The Private Company Discount

An acquisition study on private firms within the US

Kim van Oeveren

423861

Tilburg School of Economics & Management

Tilburg University

Abstract

The correct method to value private firms is a well discussed topic within research. The Private Company Discount provides an alternative view to the small firm premium commonly applied in private firm valuation by business analysts. Previous research mostly attributes the discount to the lack of marketability of private firms. This study provides a framework taking four different approaches to identify the driving factors of the Private Company Discount. A sample of 3,037 US domestic private firm transactions is considered in the period 1985-2017. Results show that private firms are sold at a median discount of 23%, 21% and 30% when looking at the sales, EBITDA and EBIT multiple respectively. This study finds that the discount can be mainly attributed to industry, firm specific characteristics, market liquidity and macro-economic events. Proxies indicating information asymmetry prove not to have a statistical significant effect on the size of the Private Company Discount. It can therefore be concluded that applying a fixed discount to private firms is erroneous as the Private Company Discount varies across firms.

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1 INTRODUCTION

The valuation of firms is a well-known topic within the world of Corporate Finance. Although there is a majority consensus on how to measure the value of public firms using the Discounted Cash Flow Model, there is still much ongoing discussion on the right method to value a private firm. According to the financial dictionary, the definition of a private firm is ‘’A company in which a small group of shareholders control all of the shares. These shareholders tend to hold onto the company’s stock and, in any case, no shares are publicly traded’’ (Farlex, inc., 2012). While many articles are written about methods of valuing private firms, they all state the high subjectivity of this process, since privately held firms have no observable stock price to provide for an objective measure of market value (Koeplin, Sarin, & Shapiro, 2000).

More than 90% of all businesses within the United States are privately owned (Paglia & Harjoto, 2010). Over the past 30 years, the baby boom generation of entrepreneurs have established large, profitable, and substantially valuable private firms. Most of those owners are now 50 and over and looking for a potential sale of the business as they approach retirement (Feldman, 2005). The demand for an appropriate model to value these firms is therefore present and increasing. There are several motivations for wanting to value a private firm. One of the most obvious reasons is that valuation is required prior to a private firm being transacted, however the majority of private firm valuations are conducted for tax-related reasons (Feldman, 2005).

A measure often applied in private company valuation is the small firm premium. This is a premium added to the cost of equity for smaller firms and is usually taken as the difference between average annual returns on small market cap stocks and the rest of the market (about 3% looking at the period 1926-2012) (Damodaran, 2014). It is used to adjust for the additional risk of investing in small (and private) companies. This measure is also applied in estimating the weighted average cost of capital of small and private firms by KPMG. However, recently there has been discussion on whether this measure is still applicable in small and private company valuation. A study by (Horowitz, Loughran, & Savin, 2000) shows there is no systematic relationship found between expected return and firm size in the period 1980-1996. It could therefore be argued that the small firm effect is no longer relevant. An interesting alternative to the small firm premium could be the Private Company Discount. In contrast to the small firm premium, this measure does not only take size into account when it regards private company valuation. It also makes the distinction between public and private firms, while the small firm premium does not. The Private Company Discount may provide a transparent manner for estimating why private firms often trade at a discount.

The focus of this study will therefore revolve around estimating the value of private firms by looking at transactions in the M&A market and identifying what drives the determination of value within

these transactions. The comparable transaction method as proposed in the study of (Kooli, Kortas, & L'Her, 2003) will be used as framework to answer the main research questions of this study:

What is the size of the Private Company Discount within the United States?

What are the driving factors of the Private Company Discount within the United States?

1.1 MOTIVATION OF THE RESEARCH

The Private Company Discount (''PCD hereafter'') is a topic which has been highly discussed within literature over the past years. Some authors attribute the discount to the lack of marketability and/or liquidity of private companies (Zanni, 2015), however there is still much room for ambiguity on what the exact determinants are of this phenomenon. While other studies by for example (Koeplin, Sarin, & Shapiro, 2000) focus more on influences like industry and cross-border transactions, this study will try to increase understanding of this phenomenon by constructing a framework taking 4 different views on the PCD. The first attributes the discount to the lack of marketability/liquidity of the market and the industry the firm operates in. The second approach tries to identify target specific characteristics that drive the height of the discount. The third approach looks at deal specific characteristics to determine if differences within M&A deals indicating information asymmetry can account for the size of the PCD. The last approach will look at the general condition of the market and the economy at the time the deal took place to see if this significantly influences the height of the PCD. Finally, this study aims at constructing a multivariate model with all the relevant factors explaining the PCD.

The added value of this research is to provide financial analysts and companies such as KPMG insight in the driving factors of the PCD, since research on this topic is relatively young and there is still much ambiguity on which variables explain this phenomenon.

1.2 STRUCTURE OF THE THESIS

In the next chapter, a literature review will be given to provide with insight in previous studies and findings, and provide a theoretical basis on which this research will be build. It will focus on finding driving factors that might influence the PCD to provide foundation for the hypotheses. In chapter 3, the theoretical framework and hypotheses will be discussed, to determine what proxies will be used as independent regressors to test the influence on the PCD. Chapter 4 will provide a description of the sample set used in this research, as well as the research methods. In chapter 5 empirical findings and interpretations will be presented, followed by chapter 6 providing final conclusions to the research and suggestions for future research.

2 EMPIRICAL LITERATURE REVIEW

Before starting to conduct this research, it first has to be determined why the need for an alternative valuation method for private firms exists. In order to do so, some light has to be shed on the fundamental differences between private and public firms. The following chapter will provide an in depth look at the distinctive features of private firms, and their implication for valuation purposes.

2.1 THE FUNDAMENTAL DIFFERENCES BETWEEN PRIVATE AND PUBLIC FIRMS

The most substantial differences between private and public firms and their implication for valuation purposes are discussed below.

Public Status

The first and foremost difference between public and private firms is their public status. Public firms are traded on a public stock exchange, and therefore a market price for equity and historical stock price information is readily available at all times (Damodaran, 2014). Since the stock of private firms is not traded, there is no market price for equity available for private companies. The implications of not being listed is that there is no ready market available for the equity of these firms, and liquidating a position in a private firm can prove to be more problematic than liquidating a position in a public company (Damodaran, 2014). Another distinction between listed and non-listed companies is the obligation to report accounting information. Public firms are ruled by a set of accounting standards with which they have to comply. These standards allow investors to identify every item on the financial statements of public companies (Damodaran, 2014). Private firms however, are not subject to these specific set of standards and have far less restrictions on their obligations to report earnings and financial statements. A consequence of being subject to looser accounting standards is that there is substantially less information available on private firms.

Ownership

One of the main consequences the public status has on a company is the structure of ownership of the equity of that company. In a private company, the firm's owner tends to be closely involved with management (or take part in it), and often has all his wealth tied up in the firm (Damodaran, 2014). This implies management will make operating decisions that will maximize the value of the firm (Jensen & Meckling, 1976). However within public firms, there often is separation of ownership and control between shareholders that hold the shares, and the managers who run daily operations of the firm. When managers hold a small (or no) portion of the firm's equity and shareholders are dispersed, they cannot enforce the maximization of firm value and managers may be inclined to make decisions that are beneficial only to them, such as empire building

(Morck, Schleifer, & Vishny, 1988). These misaligned objectives of managers and owners cause agency costs to arise, which are absent in private firms.

