22%	0.14	-9%	-14%	4%	0.38
tan ROA	0.156	0.125	15%	-2%	17%	**0.02****	4%	-21%	25%	**0.01****	7%	-11%	19%	**0.04****
WC ratio	0.089	0.091	-24%	-4%	-20%	**0.03****	-43%	-16%	-27%	0.13	-18%	10%	-27%	**0.08***
Adj. NWC ratio	0.001	-0.017	-8%	-11%	3%	0.91	-12%	-5%	-7%	0.79	-24%	5%	-29%	0.41
Number of Obs.	140	626												

			Difference Relative to T - 1											
			T + 4				T + 5				Exit			
			Buyouts % Change	Controls % Change	DiD	P-value	Buyouts % Change	Controls % Change	DiD	P-value	Buyouts % Change	Controls % Change	DiD	P-value
Sales	-	-	50%	23%	27%	**0.01*** **	59%	35%	25%	**0.09***	41%	13%	29%	**0.00*** **
EBITDA	-	-	49%	17%	32%	**0.03****	62%	19%	43%	0.13	52%	1%	51%	**0.01*** **
ROS	-	-	-11%	-9%	-2%	0.73	4%	-13%	17%	0.33	0%	-14%	15%	0.79
Asset turnover	-	-	0%	-1%	1%	0.47	5%	-3%	8%	0.67	3%	-1%	4%	0.35
ROA	-	-	-1%	-13%	12%	0.37	-10%	-21%	11%	0.35	-3%	-15%	12%	0.50
tan ROA	-	-	13%	-17%	30%	**0.02****	18%	-21%	39%	**0.04****	8%	-15%	23%	**0.03****
WC ratio	-	-	-62%	8%	-70%	**0.01*** **	-39%	27%	-66%	**0.00*** **	-39%	3%	-42%	**0.03****
Adj. NWC ratio	-	-	-18%	-15%	-4%	0.71	-44%	-4%	-40%	**0.04****	-23%	-14%	-9%	0.85

The effect of Specialized PE is estimated by testing the differences in the percentage changes of the metrics between the portfolio companies and the control group from one year prior to the buyout (T-1) to T+5, and from T-1 to the last full year prior to exit to capture the full holding period development. T-1 is the starting point of which the relative changes in the medians reflect (see equation (4)). Wilcoxon signed rank tests are used to test for significance of the median changes in relative performance over time (the DiD estimate). The tests are two-tailed. Significance levels of 1%, 5% and 10% are denoted as ***, **, and *, respectively.

We formalize our tests and conduct the following regression on the subsample of specialized PE transactions and their controls:

$$\Delta Y = \alpha + \beta_1 * (PE_D * Specialized_D) + \beta_2 * Holding\ period + \beta_3 * Y_0 + \sum_{i=1}^{10} \gamma_i * Sector_i + \sum_{i=2000}^{2018} \delta_i * Year_i \quad (7)$$

The results of the regression on specialized buyouts and their controls from entry to exit are provided in Table VIII. Surprisingly, the effect of specialized PE buyouts on CAGR sales appears to be lower than for all buyouts (6 percentage points versus 7 percentage points), and the effect on EBITDA is not significant. Similar to all buyouts, there is no effect on ROS, asset turnover or ROA, and the coefficients even turn slightly negative for ROS and asset turnover. While there is evidence of improvements in working capital, this improvement is also lower than for all buyouts (8 percentage points versus 11 percentage points). Apparently, specialized PE buyouts appear to perform worse than non-specialized PE buyouts (generalists). We also test whether these differences are statistically significant. In Table IX we run the following regression to identify whether there are differences in performance between specialized buyouts and generalist PE buyouts (relative to their control groups):

$$\Delta Y = \alpha + \beta_1 * PE_D + \beta_2 * (PE_D * Specialized_D) + \beta_3 * Specialized_D + \beta_4 * Holding\ period + \beta_5 * Y_0 + \sum_{i=1}^{10} \gamma_i * Sector_i + \sum_{i=2000}^{2018} \delta_i * Year_i \quad (8)$$

where Specialized is a dummy that takes the value of 1 for all specialized buyouts and their control companies, while PE is a dummy that takes the value of 1 for all buyouts. PE*Specialized captures the additional effect of specialization on PE-buyouts (relative to the control groups). To elaborate, PE captures the effect of non-specialized buyouts relative to the controls of non-specialized buyouts. PE*Specialized captures the effect of specialized buyouts relative to non-specialized buyouts. This will allow us to detect any potential outperformance by specialized PE deals to general PE deals.

Table VIII – Performance of Specialized PE vs Benchmark

Panel A: Post-Buyout Performance - Entry to Exit

Independent Variables	Dependent Variables							
	CAGR sales	Delta EBITDA %	Delta ROS	Delta asset turnover	Delta ROA	Delta tan ROA	Delta WC	Delta adj. NWC
PE*Specialized	**0.06*** **	0.19	-0.00	-0.02	0.01	**0.05*** **	**-0.08*** **	-0.01
	(0.0126)	(0.2585)	(0.0122)	(0.0571)	(0.0128)	(0.0174)	(0.0245)	(0.0179)
Holding period	-0.00	0.02	**0.00** **	0.02	**-0.00** **	**-0.01*** **	0.00	0.00
	(0.0023)	(0.0532)	(0.0021)	(0.0121)	(0.0020)	(0.0027)	(0.0052)	(0.0035)
Initial sales	-4.28E-09							
	(3.580E-9)							
Initial EBITDA		**-3.03E-7** **						
		(1.47E-7)						
Initial ROS			**-0.21*** **					
			(0.0394)					
Initial asset turnover				**-0.25*** **				
				(0.0325)				
Initial ROA					**-0.44*** **			
					(0.0575)			
Initial tan ROA						**-0.36*** **		
						(0.0518)		
Initial WC/sales							0.03	
							(0.0315)	
Initial adj. NWC/sales								-0.01
								(0.0229)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.03	0.39	0.02	**0.42** **	**0.05** **	**0.07*** **	-0.00	0.01
	(0.0127)	(0.4389)	(0.0240)	(0.1727)	(0.0219)	(0.0280)	(0.0492)	(0.0403)
N	569	569	569	569	569	569	569	569
R-squared	0.1066	0.062	0.1933	0.1838	0.3947	0.3316	0.0498	0.0508
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table depicts the post-buyout performance for all buyouts by specialized PE funds from entry (T-1) to Exit (exit year-1) compared to the matched control group. All observations, N (569), includes both companies backed by specialized PE investors and the control companies. The regressions are OLS regressions. In total the table shows eight separate regressions ran on eight different dependent variables. Besides controlling for the initial value of the relevant dependent variable, all regressions have the same controls. A description of all variables included in the model is given in Table A.VI in the Appendix. The significance levels 10%, 5% and 1% are denoted by asterisk *, ** and ***, respectively.