Access to capital markets

Another distinctive difference between public and private companies is the extent to which they have access to capital. We distinguish between three markets for capital within this research: the equity market, the debt market and the market for corporate control (mergers & acquisitions).

Equity market

The first market highlighted in this study is the stock market. According to the pecking order theory, due to adverse selection, companies prefer internal generated earning to external financing (Frank & Goyal, 2003). When external financing is necessary, debt is preferred over equity due to lower information costs (Frank & Goyal, 2003). Since private companies are held by a concentrated number of owners who all have substantial control within the firm, the cost of issuing equity and therefore giving away a portion of that control is higher for private firms, than for public firms with dispersed ownership (Brav, 2009). Another aspect that makes equity more expensive for private firms is that they tend to offer minority shareholder less protection they would enjoy with holding the stock of a public firm, which makes them less willing to purchase private equity (Brav, 2009).

Debt Market

Since the cost of accessing equity in private firms is higher than in public firms, they are more likely to turn to the debt market for funding. This causes 'the level effect' to occur where private firms rely more on debt financing relative to public firms (Brav, 2009). Their leverage will also show a larger sensitivity to operating performance, since is it more costly for them to rebalance their debt ratios (Brav, 2009).

Market for corporate control

Over 75% of all M&A deals within the US since 1985 involved private firms. The choice of acquiring a private firm as opposed to a public firm can be influenced by several factors. One major influencer is the availability of information. (Reuer & Ragozzino, 2008) Found that limited information on private firms increases the risk of not evaluating the private target's assets correctly. On the contrast, this information asymmetry can also create opportunities to gain high abnormal returns when an acquirer has superior information not available to the market (Makadok & Barney, 2001). Another factor that defines the difference between acquiring a private firm and a public firm is the way the firm is acquired. Since the stock of a private company is not traded on a public stock exchange open market purchases are off the table and several acquisitions methods such as a tender offers or a toeholds cannot be applied. As a consequence,

no market value for the shares of a private company exists, which brings us back to the problem on how to value private firms.

2.2 VALUATION OF PRIVATE FIRMS

The reason for wanting to value a private firm can have different origins. I can be transaction related, such as wanting to value a firm before an IPO or acquisition, but also compliance related, due to requirements for financial reporting by law (Pinto, Henry, Robinson, & Miller, 2015). The last main motive for private firm valuation is litigation related, e.g. a shareholder dispute. Each of these motives requires a special set of capabilities and knowledge, which has led to valuation professionals focusing their expertise on one of these areas. The two most commonly applied measures to valuing a private firm which will be briefly discussed in the next paragraph: the income approach and the market approach.

The income approach

The income approach is a well-known and widely used valuation method which can be applied to public ánd private firms for valuation. It is also commonly referred to as ‘’the Discounted Cash Flow’’ method. In a nutshell, this method compiles of estimating free cash flows to a firm, attaching a discount rate to the riskiness of these cash flows, and computing the present value to arrive at the enterprise value (Damodaran, 2014). Two problems occur when applying this method to private firms. The first is that there is no market value of equity and debt which have to be used as input to calculate the cost of capital through the Capital Asset Pricing Model. The second problem is that private firms do not have to comply with same financial reporting standards public firms do. Their statements are thus likely to have fewer information available. To deal with this problem in practice the unlevered beta of comparable public companies or the industry is often used and relevered with the target debt-to-equity ratio to estimate the private firm beta and the cost of equity.

The market approach

The market approach estimates the value of a private firm by using comparable public companies or transactions (Pinto, Henry, Robinson, & Miller, 2015). The two largest variations of the market based approach are the guideline public company method, in which trading multiples from comparable public companies are used as guideline to value the private company, and the guideline transactions method, which takes pricing multiples from acquisitions of comparable companies as the basis for private firm valuation (Pinto, Henry, Robinson, & Miller, 2015). The challenge in this approach lies in finding publicly traded companies (transactions) which are comparable to the private company in terms of business, size, capital structure and risk. Since market multiples reflect both the expected risk as well as the growth for a company,

they should be adjusted to accurately reflect the risk of the private company (Pinto, Henry, Robinson, & Miller, 2015).

The small firm premium

In private company valuation, business valuation professionals often incorporate the small firm premium as additional risk premium into the cost of equity for the smallest market cap stocks and private firms. The argument for doing so is that in general there is less information available for small firms than for large firms, which causes their stock to be perceived as riskier than stock of large firms (Barry & Brown, 1984). However a study by (Horowitz, Loughran, & Savin, 2000) found that there is no systematic relationship between the expected return of a security and the size of the company. It could therefore be argued incorporating a fixed small firm premium for both small cap and private firms is erroneous.

2.3 THE PRIVATE COMPANY DISCOUNT

An alternative to the small firm premium could be the private company discount. As discussed above there are some fundamental differences which distinguish private from public firms, in characteristics as well as in valuation approaches. Through the Private Company Discount (''PCD'' hereafter) empirical literature has tried to identify the differences between these two types of firms and their implication for valuation purposes. The most important studies and findings are discussed in section 2.1.1 [*Previous studies*].

2.3.1 Previous studies

Previous empirical studies have used different approaches to measure the height of the PCD. The approaches and results of these studies will now briefly be discussed.

Restricted stock studies

Restricted stock refers to equity shares issued by an organization which are not registered with the Securities and Exchange Commission (SEC) and cannot be sold in the open market (Silber, 1991). The stock is often issued to employees and affiliates of the company and can be sold after a specific holding period. In restricted stock studies the restricted securities are compared with publicly traded shares of the same company. Previous studies attributed the discount mainly to illiquidity (lack of marketability) of restricted securities. However the study of (Silber, 1991) found that the discount varies with profitability of the firm, and (Johnson, 1999) incorporated a size variable to explain some of the variability in the discount. This shows application of a universal discount would be erroneous. An overview of empirical findings is displayed in *table 1*. The largest downside of these studies is that the samples are relatively small due to the fact that restricted securities data not readily available, and the firms considered are all public firms, which arises the question to what extend these measures apply to private company valuation.

Study	Sample Period	Average Discount	Number of transactions
SEC	1966-1969	23%	398
Gelman	1968-1970	33%	89
Trout	1968-1972	34%	60
Maher	1969-1973	35%	n/a
Willamette Management	1981-1984	31%*	33
Silber	1981-1988	34%	69
Johnson	1991-1995	20%	72

* denotes median

Table 1 – overview of PCD findings in restricted stock studies

IPO studies

In an Initial Public Offering (IPO) a company brings it stock to the exchange for the first time. IPO studies compare the prices of stock transactions prior to the IPO to the IPO price (Emory, Dengel, & Emory Jr., 2002). The difference in these prices is attributed to the lack of marketability. The most prominent study in this field is conducted by John Emory, of which the results are presented in *table 2.* The largest downsides of these studies are that they cope with a major sample selection bias. Firms will only offer shares when their future prospects are positive, therefore unprofitable firms are not considered in the sample (Mukesh, Denis, Ferris, & Sarin, 2001). Another downside to this approach is the difference in buyers of the stock pre-IPO and post-IPO. Pre-IPO buyers are most likely insiders with ties to the firm, thus the price may be discounted as form of compensation for services performed by these insiders, while post-IPO buyers buy in the open market and are most likely not tied to the firm (Mukesh, Denis, Ferris, & Sarin, 2001).