Table IX - PE Specialists vs PE Generalists

Panel B: Post-Buyout Performance - Entry to Exit

Independent Variables	Dependent Variables							
	CAGR sales	Delta EBITDA %	Delta ROS	Delta asset turnover	Delta ROA	Delta tan ROA	Delta WC	Delta adj. NWC
PE dummy	**0.10*** **	**1.14** **	0.03	0.11	0.02	0.05	**-0.17*** **	0.00
	(0.0168)	(0.5067)	(0.0198)	0.0959	0.0226	(0.0300)	(0.0483)	(0.0270)
PE*Specialized	**-0.04** **	**-0.94** *	-0.03	-0.12	-0.01	-0.00	0.08	-0.01
	(0.0210)	(0.5697)	(0.0230)	0.111	0.0259	(0.0345)	0.0541	(0.0325)
Specialized	0.01	0.02	0.01	-0.06	-0.02	-0.02	**-0.09** **	-0.01
	(0.0108)	(0.2343)	(0.0137)	0.06	0.01	(0.0131)	(0.0384)	(0.0174)
Holding period	-0.00	0.02	**0.00** **	0.00	**-0.00** **	**-0.01** **	0.00	0.00
	(0.0019)	(0.0420)	(0.0022)	(0.0104)	(0.0018)	(0.0024)	(0.0057)	(0.0031)
Initial sales	-3.24E-09							
	(3.020E-9)							
Initial EBITDA		**-3.54E-7** *						
		(1.58E-7)						
Initial ROS			**-0.20*** **					
			(0.0359)					
Initial asset turnover				**-0.21*** **				
				(0.0283)				
Initial ROA					**-0.45*** **			
					(0.0530)			
Initial tan ROA						**-0.28*** **		
						(0.0688)		
Initial WC/sales							0.03	
							(0.0180)	
Initial adj. NWC/sales								**-0.01** **
								(0.0035)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.03	0.37	0.00	**0.46*** **	**0.07** **	**0.09** **	-0.04	-0.01
	(0.0246)	(0.4609)	(0.0276)	(0.1734)	(0.0230)	(0.0300)	(0.0552)	(0.0408)
N	858	858	858	858	858	858	858	858
R-squared	0.1123	0.0629	0.1627	0.1295	0.3282	0.2227	0.0445	0.0536
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table depicts the post-buyout performance for all buyouts by specialized PE funds from entry (T-1) to Exit (exit year-1) compared to PE deals by generalists' funds (non-specialized). We control for other non-specialized PE transactions' performance as well as specialized deals control groups. As such, PE*Specialized shows the multiplicative effect of being a PE-backed company acquired by specialists. All observations, N (858), includes both companies backed by PE investors and the control companies. The regressions are OLS regressions. In total the table shows eight separate regressions ran on eight different dependent variables. Besides controlling for the initial value of the relevant dependent variable, all regressions have the same controls. A description of all variables included in the model is given in Table A.VI in the Appendix. The significance levels 10%, 5% and 1% are denoted by asterisk *, ** and ***, respectively.

From Table IX we observe that the effect of PE specialization is significant and negative on CAGR sales (-4 percentage points) and EBITDA (-94%) relative to generalists. Although the effect is not significant for ROS, asset turnover and ROA, the coefficients are negative. In sum, we find no evidence of a positive specialization effect on PE in Norway. We therefore find no support for the hypothesis that there is a positive relationship between PE fund's degree of specialization by industry and performance post-buyout. In fact, our results point in the opposite direction with a negative effect on turnover growth and EBITDA, and even though the effect on ROS, asset turnover and ROA are not statistically significant, they are all negative in sign.

Our results are in line with research by Ljungqvist & Richards (2003), Lossen (2007), Brigl et al. (2008) and Aigner et al. (2008) who could not find any positive relationship between portfolio company returns and the level of specialization. On the other hand, our findings contrast Cressy's (2007) findings in the UK of a specialization premium of 8.5% on operating profitability and a positive (although not always statistically significant) effect on turnover growth.

One possible explanation for the poor performance of specialized buyouts relative to generalists, is the Norwegian market's relative specialization in Oil & Gas. The Oil & Gas industry has performed poorly since the oil prices plunged in 2014. We have aimed to control for this by controlling for sector and year fixed effects, but the SNF database's sector classification might not be sufficiently granular to properly deal with this issue as Oil & Gas is not classified as a separate sector. Another explanation for the poor performance of specialized buyouts relative to generalists could be that foreign GP's that invest in Norway are not able to capitalize on their inhouse expertise cross-border. In other words, the three potential advantages of specialization outlined in section 2.3 do not seem to result in any superior operating performance to general or more diversified funds, and actually suggest the opposite. However, these advantages are predominantly related to entry, leverage capabilities and exit factors and is therefore something that might be more prevalent on fund-level. In contrast, our findings are more in line with the counterarguments suggesting that PE is able to leverage outside expertise regardless or selecting companies with already strong management teams in place. These factors might offset the hypothesized advantages of specialization, at least on company-level.

5.3 Deal Types

Finally, we assess whether there exist any systematic differences in performance among different deal types. We run the following regression where each deal type (except PIPE) is tested against its respective benchmark:

$$\Delta Y = \alpha + \sum_{i=1}^{4} \pi_i * Deal\ Type_i + \sum_{i=1}^{4} \theta_i * (PE_D * Deal\ Type_i) + \beta_4 * Holdinig\ period + \beta_5 * Y_0 + \sum_{i=1}^{10} \gamma_i * Sector_i + \sum_{i=2000}^{2018} \delta_i * Year_i \quad (9)$$

where PIPE is the omitted variable. The interaction terms between PE and the deal type captures the performance of the respective deal type relative to its control companies.

Table X below provides evidence that all the deal types outperform their benchmarks with respect to sales growth. The exception is public buyouts for which the effect is not significant (possibly because of fewer observations). Furthermore, the effect of PE on sales growth appears to be strongest for private buyouts, with an outperformance of 8 percentage points. A possible explanation for secondary and private-to-private buyouts significantly outpacing their controls in terms of CAGR sales is that they have more underleveraged potential from financing and ramping up organic and structural growth post-buyout, compared to public-to-private companies which have had better access to capital pre-buyout. This is consistent with previous research finding that the former category is more likely to make add-on acquisitions than public-to-private buyouts (Hammer et al., 2017). Hammer et al. (2017) suggests that this is likely because public PE-targets already have realized inorganic growth opportunities as a public company. Our findings are also in line with Boucly et al.'s (2011) findings in France. They suggest that this might be the result of new sources of value creation strategies in PE, with PE targeting under-developed, credit-constrained firms to support them in growing faster. Since targets of private-to-private deals are more likely to be credit constrained pre-buyout than public companies (or former divisions of larger companies), PE supports these companies with capital to take advantage of unexploited growth opportunities (Boucly et al., 2011).