Empirical findings of the studies conducted by John Emory, from the period 1989-2000

Period	Number of transactions	Average Discount
1980-1981	13	60%
1985-1986	21	43%
1987-1989	27	45%
1989-1990	23	45%
1990-1992	35	42%
1991-1993	54	45%
1994-1995	46	45%
1995-1997	91	43%
1997-2000	53	54%

Table 2

Acquisition Studies

The last approach to the Private Company Discount that will be considered in the literature review are the acquisition studies. These studies compare acquisitions multiples of public and private companies to arrive at a discount. The study of (Koeplin, Sarin, & Shapiro, 2000) considered transactions of domestic and foreign companies. This study conducts one-on-one matching of a private and a public transaction which are comparable in proximity, industry and size, then compares the difference in valuation ratio's to arrive at the discount. They found a significant discount in the earnings based multiples, and no significant differences between the revenue based multiples. The Koeplin study acknowledges that liquidity only partly explains the size of the discount, and incorporates differences in size and historical growth rates in the research model.

The study of (Kooli, Kortas, & L'Her, 2003) adapts the matching method of the Koeplin study to match each private transaction to a portfolio of comparable public company transactions instead of a one-on-one matching procedure. The Kooli study ranks each private acquisition on the basis of year, size and industry, and constructs size-quartile portfolio's based on these rankings (Kooli, Kortas, & L'Her, 2003). After that, the same is done to the public acquisitions, after which size-period-industry portfolio's based on the breakpoints of the private size-quartiles are formed. Private transactions are then matched to a control public portfolio. The Kooli study found that the PCD varied due to differences in industries and firm classifications.

The study of (Officer, 2006) investigates discounts for stand-alone private firms as well as subsidiaries. Officer includes successful and unsuccessful bids for controlling interest deals (at least 50% of equity) and a minimum deal value of $50 million. The matching procedure is slightly different from the study of Kooli in that for each unlisted target a unique portfolio of comparable public transactions is formed based on two-digit SIC code, deal value within 20% of the deal value of the private target, and a 3-year calendar window. In addition to the illiquidity of private companies, Officer controls for information asymmetry including the same method of payment as a requirement for comparability. Findings were that information asymmetries contribute to the size of the PCD, however 75% of the discount is related to other factors (Officer, 2006).

Other acquisition studies include the study of (Block, 2007), which can be seen as a replication of the Koeplin study in a more recent time period (1999-2006), and the study of (De Franco, Gavious, Jin, & Richardson, 2011) which found that private firms who hired a Big4 auditor were sold with a higher enterprise value in majority interest deals than firms who did not. The results of all relevant acquisition studies can be found in *table 3.*

An overview of previous acquisition studies on the Private Company Discount and their findings. ''Other'' relates to other multiples used in studies such as cash flow multiple and P/E ratios. The number of observations relates to the total sample used in the study. Number of available observations may differ between different metrics, for example, for the EBITDA PCD less observations are found in general than for the sales PCD.

Study	Year	Period	observations	Sales PCD	EBITDA PCD	EBIT PCD	Other	Geographic Focus
Koeplin, Shapiro, Salin	2000	1984-1998	192	9.8%	21.1%	17.1%	-	Global
Kooli, Kortas, L'Her	2003	1995-2002	331	17.0%	34.0%	-	20.0%	US
Block	2007	1999-2006	91	24.5%	22.5%	24.3%	23.3%	US
Officer	2007	1979-2003	364	-	17.2%	-	22.9%	Global
Paglia & Harjoto	2010	1993-2008	431	68.0%	25.0%	-	-	Global
De Franco, Gavious, Jin et al.	2011	1995-2004	664	32.8%	33.3%	-	-	US
Average			296	30.42%	25.52%	20.25%	22.07%	

Table 3

2.3.2 Liquidity

As shown in chapter 2.2.1 [*Previous studies*], liquidity is often seen as the main driver of the discount for private firms. When looking up liquidity in a dictionary, one comes across several descriptions, such as ‘’the availability of liquid assets to a market or company’’, ‘’cash’’, or ‘’high volume of activity in a market’’. It can therefore be stated that there are many dimensions to liquidity.

Liquidity of the market relates to the ease of selling or buying an asset (or firm) in the market. When funding liquidity is tight, traders are less inclined to take on positions in high-margin securities, which lowers the liquidity of the market and leads to higher volatility and risk premiums (Brunnermeier & Pedersen, 2009). The study of (Acharya & Pedersen, 2005) found that investors demand a premium for a security that is illiquid when the market liquidity is low. Relating this topic to private firms, (Officer, 2006) found significant evidence that sellers of a nontraded asset have to accept a higher discount when the liquidity of the market is low, implying cost of obtaining liquidity from another source (such as the debt market) is higher.

The next spectrum of liquidity considered in this study is the ‘’cash’’ dimension of liquidity, also called ‘asset liquidity’. When assets are less liquid, the cost of selling those assets is higher (Sibilkov, 2009). The notion that follows is that when private firms have many illiquid assets, the ease of selling the firm decreases and the private company discount is expected to increase.

2.3.3 Firm specific characteristics

Several studies on the Private Company Discount such as the study of (Koeplin, Sarin, & Shapiro, 2000), found significant evidence that the PCD differs due to firm specific characteristics. One of the largest influencers found in previous studies is firm size. The study by (Paglia & Harjoto, 2010) confirmed that larger firms on average have lower discounts than smaller firms. This study also found additional evidence on the influence of profitability and acquirer characteristics on the PCD. The study of (Kooli, Kortas, & L'Her, 2003) found significant differences in discounts for private firms with different growth rates. From this the expectation follows that the PCD is influenced by firm specific characteristics.

Another firm characteristic that influences the height of the PCD is the industry the target operates in. The study of (Paglia & Harjoto, 2010) and (Kooli, Kortas, & L'Her, 2003) found significant evidence that the discount to which private firms are sold differs between industries. The largest discounts were found for companies operating in wholesale & retail trade and construction (Kooli, Kortas, & L'Her, 2003). Within the study of (Paglia & Harjoto, 2010) the largest discounts were identified in the information and professional services sectors. Not only the industry in which the target firm operates influences the height

of the PCD. The study of (Officer, 2006) found that a firm sold in another industry sells at almost twice the discount to a firm who is sold in the same industry.

2.3.4 Deal characteristics

The third view on influencers of the PCD relate to the characteristics of the transaction itself. One factor that might influence the height of the PCD is the method of payment. The financing decision is an important step within the M&A process. It can significantly influence ownership structure, as well as leverage, and future financing decisions (Faccio & Masulis, 2005). The decision to pay for the acquisition in cash or stock can have different motivations. In the study of (Officer, 2006), the variable was incorporated with the rationale that when bidders face information asymmetries in potential targets they will choose stock as the preferred method of payment over cash. A motivation for the decision to pay in cash can be related to the need for liquidity of the seller, which could be willing to accept a higher discount in return for immediate liquid funds. On the other hand, a study by (Renneboog & Goergen, 2004) stated that when the acquiring firm feels their stock is undervalued, they prefer financing the acquisition with cash, to make sure only the bidding firm will share in the wealth effects of future stock price appreciation. Intuitively, when the acquiring firm thinks their stock is overvalued, they will be inclined to pay for the acquisition with stock.