Table X – Performance by Deal Type

Panel A: Post-Buyout Performance - Entry to Exit

Independent Variables	Dependent Variables							
	CAGR sales	Delta EBITDA %	Delta ROS	Delta asset turnover	Delta ROA	Delta tan ROA	Delta WC	Delta adj. NWC
Private-to-Private	0.02	0.13	-0.02	0.04	-0.01	-0.01	0.06	-0.01
	(0.0258)	(0.6683)	(0.0250)	(0.1174)	(0.2570)	(0.0290)	(0.0614)	(0.0362)
Secondary	0.03	0.13	-0.03	0.06	-0.01	-0.02	0.01	-0.02
	(0.0269)	(0.6922)	(0.0257)	(0.1217)	(0.0266)	(0.0296)	(0.0644)	(0.0373)
Public-to-Private	0.03	-0.05	-0.01	0.11	0.01	0.01	0.07	0.01
	(0.0317)	(0.6938)	(0.0324)	(0.1426)	(0.0298)	(0.0364)	(0.0918)	(0.0449)
Div. Buyout	0.03	0.26	-0.02	-0.07	-0.02	-0.03	0.09	-0.02
	(0.0283)	(0.6861)	(0.0272)	(0.1223)	(0.0298)	(0.0306)	(0.0705)	(0.0398)
PE*Private-to-Private	**0.08*** **	0.47	-0.01	0.07	-0.00	0.02	**-0.14*** **	-0.01
	(0.0139)	(0.3475)	(0.0139)	(0.7549)	(0.0163)	(0.0222)	(0.0291)	(0.0194)
PE*Secondary	**0.06*** **	-0.06	0.02	-0.12	0.04	**0.07***	0.04	0.05
	(0.0178)	(0.3555)	(0.0244)	(0.0989)	(0.0269)	(0.0356)	(0.0607)	(0.0353)
PE*Public-to-Private	0.06	**1.51** **	**0.06***	0.09	**0.05** **	**0.14*** **	-0.07	0.01
	(0.0414)	(0.7185)	(0.0371)	(0.1827)	(0.0202)	(0.0477)	(0.0849)	(0.0537)
PE*Div. Buyout	**0.06** **	0.47	0.04	0.05	0.04	**0.08** **	**-0.22*** **	-0.04
	(0.0272)	(0.6394)	(0.0297)	(0.0847)	(0.0262)	(0.0352)	(0.0595)	(0.0411)
Holding period	-0.00	0.03	0.00	0.00	**0.00** **	**-0.01** **	0.00	0.00
	(0.0020)	(0.0428)	(0.0022)	(0.0105)	(0.0018)	(0.0023)	(0.0056)	(0.0030)

Initial sales	-2.05E-09							
	(3.190E-9)							
Initial EBITDA		**0.00****						
		(1.700E-07)						
Initial ROS			**-0.20*****					
			(0.0367)					
Initial asset turnover				**-0.22*****				
				(0.0289)				
Initial ROA					**-0.45*****			
					(0.0537)			
Initial tan ROA						**-0.28*****		
						(0.0690)		
Initial WC/sales							0.03	
							(0.0178)	
Initial adj. NWC/sales								**-0.01*****
								(0.0035)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.00	0.19	0.03	**0.38***	**0.07****	**0.08****	-0.08	0.00
	(0.0362)	(0.8005)	(0.0345)	(0.2018)	(0.0320)	(0.0386)	(0.0760)	(0.0512)
N	858	858	858	858	858	858	858	858
R-squared	0.1157	0.0595	0.1685	0.1309	0.3298	0.2315	0.0447	0.0584
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table X depicts the post-buyout performance for all buyouts segmented into deal types from entry (T-1) to Exit (exit year-1) compared to their control group. As such, PE*Deal type is the performance of PE-backed companies belonging to the specific deal type relative to its controls. All observations, N (858), includes both companies backed by PE investors and the control companies. All eight regressions are OLS regressions. A description of all variables included in the model is given in Table A.VI in the Appendix. The significance levels 10%, 5% and 1% are denoted by asterisk *, ** and ***, respectively.

On EBITDA, Table X illustrates that public-to-private buyouts have the only significant impact with a 151% improvement (relative to their benchmark). Public buyouts are also the only deal type with a significant and positive effect on ROS (6 percentage points) and ROA (5 percentage points). This is in line with that public buyouts in particular are motivated by margin and asset productivity improvements which are often not captured in public companies (Muscarella & Vetsuypens 1990; Harris et al., 2005). The effects of secondaries and divisional buyouts on ROA are positive in sign, although barely not statistically significant. Finally, divisional buyouts and private buyouts have significant working capital improvements of 22 and 14 percentage points, respectively.

To formally test whether there are differences in performance between the different PE deal types (relative to their control groups), we run the following regression:

$$\Delta Y = \alpha + \beta_1 * PE_D + \sum_{i=1}^{4} \pi_i * Deal\ Type_i + \sum_{i=1}^{4} \theta_i * (PE_D * Deal\ Type_i) + \beta_4 * Holdinig\ period + \beta_5 * Y_0 + \sum_{i=1}^{10} \gamma_i * Sector_i + \sum_{i=2000}^{2018} \delta_i * Year_i \quad (10)$$

where the performance of each deal type relative to its respective benchmark is tested against the performance of private-to-private buyouts relative to its benchmark (the omitted variable). Hence, this regression is testing for differences between the coefficients of the different deal types and private buyouts from the previous regression. PE*deal type captures the additional effect of the respective deal type relative to private-to-private buyouts which is the omitted variable (again, relative to each deal type's matched control group).

The regression results in Table XI provide evidence that private-to-private buyouts outperform PIPEs with respect to CAGR sales by 10 percentage points. However, the differences between all other deal types and private-to-private are not statistically different from zero. Hence, the regression analysis does not lend support to infer that private-to-private buyouts have a higher sales growth than public buyouts, secondaries or divisional buyouts (relative to their benchmarks).