Another characteristic of the transaction relates to the hiring of financial advisors to manage and advise during the transaction process. (Servaes & Zenner, 1996) Find that when the complexity and the asymmetric information aspect of a transaction increase, acquirers are more inclined to hire investment bank advisors. Another study by (Bowers & Miller, 1990) found that hiring an advisor during the acquisition process was an important factor in determining the wealth gains to both target and acquirer. It can therefore be argued that the payment structure of the deal and the financial advisors hired by the acquirer or target can significantly influence the size of the PCD.

2.3.5 Macroeconomic environment

The last aspect considered in this research is the influence by the macroeconomic environment. The first potential macroeconomic influencer that will be considered are merger waves. Prior research found that M&A activity tend to cluster in time (Maksimovic, Phillips, & Yang, 2013). Historically six completed merger waves have been identified. For this research, only the last 3 waves are relevant and will be considered. The fourth US merger wave started in 1981 and ended in 1989. The fifth wave started in 1993 and ended in 2000 (Renneboog & Martynova, 2008). The last wave started in 2003 and ended late 2007 with the outbreak of the subprime crisis (Alexandridis, Mavrovitis, & Travlos, 2011). A study by (Rhodes-Kropf & Viswanathan, 2004) found that market overvaluation increases the chances of an acquisition occurring. This implies that when an acquisition occurs during a merger wave, the PCD is expected to be lower.

The second aspect is related to the general health of the economy as a whole, and is measured using the business cycle. The business cycle is a process describing the rise and fall in the production output of goods and services within an economy. The cycle typically follows a pattern of economic expansion, through a peak into a recession, to the trough (bottom), where the cycle starts again with expansion. The periods of economic downturn and expansion are often measured using the GDP and corrected for inflation. A paper by (Becketti, 1986) mentioned that mergers are procyclical, which implies that they follow the business cycle. The expectation is that when the US economy is healthy, the PCD will be lower.

3. CONCEPTUAL FRAMEWORK & RESEARCH QUESTIONS

In this chapter the conceptual framework and motivations for the research questions, hypotheses and explanatory variables will be discussed. The aim of this research is taking different angles at the Private Company Discount and developing a framework to try and find the main value drivers of this phenomenon. The main research questions of this study are therefore formulated as follows:

What is the size of the Private Company Discount within the United States?

What are the major value drivers of the Private Company Discount within the United States?

This study will take 4 different approaches to the PCD, which will be accompanied by appropriate hypotheses and motivated accordingly. The four approaches are listed in *figure 1*.

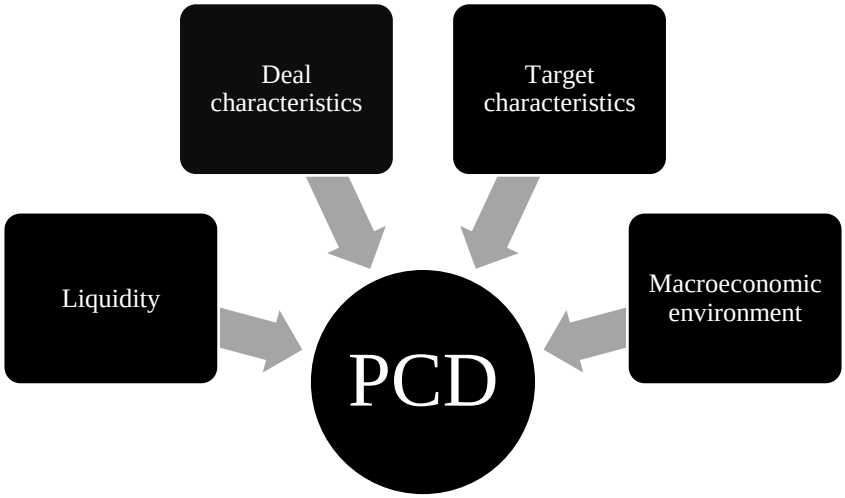

Figure 1

3.1 THE PRIVATE COMPANY DISCOUNT

The first step in this process is determining how the PCD will be observed. As discussed in the previous chapter, the comparable transaction method as first proposed by (Koeplin, Sarin, & Shapiro, 2000) and modified by (Kooli, Kortas, & L'Her, 2003) will be used and adapted slightly in estimating the PCD. At first the sample set of private acquisitions that is going to be used will be compiled. After that, a reference portfolio of public companies will be established for each private transaction. The requirements for the comparable company portfolios are that the public transactions have to be similar in terms of industry, time of the acquisition and company size. A comprehensive explanation on the matching process and calculation

of the PCD can be found in chapter 4 [*Data set & Methodology*]. After the matching procedure the PCD is established as follows:

$$Private\ Company\ Discount = 1 - \frac{private\ company\ multiple}{median\ public\ company\ multiple}$$

Three parameters of multiples will be used for comparison: Deal value/EBITDA, Deal value/SALES, and Deal value/EBIT. The motivation for the multiples can be found in chapter 4 [*Data set & Methodology*]. The median of the multiples for the public companies will be used for comparison and is preferred over using the average since the median is less sensitive to outliers. The outcome of the calculation follows three scenarios: the private company trades at the same value as the reference portfolio (PCD=0), trades at a premium as opposed to the reference portfolio (PCD<0) or trades at a discount as opposed to the public comparable portfolio (PCD>0). Since this research aims at explaining the existence of the Private Company Discount, the sign of this relationship is expected to be positive. The first hypothesis of this research following from the first research question is therefore as follows:

H1 – Private companies on average trade at a discount compared to a portfolio of comparable public companies

After this hypothesis is accepted, the remainder of this research is focused on explaining the cross-sectional variation within the Private Company Discount, with the aim at proving the discount varies due to differences in the 4 characteristics described above.

3.2 LIQUIDITY

As extensively covered in the literature review, one of the main explanatory variables in previous research for the PCD is the need for liquidity, sometimes put as lack of liquidity. Liquidity can be stated as: The availability of a market which can absorb the sale of an asset without adverse price changes, so without substantial transaction costs (Pagano, 1989). This dimension of liquidity is split into two parts: liquidity of the market as a whole, and liquidity of the industry the target operates in. Both will be discussed in this chapter.

3.2.1 Market liquidity

The study of (Officer, 2006) claims that the discount will be affected by the need for liquidity of the unlisted company as well as the availability of liquidity in the market. The discount is therefore expected to be higher in periods when capital markets are more illiquid. Periods where markets are illiquid are often related to periods of economic downturn or recession. The hypothesis related to market liquidity is formulated below:

H2A – The Private Company Discount will be higher when the liquidity of the market is low

To be able to prove this hypothesis several measures of liquidity of the market will be considered. The variables to test the third hypothesis are stated in *table 4* and motivated below.