Table XI - Deal Types Relative Performance

Panel B: Post-Buyout Performance - Entry to Exit

Independent Variables	Dependent Variables							
	CAGR sales	Delta EBITDA %	Delta ROS	Delta asset turnover	Delta ROA	Delta tan ROA	Delta WC	Delta adj. NWC
PE dummy	**0.08*** **	0.47	-0.01	0.07	-0.00	0.02	**-0.14*** **	-0.13
	(0.0139)	(0.3477)	(0.0138)	(0.0755)	(0.0163)	(0.0222)	(0.0292)	(0.0194)
Secondary	0.01	0.00	-0.01	0.03	0.00	-0.01	-0.05	-0.01
	(0.0136)	(0.3363)	(0.0155)	(0.0716)	(0.0134)	(0.0165)	(0.0457)	(0.0214)
Public-to-Private	0.01	-0.19	0.02	0.07	0.02	0.02	0.01	0.03
	(0.0218)	(0.4170)	(0.0255)	(0.1038)	(0.0190)	(0.0255)	(0.0811)	(0.0337)
Div. Buyout	0.01	0.13	0.00	-0.10	-0.01	-0.14	0.02	-0.00
	0.02	0.36	(0.0191)	(0.0684)	0.02	0.02	(0.0484)	0.02
PIPE	-0.02	-0.61	0.01	-0.10	0.01	0.00	-0.07	0.01
	(0.0299)	(0.5576)	(0.0279)	(0.1392)	(0.0305)	(0.0340)	(0.0715)	(0.0403)
PE*Secondary	-0.02	-0.53	0.03	-0.19	0.04	0.05	**0.18*** **	0.06
	(0.0226)	(0.4980)	(0.0279)	(0.1243)	(0.0314)	(0.0413)	(0.0673)	(0.0403)
PE*Public-to-Private	-0.02	1.04	**0.07***	0.02	**0.05***	**0.13** **	0.07	0.03
	(0.0437)	(0.7974)	(0.0390)	(0.1973)	(0.0271)	(0.0532)	(0.0896)	(0.0569)
PE*Div. Buyout	-0.02	0.00	0.05	-0.02	0.04	0.06	-0.08	-0.03
	(0.0305)	0.73	(0.0329)	(0.1137)	0.03	(0.0415)	(0.0660)	0.05
PE*PIPE	**-0.10** **	1.81	**0.08***	-0.16	0.01	0.02	**0.15***	0.01
	(0.0487)	(1.8200)	(0.0448)	(0.1595)	0.04	(0.0445)	(0.0809)	0.07
Holding period	-0.00	0.03	0.00	0.00	**0.00** **	**-0.01** **	0.00	0.00
	(0.0020)	(0.0429)	(0.0022)	(0.0105)	(0.0019)	(0.0024)	(0.0056)	(0.0031)

Initial sales	-2.06E-09							
	(3.150E-9)							
Initial EBITDA		**3.55E-7****						
		(1.790E-7)						
Initial ROS			**-0.20*****					
			(0.0366)					
Initial asset turnover				**-0.22*****				
				(0.0289)				
Initial ROA					**-0.45*****			
					(0.0537)			
Initial tan ROA						**-0.28*****		
						(0.0691)		
Initial WC/sales							0.03	
							(0.0178)	
Initial adj. NWC/sales								**-0.01*****
								(0.0035)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.03	0.33	0.01	**0.42****	**0.06*****	**0.07*****	-0.02	-0.01
	(0.0237)	(0.4457)	(0.0264)	(0.1730)	(0.0211)	(0.0260)	(0.0526)	(0.0389)
N	858	858	858	858	858	858	858	858
R-squared	0.1159	0.0635	0.1701	0.1311	0.3298	0.2318	0.0447	0.0584
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table XI depicts the post-buyout performance for all buyouts segmented into deal types from entry (T-1) to Exit (exit year-1) relative to private-to-private. We have omitted private-to-private deals and its controls, which the relative performance of the other deal types is measured against. All observations, N (858), includes both companies backed by PE investors and the control companies. All eight regressions are OLS regressions. A description of all variables included in the model is given in Table A.VI in the Appendix. The significance levels 10%, 5% and 1% are denoted by asterisk *, ** and ***, respectively.

On the other hand, PIPEs have a positive effect of 8 percentage points on ROS relative to private-to-private buyouts. When it comes to working capital management, private-to-private buyouts perform significantly better than secondaries and PIPEs. Relative to secondaries, this is not particularly surprising, given that "quick fixes" have already been captured by the previous PE owner. More importantly, the results in Table XI confirm that public buyouts outperform private-to-private buyouts with respect to ROS and ROA with 7 and 5 percentage points, respectively. Notably, most of the previous research on PE operating profitability has been conducted on public buyouts. Because our sample is skewed towards private buyouts, this could partly explain why we did not, on an overall basis, find evidence of operating profitability improvements (except when restricting the sample to public buyouts), in contrast to previous research such as Kaplan (1989) which focused on public buyouts[44].

It is, however, interesting to observe that the evidence on the operating performance of public buyouts is also divided. While there is clear evidence for operating improvements in the first buyout wave (see e.g., Kaplan, 1989; Smith, 1990; Singh (1990), the evidence is less clear after the first buyout wave, where most studies (see e.g. Guo et al., 2011; Cohn et al., 2014; Weir et al., 2015) find modest to no improvements. The latter findings may be due to more well managed investment targets over time.

The lack of operating profitability improvements in our sample might be due to private-to-private buyouts (which is the predominant deal type in our sample) already having concentrated ownership, and hence PE's investment rationale and value creation levers for these companies might not be the same as hypothesized by Jensen (1989) (Morris & Phalippou, 2019). More specifically, the advantages of concentrating ownership and using leverage to align management incentives in order to free up cash might not be as relevant in the typical (private-to-private) post 2000 PE deals in Norway. Instead, the rationale and levers for these deals might be to support these companies with capital, management skills and experience to take advantage of unexploited growth opportunities as suggested by Boucly et al. (2011). The latter approach favors growth and not necessarily margins, which is also in line with our findings.

[44] Note that there are of course many other factors in play here, such as the time period and geography.

5.4 Limitations

It is important to point out that although we have applied the PSM methodology to mimic a random experiment and furthermore based our analysis on difference in difference estimates, one should be careful with interpreting the results causally. Distinguishing PE's investment selection skills from their active ownership skills (and impact on performance) have limitations almost regardless of methodologies, although we have diligently designed and implemented the empirical research to reflect best practice. The accounting metrics used for constructing the control group through PSM are likely not able to encompass all factors impacting the buyout decision and the subsequent performance due to the potential existence of unobservable effects. For example, GP's might be superior in identifying companies with strong management or favorable growth prospects and matching on pre-buyout growth could have further strengthened the distinction as PE appears to target companies in growth (NVCA, 2020; Gulliksen et al., 2008). By matching on pre-event performance through the chosen covariates, we have likely captured some of the effect, but we cannot confidently rule out that there might be an endogeneity problem. As emphasized by Boucly et al. (2011), the lack of a proper source of exogenous variation in the probability to be involved in a deal leads to a bias in the results. The results we provide should thus be interpreted as descriptive for the Norwegian PE market, while more caution should be applied in the causal interpretations.

We have assumed that operating changes (sooner or later during the holding period) manifest themselves in the accounting figures used for measuring operating performance. Applying the exit year to measure PE operating performance might not be optimal, since the timing of the exit may be correlated with performance and stock market valuations. However, the nature of the buyout process involves implementation of measures which often do not materialize before the very end of the holding period. In this regard, the exit should be expected when the implemented measures in fact materialize suggesting that the exit year best depicts the true value creation of a buyout.

6. Conclusion

By comparing the post-buyout operating performance of a comprehensive sample of 214 buyouts in Norway to the performance of a propensity matched control group, our main objective is to answer the following question: *Does Private Equity have a (relative) positive impact on operating performance?* Our research documents that PE ownership appears to improve sales and EBITDA growth. Our findings also indicate that PE portfolio companies experience working capital improvements under PE ownership. However, we find no evidence of improvements in operating profitability (ROA) across the entire sample of buyouts. Examining the subcomponents of ROA yields some evidence of improvements in asset turnover which are offset by stable margins.

Furthermore, we find no support for the hypothesis that there is a positive relationship between PE fund's degree of specialization by industry and performance post-buyout. If anything, this effect appears to be negative. Finally, our research indicates that there are differences in performance among deal types in Norway. For the subsample of public buyouts, we find improvements in operating profitability and margins, also relative to private-to-private buyouts. In contrast, private-to-private buyouts appear to be more growth-oriented, clearly outperforming their benchmark in sales growth. We also find that private-to-private buyouts improve the working capital ratio more than other deal types.

On an overall basis, our findings suggest that value created in Norwegian PE deals is generally attributable to sales and EBITDA growth which is in line with most previous research on the Nordic PE market. Thus, PE appears to actively focus on boosting the sales of their companies organically and structurally, particularly through acquiring market shares. This is consistent with previous research documenting the positive relationships between growth and investment returns (Cambridge Associates, 2019), as growth can directly generate multiple expansion and these growth investments have also benefited from the general multiple increases over the last decades. It is also consistent with the previously outlined structural shift taking place in PE markets with the development of new value creating strategies in parallel to the maturing of the traditional LBO market.

Growth versus LBO type strategies is also reflected in the performance dynamics we observe within different deal types. Private-to-private and secondaries experience significant improvements in sales growth, in contrast to public buyouts experiencing improvements in

margins and operating profitability. The two former types are likely more growth-oriented strategies and the latter are likely more oriented towards the traditional LBO strategies. The solid outperformance in sales and EBITDA in general can indicate that PE ownership enables advantageous long-term planning and execution compared to companies under different ownership forms. Hence, being able to support their portfolio companies with capital over years, combined with concentrated execution power enabling swift decision making, can create a more efficient vehicle for growth and expansion.

By examining the operating performance of 214 portfolio companies, our findings yield additional understanding and insight on the value creation impact and value creation areas of private equity in Norway. While we have focused on assessing the operating performance of PE portfolio companies, specialized versus generalist PE fund managers and the differences in performance among different deal types, we have not formally attempted to examine the relationship between performance and specific initiatives (such as cost cutting, productivity improvements, organic revenue improvement, internationalization, M&A, working capital reduction and capital expenditure reduction initiatives) PE implement to create value. It would also be interesting to examine the relationship between operating performance improvements and gross and net (after the costs of the PE model) investment returns. This would have enabled an understanding of the relative investment return impact of various performance improvement typologies (such as organic growth, structural growth, margin improvement and working capital efficiency) and underlying initiatives to deliver such performance improvements. Future research should test these relationships so that we can try to understand the impact of different PE initiatives on performance typologies and overall investment returns. Such highly relevant and interesting relationships will become more accessible to research as the sample and codification of Norwegian buyouts expands in line with the continuously maturing Norwegian PE market. Moreover, this will enable research on the sources of the wide dispersion in investment returns among different GP’s.

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Appendix

Figure A.I – Total Sample Sector Distribution

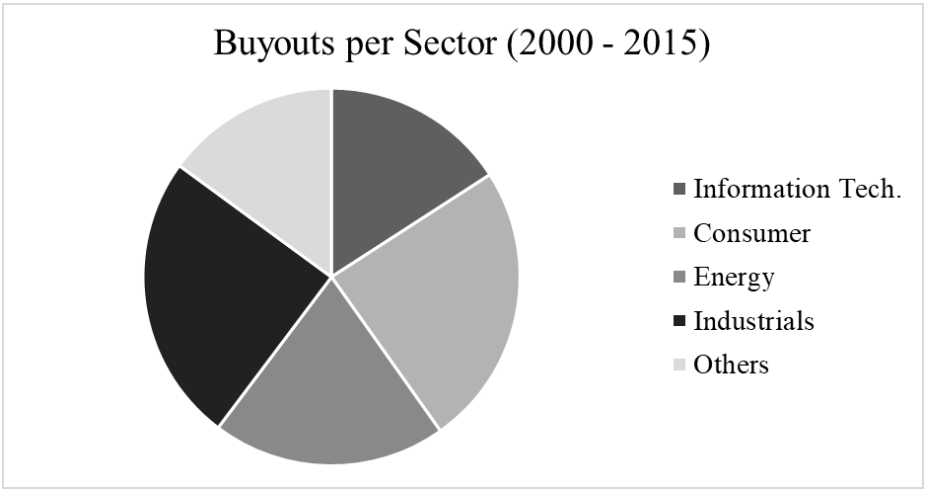


Figure A.1 illustrates the total sample of buyouts conducted between 2000 - 2015 distributed by sector. The four largest sectors range from 34 (IT) to Industrials (53) in number of buyouts. Others: Communication, Health Care, Materials, Utilities, Financials.

Figure A.II – Buyout Distribution by Deal Type and Investment Year (data sample)