Variable name	Expected sign
Historical Libor rate	Positive
C&I loan rate spread	Positive
IPO volume	Negative
IPO underpricing	Negative
M&A Volume	Negative

Table 4 – overview of proxies for Market Liquidity

Historical LIBOR rate – The LIBOR rate is often used as a benchmark interest rate for short-term loans. It is based on the average interest rates at which international banks in London borrow money from each other. There are 35 different LIBOR rates each business day. For this research the most commonly quoted rate will be used, the daily three-month US dollar rate (also known as 'the current LIBOR rate'). Expected is that when the LIBOR rate is low, debt is relatively cheap and therefore the market's liquidity is higher, and the PCD is expected to be lower.

C&I loan rate spread - Another proxy for liquidity of the credit market is the spread between the quarterly average interest rate on commercial and industrial loans within the US and the Federal Funds rate. It may provide some insight in the ease of financing in the debt market. This variable is used following the research of (Harford, 2005).

IPO volume – Following (Officer, 2006), IPO volume is measured as the quarterly average amount of IPOs within the US. Each private firm transaction is matched to the quarter in which the announcement date falls. (Lowry, 2003) Found that in times when investor sentiment is high, they are willing to pay more for firms, hence managers will make use of these periods to issue equity. During this periods of over-optimism, the discount on private firm transactions is expected to be lower. Therefore when IPO volume increases, the PCD is expected to decrease.

IPO underpricing - The underpricing of IPOs is the listing of an initial public offering lower than its market value. This results in the stock increasing in value from the offering price to the first-day closing price. It's measured in a similar way to IPO volume, by taking the quarterly average of the first-day returns for all IPOs within the US, and matching a private firm transaction to the announcement quarter. When average first-day returns are high, this indicates high IPO underpricing and high investor sentiment. This is

supported by the research of (Manigart, 2003). Intuitively, using the same reasoning as with IPO volume, when IPO underpricing is high, market sentiment is high and the PCD is expected to be lower.

M&A volume – This variable is defined as the number of quarterly M&A transactions within the US. When M&A volume is high, transactions costs are said to be low, and this indicates high liquidity of the market, since it is then relatively easy to sell or purchase a business (Harford, 2005). Therefore when M&A volume is high, the PCD is expected to be lower. All deals with majority interest stakes and with either disclosed or undisclosed value are considered.

3.2.3 Industry Liquidity

Another dimension of the liquidity aspect discussed in this research is related to the industry the target firm operates in. It can be argued that when the PCD differs between industries, which will be tested in chapter 3.3.1 [*Industry*], the liquidity of the industry a firm operates in will play a significant role in the extent of the discount in addition to general market liquidity. This statement is supported by several studies. (Shleifer & Vishny, 1992) Documented that firms have similar compositions of assets within a certain industry, and that fire sales of assets and periods of illiquidity differ across industries. Therefore cross-sectional differences will closely be examined using different industry proxies for liquidity as displayed in *table 5*.

Variable Name	Calculation	Expected Sign
M&A volume per industry	Number of deals for an industry in a particular year	Negative
Liquidity index	Value of all deals in a year in an industry / total assets industry	Negative

Table 5 – overview of proxies for Industry Liquidity

M&A volume per industry – The number of deals within an industry in a particular year will be used as an indicator of the easy of selling an asset within a particular industry and in a particular period. As with M&A volume, all majority interest deals are considered, either with disclosed or undisclosed value.

Liquidity Index – Following (Schlingemann, Stulz, & Walkling, 2002), the liquidity index is an indication of liquidity within a certain industry and is calculated by taking the total value of all controlling interest transactions in a particular year and industry and divide it by the total book value of all assets in the corresponding year and industry.

From the expectations formulated in this section relating to industry liquidity the following hypothesis is formulated:

H2B – the Private Company Discount will be higher when liquidity of the target's industry is low

3.3 TARGET CHARACTERISTICS

As (Mukesh, Denis, Ferris, & Sarin, 2001) already stated in the concluding remarks of their research, the difference in valuation between firms might not only be explained by the lack of marketability (liquidity) of the firm in question. This implies that there are other, unexplained, factors that drive the height of the PCD. Therefore this research will also consider fundamental differences in firm characteristics which might influence this phenomenon. The characteristics and corresponding hypotheses examined in this research are discussed below.

3.3.1 Industry

As discussed in chapter 2, one of the factors that might explain the differences in height within the PCD is industry. (Block, 2007) stated that the industry a firm operates in should be considered when determining the height of the PCD, and using a general discount applied to all industries would be erroneous. In order to investigate whether the PCD differs across industries the primary industry as reported by the SDC database will be used. A distinction will be made between 10 industries of which an overview can be found in *appendix B*. The hypothesis following from this expectation is the following:

H3 – The height of the Private Company Discount depends on the industry the firm operates in

3.3.2 Target size

As covered in the literature review, in public company valuation investors often demand an additional 'small firm premium' to be compensated for the risk of buying small cap stocks. It can be argued that this additional risk is not only present in public company valuation, but also plays a role in private firm transactions. The expectation is therefore that as size of the target increases, the risk decreases and the discount is lower. As a proxy for size this study will use the natural logarithm of book value of assets and the natural logarithm of sales as presented in *table 6.*

Variable	Expected sign
Natural logarithm of book value of assets	Negative
Natural logarithm of sales	Negative

Table 6 – overview of proxies for size

The hypothesis which follows from this expectation is the following:

H4A – Larger private targets are sold at a lower discount than smaller private targets

3.3.3 Target profitability

Another characteristic of the target that could be an explanatory variable to the PCD is the performance of the target at time of the takeover. The effect of profitability of the target on the Private Company Discount

will therefore also be examined. The intuition that follows from this is that in general firms are willing to pay a higher price if a target firm is more profitable. The proxy for profitability that will be used for this study is Return on Assets. The hypothesis that follows from this expectation is stated as:

H4B – More profitable targets are sold at a lower discount

3.3.4 Target growth

Another aspect of the target firm that might cause the PCD to differ between observations is the growth rate of the business. Targets with high growth in the past are more attractive for buyers and may induce bidders to overpay for the acquisition (Capron & Shen, 2007). The study by (Kooli, Kortas, & L'Her, 2003) found that the PCD is lower for targets which have a high potential for growth. The PCD is thus expected to be lower when the target experienced high growth in the past. We will measure growth as the % increase in net sales over the last 3 years.

The hypothesis that follows from the target growth described above is the following:

H4C – The Private Company Discount is lower when target's revenue growth increases

3.3.5 Asset Liquidity

Another firm characteristic that might influence the height of the PCD is how liquid the firm's assets are. Damodaran stated that is it wrong to think of assets as either liquid or illiquid, but rather that liquidity should be thought of as a continuum, where some assets might be more or less liquid than others (Damodaran, 2005). Some assets, like cash & marketable securities, can be easily converted to cash and are therefore more liquid than other (intangible) assets. Therefore multiple proxies are used as an indicator for the level of asset liquidity of a company. The parameters used to measure asset liquidity and their motivation are stated in *table 7*. The hypothesis on asset liquidity is formulated as follows:

H4D – The Private Company Discount will be higher when the liquidity of the firm's assets is low

Variable name	calculation	Expected sign
Cash to total assets ratio	$\frac{(cash\ +\ marketable\ securities)}{total\ assets}$	Negative
Cash flow to total assets	$\frac{cash\ flow\ from\ operating\ activities}{total\ assets}$	Negative
Current ratio	$\frac{current\ assets}{current\ liabilities}$	Negative

Table 7 – overview of proxies for Asset Liquidity

The most current information prior to the sale was taken to measure the target's liquidity position (last twelve months). To determine which parameters to incorporate the studies of (Kirkham, 2012) and (Officer, 2006) were used as reference.

Cash to total assets ratio – The cash to total assets ratio measures the actual cash and marketable securities present within the company, scaled by total assets. Companies with lower cash balances will be less liquid and therefore the discount is expected to be higher.

Cash flow to total assets – Total cash flow from operating activities is divided by the firm's total assets. This ratio shows how efficient the business is at using its assets to generate cash flows. The higher the ratio, the more efficient the business is at generating cash and the lower its need for liquidity.

Current ratio – The current ratio is determined by dividing current assets by current liabilities. This ratio is one of the most basic analysis ratios for measuring liquidity and indicates the firm's ability to meet short-term obligations with its current assets. The intuition behind this ratio is that it gives a rough indication of a company's financial health. A low current ratio can indicate that a company has trouble getting paid on their accounts receivable or has very high inventory turnover and indicates liquidity problems.

3.4 DEAL CHARACTERISTICS

There is still much to learn about the M&A process and the decisions firms make at every stage within a transaction. Therefore aspects of the transaction that differ across individual M&A deals could be potential explanatory variables for the PCD. The most distinctive deal features and how they possibly influence the PCD are discussed below.

3.4.1 Payment method

As discussed in chapter 2.3.4 [*Deal Characteristics*], the decision to pay with cash or stock could potentially affect the PCD. Although there can be several motivations for the acquirer to fully pay for the deal in cash, within this study the expectation is that all cash deals relate to less information asymmetry between the target and the acquirer, and therefore the discount is expected to be lower in an all cash deal following the study of (Officer, 2006). A dummy variable will be created equaling 1 if the deal is all cash, and 0 for other payment types.

3.4.2 Number of financial advisors

Another important aspect of an acquisition transaction that might explain the cross sectional variation in the PCD is whether a private firm hired a financial advisor to consult them during the M&A process. The expectation in this research is that when the target hired one (or more) financial advisors, this significantly

lowers the information asymmetry (Officer, 2006). The expectation is therefore that hiring more advisors will decrease the PCD.

The hypothesis that follows from the deal characteristics and their implication for information asymmetry is as follows:

H5 – The height of the Private Company Discount decreases as the information asymmetry decreases

3.5 MACROECONOMIC ENVIRONMENT

The general state of the economy might also be a key value driver explaining the PCD as discussed in chapter 2.3.5 [*Macroeconomic environment*]. We look at two macroeconomic aspects described below.

3.5.1 Merger waves

Since merger waves are general indicators for several variables that could influence the PCD, such as market liquidity, market optimism, managerial (in)efficiency and stock market peaks, it is expected that if a transaction took place during one of these waves, the PCD is lower.

To research this phenomenon we will create dummy variables with the value 1 if the transaction took place during a merger wave, and 0 otherwise.

3.5.2 Business cycle

We will measure the business cycle using a GDP quarterly recession indicator index provided by (Chauvet & Hamilton, 2006) and updated regularly on their website. The expectation is that when the recession indicator is high, market sentiment is low and the PCD will be higher.

The hypothesis corresponding to the macroeconomic environment is formulated as follows:

H6 – The height of the Private Company Discount will be higher when market sentiment is low

3.6 CONTROL VARIABLES

The next step in the process is to identify a set of control variables that will most likely influence the Private Company Discount, but are not the primary focus of this research. These variables are used to isolate the causal effect of a variable of interest (Woolridge, 2012). The control variables used in this research relate to the characteristics of the acquiring firm. Firms can have different motives to engage in acquisition activities. We can divide the type of buyers into two classifications: firms seeking to create value mainly from operating synergies, which arise from changes in cash flows from operations, and firms seeking to create value from financial synergies (Devos, Kadapakkam, & Krishnamurthy, 2009). We can therefore

classify buyers as strategic buyers or financial buyers. This study expects that strategic buyers are willing to pay more for an acquisition due to long term gains than financial buyers.

Just as the effect of size of the target, the size of the acquirer may also play a part in the size of the PCD. Previous research discovered that in general large firms are 'bad' acquirers. There are several theories to support this statement. For example, (Moeller, Schlingemann, & Stulz, 2004) stated that large firms might suffer from managerial hubris, where managers display excessive confidence and make business decisions that might not be beneficial to the firm, which might result in overpaying for acquisitions.

As next control variable the public status of the acquirer is considered, since it can be argued that since public firms often have dispersed ownership and management that potentially engages in empire building (Maksimovic, Phillips, & Yang, 2013), they are more inclined to make uninformed decisions on acquiring a firm and are likely to overpay for the transaction, as opposed to private firms, who have less access to capital sources.

The next control variable relates to the industry the acquirer operates in relative to the industry the target operates in. As discussed in chapter 2 [*Empirical literature review*], companies acquiring a target in the same industry are expected to create more wealth than conglomerate acquisitions. They are therefore expected to be willing to pay more for the expected synergies of the merger.

The last variable considered is the number of acquirer advisors. This variable is expected to have the same effect as the effect of target's advisors, namely reducing information asymmetry and therefore reducing the PCD. A comprehensive overview of all control variables used in this research can be found in *table 8*.

A comprehensive overview of control variables used in this research. The control variables relate to the characteristics of the acquirer. The expected sign of these variables is displayed on the right.

Variable Name	Calculation	Expected Sign
Acquirer type	1 if strategic buyer, 0 if financial buyer	Negative
Natural logarithm of the book value of total Assets (Acquirer)	Ln(BV total assets acquirer)	Negative
Natural logarithm of net sales (Acquirer)	Ln(net sales acquirer)	Negative
Public status acquirer	1 if public, 0 otherwise	Negative
Acquirer industry	Dummy variable equaling 1 if operating in the same industry	Negative
Number of Acquirer advisors	number of acquirer advisors	Negative

Table 8

4. DATA SET & METHODOLOGY

4.1 DATA

4.1.1 Data description

The sample considers completed domestic M&A transactions within the United States from the period 1985-2017. Data is obtained from de SDC Platinum database. This database contains extensive information on global M&A transactions since the 1970s. 1985 was taken as starting point due to the fact that the SDC does not provide reliable acquisition data for private firms before that (Officer, 2006). All completed deals up to 31/12/2017 are included. Financial firms and regulated utilities with SIC codes 6 and 49 respectively were excluded following (Koeplin, Sarin, & Shapiro, 2000), due to the fact that these businesses are heavily regulated and are typically characterized by high levels of cash and debt, which might influence the results. Only deals with disclosed value were considered, and as a condition the target had to be classified as 'private' or 'public'. Only stand-alone private firms are included in the sample, which implies that firms classified as joint ventures, government owned corporations, and subsidiaries were excluded. All firm specific information needed for analysis such as financial statement information, industry SIC code and acquirer type are also retrieved from the SDC Platinum database. Although the SDC Platinum database contains limited accountancy information on private firms, this study refrains from merging with other databases such as Compustat since matching of the two databases can create noise and might reduce the number of usable observations. Another criterion set to include observations in the dataset was that the percentage of shares owned before the transaction had to be less than 50%. This is in line with previous research of (Moeller, Schlingemann, & Stulz, 2004). All observations with pre-transaction ownership of 50% or more were therefore omitted, as well as transactions where ownership after transaction was less than a controlling interest (50%).