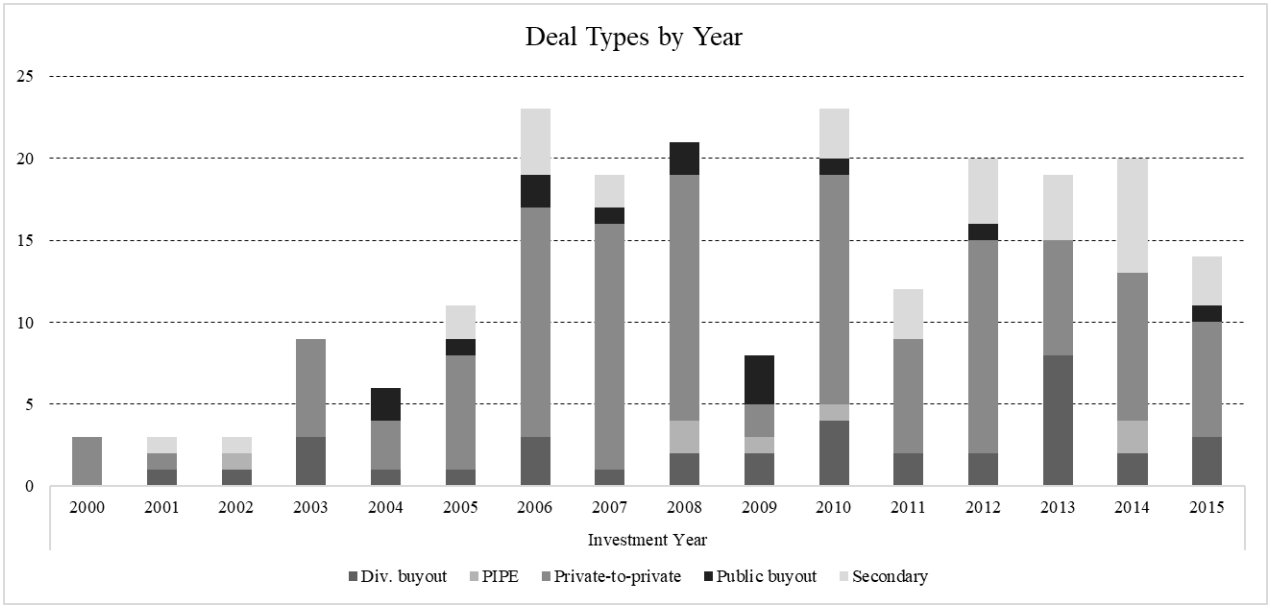


Figure A.II depicts the buyout distribution by deal type and the year the investment was made. We can notice a strong growth in number of investments made since 2000. Additionally, we notice substantial variation in numbers of investments as well, indicating that economic cycles and other time dependent factors are impacting the timing of the investments.

Figure A.III – Sample Buyout Distribution by Exits (2000-2015)

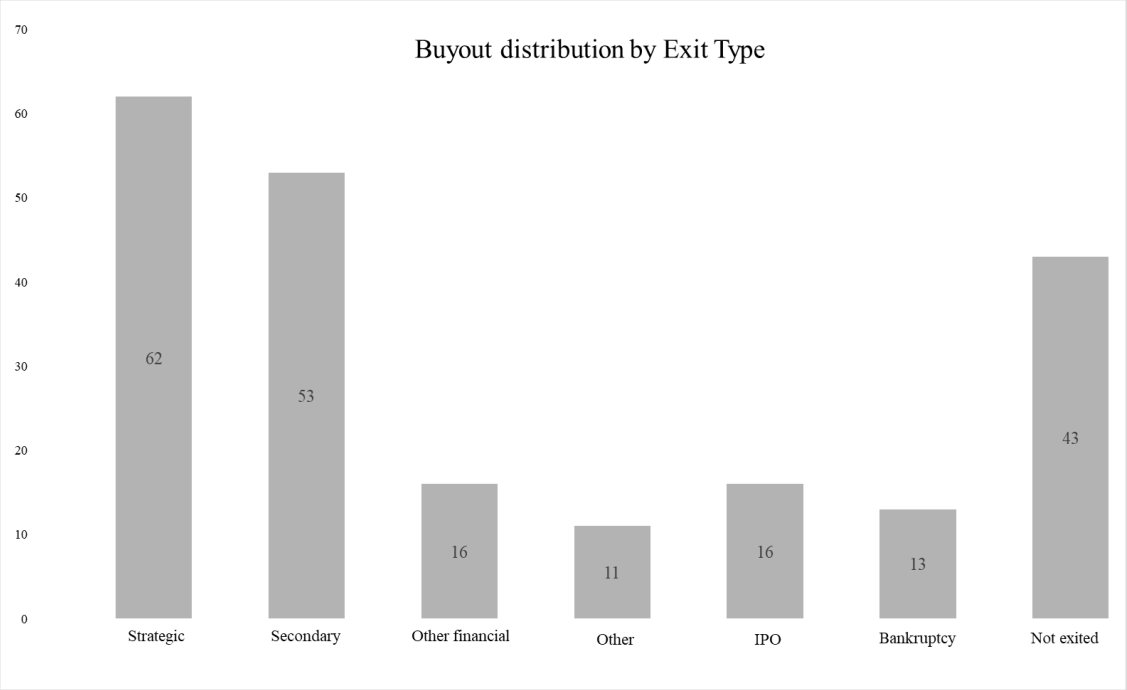
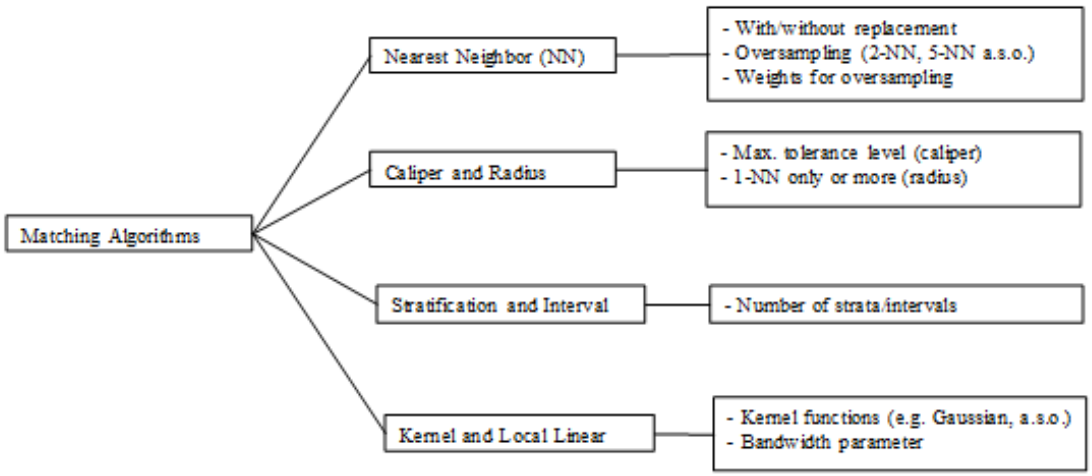


Figure A.III provides an overview of the buyout sample distributed by exit channels. For further research, it could be interesting to study the relationship between choice of exit channel and performance.

Figure A.IV – Matching Algorithms



(Source: Caliendo & Kopeinig, 2008). We have chosen the alternative of Nearest Neighbor (NN) and allow for replacement, in line with Caliendo & Kopeinig (2008) and Austin (2011).

Figure A.V – Distribution of Propensity Scores

In this figure we conduct a rough assessment of the common area of support. Since we do not condition on all covariates but on the propensity score, i.e., the predicted probability of treatment derived from the fitted logistic regression model, it has to be checked if the matching procedure is able to balance the distribution of the relevant variables in both groups. Below we see that the propensity score between treated and untreated subjects overlaps, indicating that there is a nonzero probability of being in the untreated and treated group for each value of a covariate, satisfying the common support assumption (Ho et al., 2007).

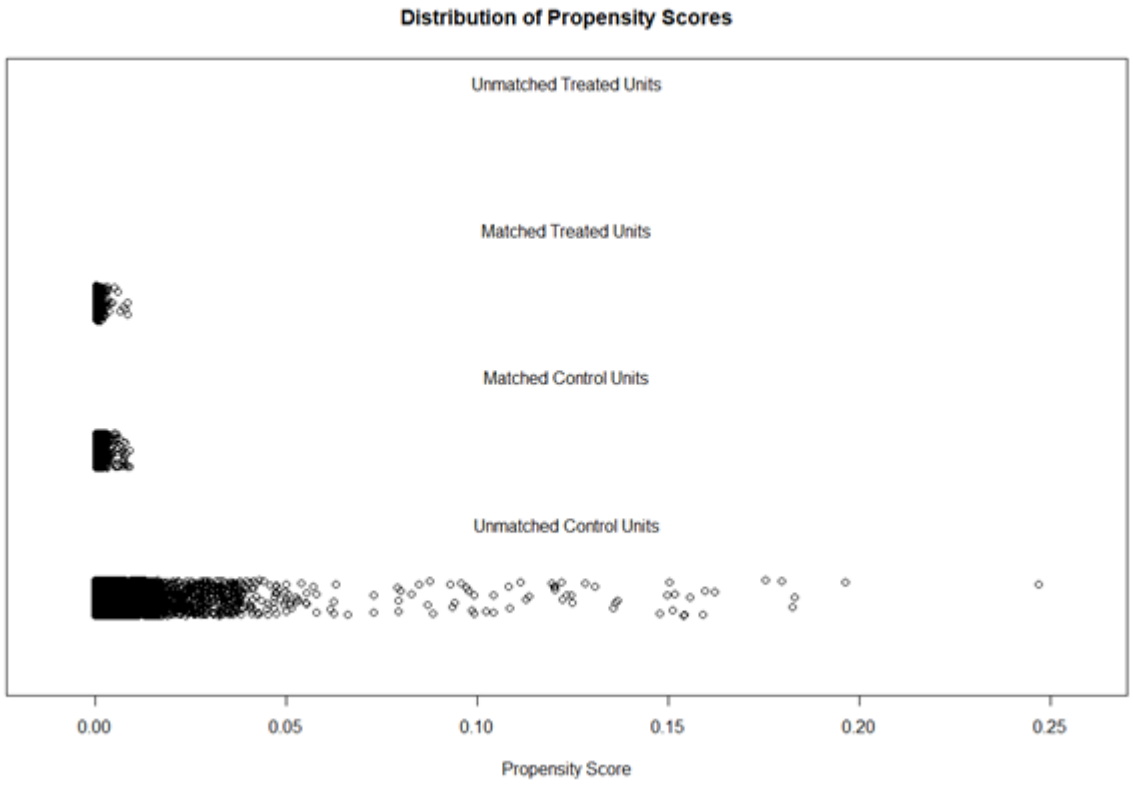


Table A.I – Estimation of Propensity Score

Table A.I shows the output from the propensity score estimation using logistic regression. These are the variables we have decided to include for matching. We see that year, sector, log_sales and sales/assets all are significant variables at 95% level of confidence or higher for receiving treatment. However, while the ebitda/sales variable is not statistically significant, variables known to be associated with selection should also be included (even non-significant) (Caliendo & Kopeinig, 2008). After testing several other combinations of variables, this combination was found to provide the best trade-off between sample size and economic significance based on previous literature and GP surveys. We have provided an explanation of why we have decided to not include any other variables for matching when determining the distance measure in section 4.4.1.

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	7.55E+01	2.35E+01	3.218	0.00129	**
year	-4.62E-02	1.17E-02	-3.951	7.78E-05	***
sector	5.66E-02	2.74E-02	2.068	0.03862	*
ebitda/sales	-3.68E-05	9.21E-04	-0.04	0.96814	
log_sales	7.89E-01	2.34E-02	33.667	< 2e-16	***
sales/assets	-2.29E-01	5.14E-02	-4.461	8.16E-06	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table A.II – SNF Sector List

This is a subdivision into 10 common industry groups based on matching the two sets of industry codes in the SNF database. We note that there are a significant number of firms in each sector, thus we argue that the common support is likely satisfied.

Common industry group sector code	**Number of firm*year**	**Distribution**
Agriculture	70,577	2.0%
Offshore/Shipping	70,466	2.0%
Transport	109,041	3.0%
Manufacturing	211,949	5.9%
Telecom/IT/Technology	115,863	3.2%
Electricity	16,217	0.5%
Building & Construction	1,134,645	31.7%
Trade	747,528	20.9%
Finance	203,188	5.7%
Other	897,236	25.1%
Total	3,576,710	100.0%

(SNF, 2016)

Table A.III – Potential Controls sample vs Buyout sample

This table shows the number of controls relative to PE-backed companies. 1053 control companies are matched to the buyouts. Thus, it does not appear to be an issue with allowing for replacement in the nearest neighbor matching procedure as it is 4.92 controls per treated company. Additionally, prior to matching, the data sets have been filtered to exclude observations with missing information (e.g. Sector) or misspecified values (e.g. negative Revenues or Total Assets) for the variables which are included in the empirical tests. This results in a loss of 5 buyout companies. Hence, observations missing any necessary matching parameters were already removed which is why *discarded* shows zero.

	Control	*Buyout*
All	3192017	214
Matched	1053	214
Unmatched	3190964	0
Discarded	0	0

Table A.IV – Bias reduction in Covariates (1:1)

Table A.IV shows an assessment of the one-to-one nearest neighbor matching with replacement. One-to-one matching provides a substantially percent balance improvement on all covariates. However, compared to five-to-one matching the standardized mean differences in the EBITDA margin and asset turnover compared are higher. Meanwhile the variance ratios are within the range of acceptance. However, the variance ratios of asset turnover and log of sales shows an increase in the variance. Additionally, the P-values are substantially lower in one-to-one matching compared to five-to-one. Overall, the closest neighbor to the treated individuals appears to be similar on the covariates, but the five-to-one matching provides the benefit of better balancing the mean differences. Thus, the five-to-one matching is preferred.