The data on macro-economic variables such as the GDP and interest rates were retrieved from the database of the Federal Reserve Bank of St. Louis (FRED economic data). The information on general M&A and IPO data were retrieved from the SDC Platinum One database.

A complete overview and definition of all variables can be found in *Appendix A*

4.1.2 Sample size

The raw dataset contains observations on 27,988 private and 8,286 public firms. As we add more criteria as conditions to be included in the research the number of observations decreases significantly. The first condition for this research relates to the construction of the comparable portfolios of public peers to measure the PCD, and it requires data on either net sales ór total assets, SIC code, and announcement date to be

available. The availability of the data regarding the most important criteria for this research can be found in *table 9*. As shown in the table, almost 80% of the observations are lost due to availability of financial statement information on private companies such as net sales.

The next step consists of dropping observations on which critical information needed for the construction of multiples is missing (an elaboration on the construction of multiples can be found in section 4.2.1 [*Acquisition multiples*]). Since at least one multiple needs to be present in order to compare observations, transactions in which all multiples were absent were omitted. In addition to these criteria, observations for which data seemed erroneous (e.g. net sales and debt < 0) were removed as well. Finally, observations were deleted for which the multiples were not economically reasonable and which could not be interpreted (e.g. extremely high multiples above 65 and negative multiples).

After implementing these criteria a sample set remains of 3,467 private company transactions and 6,960 public company transactions. However this will not be the final sample set for analysis since a comparable portfolio of peers has to be constructed for each private transaction. If there are no public companies that fit the criteria to be matched to a certain private transaction, the private transaction observation will be dropped. The final dataset for statistical research will be discussed in 4.2.2 [*Private Company Discount*].

Criteria	Number of private target observations	Number of public target observations
None (raw dataset)	27,988	8,286
Value of transaction	27,988	8,286
Target primary SIC code	27,988	8,286
Announcement date	27,988	8,286
Target net sales	6,575	7,636
Total assets	3,188	7,767
EBIT	2,880	7,604
EBITDA	2,398	7,244

Table 9 – availability of data

4.2 METHODOLOGY

4.2.1 Acquisition multiples

The next step in moving to the final dataset concerns construction of multiples. For this study three multiples will be constructed based on deal value. Deal value as reported by the SDC Platinum database is defined as

follows: ‘’ Total value of consideration paid by the acquirer, excluding fees and expenses. The dollar value includes the amount paid for all common stock, common stock equivalents, preferred stock, debt, options, assets, warrants, and stake purchases made within six months of the announcement date of the transaction. Liabilities assumed are included in the value if they are publicly disclosed. Preferred stock is only included if it is being acquired as part of a 100% acquisition. ‘’ In this case deal value will be approximately equal to enterprise value as it also includes the value of debt. This study will therefore consider multiples based on deal value instead of enterprise value as reported by the SDC, since there is more data available on deal value. If less than 100% of the shares are acquired in the transaction, deal value will be transformed to reflect a 100% stake in the firm.

Within this study three different multiples will be considered for analysis: deal value/EBITDA, deal value/EBIT, and deal value/Net sales. All the multiples are measured as the ratio of transaction value as reported by the SDC over the denominator taken from the financial statements of the target for the fiscal year prior to the acquisition.

This research makes use of two earnings based multiples and one revenue based multiple. Earnings multiples are used to measure the value of company in terms of income the company generates. The biggest advantage is it allows for comparison of firms with different capital structures and eliminates the distorting effects of differences in tax rates across firms. EBITDA is a good proxy of free cash flows available to investors within the business. However since the EBITDA multiple does not measure capital intensity, which might be critical in certain industries, the EBIT multiple is included as well.

Since earnings based multiples are defined by general accounting policies of a firm and have the disadvantage of possibly being manipulated, the ratio of the deal value to the revenues this firm generates (as measured by net sales) is also compared. The benefit of using revenues is that even though public and private firms are subject to different accounting regulations, it will not affect this multiple (Damodaran, 2012). It also has the benefit that it can be calculated for firms even if they report negative earnings. A disadvantage of the sales multiple is that it does not accurately account for the differences in profitability between firms.

Since the SDC Platinum database does not provide complete information on multiples, in addition to the multiples reported they were calculated by hand. The correlation between the multiples calculated by hand and those reported by the SDC Platinum database were very high (>0.99). This study therefore progresses in using the multiples calculated by hand for analysis. For a complete overview of how the multiples are calculated see the definition of all variables in *appendix A.*

4.2.2 Private Company Discount Calculation

The next step will be to initiate the matching procedure of public to private transactions. The challenge in this research lies in the ability to find comparable public firms. In theory a comparable firm should be equal in terms of growth potential, cash flows, and risk to the firm being valued (Damodaran, 2012). The general assumption made in valuation is that firms within the same industry sector have similar profiles that fit these three criteria. Therefore the first measure for comparison requires the comparable firms to operate within the same industry. Industry classification will be based on the Standard Industrial Classification (SIC) code. These 4-digit codes classify firms within 10 general industries. An overview of the industries and the corresponding SIC-codes can be found in *Appendix B*. The hierarchical structure of the SIC-codes can best be illustrated by an example. A firm classified under the 4-digit industry code 2053 (frozen bakery products, except bread) belongs to industry group 205 (bakery products), which is part of the major group 20 (food and kindred products), which in turn is classified within the general industry 20-39 (manufacturing). As can be derived from the example, firms compared on the 4-digit level will be more similar in terms of core business than firms compared on the 2-digit level. However the trade-off has to be made in terms of quality and quantity of data since there are less comparable firms on the 4-digit SIC code level than on the 2-digit level. How this study will account for this trade-off will be discussed by the end of this paragraph.

The next requirement the public firm has to meet in order to be deemed comparable is size. This criterion is essential since it does not make economic sense to compare a large supermarket chain like wholefoods to a small family owned grocery store even though they might classify within the same industry SIC-code. This research will use two proxies for size: net sales and total assets. These two measures are common proxies used in empirical studies. The criterion requires the public firm to report either net sales or total assets within a 30% range of the private company over the last fiscal year. The public firm will be included if it satisfies either of the two conditions.

The last criterion on which the public firm has to equal the private firm is the proximity of the deal in time. This requires the announcement date of the public acquisition target to be in a three-calendar-year window from the private target. This criterion is similar to the one used by (Kooli, Kortas, & L'Her, 2003).