1 : 1 Nearest Neighbor Matching

Matched Variables	*Sample*	*Buyout Group*	*Control Group*	*Standardized Mean Diff.*	*Percent Balance Improvement*	*Var.Ratio*	*T-test, P-value*
Year	Unmatched	2008.3925	2009.3131	-0.2452		0.3865	0
	Matched	2008.3925	2008.3925	0	100.00%	0.9999	1
Industry	Unmatched	6.6121	7.5135	-0.3207		1.6422	0
	Matched	6.6121	6.6121	0	100.00%	0.9999	1
Log Sales	Unmatched	12.749	7.7104	4.1815		0.3118	0
	Matched	12.749	12.7852	-0.03	99.30%	0.9503	0.7593
EBITDA/Sales	Unmatched	0.1283	-0.7718	5.827		0	0
	Matched	0.1283	0.1094	0.1225	97.90%	0.7026	0.2502
Sales/Assets	Unmatched	1.5618	2.3611	-0.9797		0.0007	0
	Matched	1.5618	1.6896	-0.1567	84.01%	0.5156	0.1821
Number of observations	Unmatched	214	3192017				
	Matched	214	212				

Table A.V – Bias Reduction in Covariates (w. caliper 0.1)

This table show the bias reduction in the covariates means after five-to-one nearest neighbor matching with a caliper of 0.1. Given that the sample size is branched into year and industry, this might result in few observations remaining in some categories. However, based on the large number of observations within each sector shown in Table A.II, we deem this unlikely. Additionally, a caliper is commonly implemented in fear of being outside the common area of support. As shown in Figure A.V we see that most of the individuals are in (or close to) the area of common support. By comparing this table to Table IV we note that the standardized mean differences somewhat increase for log of sales, EBITDA margin and asset turnover. Thus, we argue that the caliper does not provide any significant changes besides reducing the treatment sample by 9.

5 : 1 Nearest Neighbor Matching (w. caliper 0.1)

Matched Variables	*Sample*	*Buyout Group*	*Control Group*	*Standardized Mean Diff.*	*Percent Balance Improvement*	*Var.Ratio*	*T-test, P-value*
Year	Unmatched	2008.3925	2009.3131	-0.2452		0.3865	0
	Matched	2008.3463	2008.3463	0	100.00%	1.0038	1
Industry	Unmatched	6.6121	7.5135	-0.3207		1.6422	0
	Matched	6.6341	6.6341	0	100.00%	1.0038	1
Log Sales	Unmatched	12.749	7.7104	4.1815		0.3118	0
	Matched	12.6321	12.6408	-0.0072	99.80%	0.9299	0.3793
EBITDA/Sales	Unmatched	0.1283	-0.7718	5.827		0	0
	Matched	0.1272	0.1109	0.1053	98.20%	0.4444	0.2602
Sales/Assets	Unmatched	1.5618	2.3611	-0.9797		0.001	0
	Matched	1.5824	1.6108	-0.0349	96.40%	0.595	0.57151
Number of observations	Unmatched	205	3192017				
	Matched	205	970				

Table A.VI – Description of All Variables Included in the Regression Models

Dependent Variables	
CAGR sales	The mean Continuous Annual Growth Rate for Sales
Delta EBITDA %	The mean %-change in Earnings Before Interest, Tax, Depreciation and Amortizations
Delta ROS	Mean change in Return on Sales (EBITDA/Sales)
Delta asset turnover	Mean change in asset turnover (Sales/Total Assets)
Delta ROA	Mean change in Return on Assets (EBITDA/Total Assets)
Delta tan ROA	Mean change in Return on Tangible Assets (EBITDA/Tangible Assets)
Delta WC	Mean change in Working Capital relative to Sales (WC/Sales)
Delta adj. NWC	Mean change in adjusted Net Working Capital relative to Sales (Adj. NWC/Sales)
Theoretical Independent Variables	
PE dummy	A dummy variable that takes the value of 1 if the company is a portfolio company (PE-owned) and 0 for control companies
PE*Specialized	An interaction term between the PE dummy and Specialized dummy both taking the value 1 at the same time, 0 if otherwise
PE*Deal Type	An interaction term between the PE dummy and Deal Type dummy both taking the value 1 at the same time, 0 if otherwise
Control Variables	
Holding period	The number of years from (and including) the first full (fiscal) year of ownership till (and including) the last full (fiscal) year prior to exit
Initial values	The level of the dependent variable of interest at the time of the PE transaction for the portfolio companies and the matched control companies
Deal Types	A dummy variable that takes the value 1 for the specific deal type it belongs to. Matched controls also take the value 1 for the same deal type as the portfolio company
Specialized	A dummy variable that takes the value of 1 if the portfolio company is acquired by a PE fund that is specialized according to the ICA index, 0 if otherwise. The matched controls take the same value as the corresponding portfolio company.
Year Fixed Effects	A dummy that takes the value of 1 for the given years the company is owned by PE. Same for the matched controls.
Sector Fixed Effects	A dummy that takes the value 1 if a company is classified into one of the 10 industries based on the SNF database

Table A.VII – Regression Analysis for All Buyouts without Fixed Effects (FE)

Panel B: Post-Buyout Performance - Entry to Exit

Independent Variables	Dependent Variables							
	CAGR sales	Delta EBITDA %	Delta ROS	Delta asset turnover	Delta ROA	Delta tan ROA	Delta WC	Delta adj. NWC
PE dummy	**0.071*** **	**0.53** **	0.01	0.04	0.015	**0.04*** **	**-0.11*** **	-0.01
	(0.0101)	(0.2504)	(0.0107)	0.0498	(0.0114)	0.0161518	0.0227857	0.0150242
Holding period	**0.00***	-0.01	**0.00***	0.01	**0.00***	**-0.01** **	0.00	0.00
	(0.0020)	(0.0382)	(0.0017)	(0.0095)	(0.0017)	(0.0021)	(0.0043)	(0.0037)
Initial sales	**0.00** **							
	(3.04E-9)							
Initial EBITDA		**0.00*** **						
		(172.00E-9)						
Initial ROS			**-0.20*** **					
			(0.0362)					
Initial asset turnover				**-0.17*** **				
				(0.0288)				
Initial ROA					**-0.45*** **			
					(0.0052)			
Initial tan ROA						**-0.27*** **		
						(0.0783)		
Initial WC/sales							0.03	
							(0.0193)	
Initial adj. NWC/sales								**-0.01*** **
								(0.0037)
Year FE	No	No	No	No	No	No	No	No
Sector FE	No	No	No	No	No	No	No	No
Constant	**0.05*** **	**0.86*** **	**0.03** **	**0.19*** **	**0.06*** **	**0.05*** **	0.04	0.02
	(0.0121)	(0.2283)	(0.0123)	(0.0581)	(0.0125)	(0.0149)	(0.0268)	(0.0159)
N	858	858	858	858	858	858	858	858
R-squared	0.0589	0.0116	0.1195	0.0708	0.2849	0.1671	0.0225	0.0122
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A.VII depicts the post-buyout performance for all buyouts from entry (T-1) to exit (exit year-1) compared to the matched control group. This means that N (858) includes both PE-backed companies and the control companies. The regressions are OLS regressions. In total the table shows eight separate regressions ran on eight different dependent variables. Besides controlling for the initial value of the relevant dependent variable, all regressions have the same controls. A description of all variables included in the model is given in Table A.VI in the Appendix. The significance levels 10%, 5% and 1% are denoted by asterisk *, ** and ***, respectively. The results do not differ compared to Table VI, confirming that our matching approach has successfully accounted for year and sector effects.