This research aims at establishing at least 3 comparable transactions per private company transaction. Since this research deals with scarcity of data in finding comparable companies, the matching criteria inevitably have to be relaxed. In *table 10* an overview is provided of the matched transactions and multiples available corresponding to the different criteria. The first considers a sample matched on the 'hardest' criteria, e.g. 4-digit SIC-code and the criteria of size and time mentioned above. In the second sample the industry criterion is relaxed, and firms are matched on the 2-digit SIC-code. All observations

with less than three comparable transactions were discarded in all the samples. As the aim of this study is keeping as much usable data as possible, firms for which less than three multiples are available for comparison were not discarded. Since the aim is to establish a sample as large as possible which is still representative, further analysis will be conducted using sample 2. Benchmark analysis on sample 1 can be found in *Appendix G*.

A comprehensive overview of the number of transactions per year and industry of the final sample can be found in *appendix C and D.*

Sample	Total matched private transactions	Sales multiple	EBITDA multiple	EBIT multiple
Sample 1 – 4-digit SIC, 3-year window	879	874	130	110
Sample 2 – 2-digit SIC, 3-year window	**3,037**	**3,028**	**650**	**596**

Table 10 – matched samples

This matching method is fundamentally different from the study of (Kooli, Kortas, & L'Her, 2003) in that this research does not engage in constructing reference portfolios based on size-quartiles, but makes unique peer groups of reference transactions for each private transaction. Public companies are allowed to enter more than one portfolio of private transactions. The method used in this research is most comparable to the method used in the study of (Officer, 2006), but differs in that transactions are not matched on deal value but on two other proxies for size (net sales and total assets).

After the transactions are matched the median multiples for each reference portfolio of a private transaction are calculated to use as benchmark for calculation of the Private Company Discount. The calculation of the PCD is stated below following (Koeplin, Sarin, & Shapiro, 2000):

$$Private\ Company\ Discount\ = 1 - \frac{private\ company\ multiple}{median\ public\ company\ multiple}$$

The determination of the final size of the PCD will be different from the studies of (Koeplin, Sarin, & Shapiro, 2000) and (Block, 2007) in that this study does not calculate the average or median multiple for all private and public companies and use these as input for the formula to calculate the PCD, but calculates the individual PCD for every transaction of a private firm following (Kooli, Kortas, & L'Her, 2003) and (Officer, 2006). A graphic example of the calculation method applied in this study can be found in *Appendix E*.

4.2.3 Research method

In this paragraph the overall statistical procedure conducted in this research will be described. This study will start with proving the presence of the Private Company Discount, to be able to answer the first hypothesis. In order to do so a one sample t-Test will be conducted to test whether the multiples of the private and public companies differ significantly. This is referred to as the ‘’traditional method’’ and was first applied by (Koeplin, Sarin, & Shapiro, 2000). In addition to that a Mann-Whitney U-test is conducted which does not assume normal distribution, since our sample is expected to contain outliers. Next the existence of the PCD is tested against the null hypothesis of the non-existence of the PCD (<0). Since this study focusses on the median of the multiples in each reference portfolio, in addition to the t-Test and Wilcoxon signed rank test a univariate median quantile regression will be run to confirm the existence of the PCD. After hypothesis 1 is verified the other hypotheses on the value drivers of the PCD will be tested with bivariate analysis using quantile regression. Quantile regression is preferred over OLS in this case since this study deals with skewed data. Median quantile regression allows this research to investigate the median PCD of the sample as opposed to OLS which focusses on averages. After testing all the individual value drivers and accepting/rejecting the different hypotheses this research will continue to conduct a backward stepwise regression to build a multivariate regression model with the significant value drivers to be able to explain the variation within the PCD. Before the multivariate regression model is composed the correlation between the variables will be checked to avoid the issue of multi-collinearity in the final regression model.

4.2.4 Robustness tests

In addition to testing the statistical significance of the variables to see if they explain some of the cross-sectional variation in the PCD, potential data robustness problems need to be addressed. These problems are the sample selection bias, endogeneity, heteroscedasticity, and serial correlation. Why these problems need to be addressed and how they will be tested will be covered in this paragraph. The first issue which might be encountered is the sample selection bias. As this study relies on information provided by the SDC Platinum database, the robustness of the sample could be influenced by the quality of the information in this database. As the smallest private transaction already involves a firm with over $1 million in net sales, it is very well possible that many more transactions took place of smaller firms which are not covered in this database. The second issue related to the sample selection is that in general public firms are substantially larger than private firms. The 95^{th} percentile of public firms in the raw sample reports sales of $3,197 million dollars, while the 95^{th} percentile of private firms reports sales of $296 million dollars. This increases the probability of transactions of the smallest firms to be dropped due to lack of comparable public firms, and should be kept into mind when analyzing the results. Another sample selection problem arises due to

the fact that for some variables such as sales growth, data is very scarce and only a subset of the sample is able to be analyzed. This should be taken into account when constructing the multivariate regression model as loss of data can cause issues for significance and interpretation of the results. The last issue regarding the sample selection bias is that approximately 85% of all transactions classify within 2 general industries as can be seen in *appendix D*. This should be kept in mind when analyzing the cross-sectional results between industries.

The next issue which has to be dealt with is heteroscedasticity. This issue arises when the assumption that the variance of the unobserved error *u* is constant and finite for any value of the explanatory variables fails to hold. When this issue occurs in OLS regression, robust standard errors should be used. However since this study focuses on Median Quantile regression as opposed to OLS regression an alternative measure should be applied when heteroscedasticity arises. Since in the case of quantile regression the asymptotic distribution of an estimator is very hard to compute, heteroscedasticity cannot be confirmed or rejected. The solution arises in using bootstrap standard errors when conducting the multivariate regression.

Serial correlation is the next issue which should be addressed in this research. This phenomenon occurs when errors in two different time periods are correlated. This causes the standard errors to be biased and the model to be inefficient. When using OLS the model can be tested for autocorrelation using the Breusch-Godfrey test. However with quantile regression this test is not appropriate as it could result in large size distortions (Huo, Kim, Kim, & Lee, 2017). When using bootstrap standard errors, the model is corrected for possible unobserved autocorrelation.

5. EMPIRICAL FINDINGS

5.1 DESCRIPTIVE STATISTICS

The following chapter will give a quick preview of the data and the distribution of the sample by means of some descriptive statistics which will be presented and illustrated below. This study will use sample 2 as described in chapter 4.2.2 [*Private Company Discount*] with firms matched on 2-digit SIC and with a 3-year window for analysis and hypotheses testing. Additional benchmark analysis on the other sample can be found in the *Appendix G*. The histograms and frequency distributions in figure 1, 2 and 3 display the distribution of the multiples of the private and public targets in the sample. As is shown visually in the figures, the sample is positively skewed, even after correcting for the most extreme outliers (e.g. multiples above 65). The cause of the positive skew can partly be attributed to the fact that negative multiples cannot be interpreted and are therefore omitted from the dataset. Closer investigation of the data shows that the skewness is caused by high multiples in particular industries such as software (7372) and oil & gas extraction (1311). These multiples should not be omitted from the sample since this research aims at explaining the PCD across all industries, including those with high acquisition multiples. However, this should be taken into account when interpreting the results of the regression and the statistical tests on the PCD, as some statistical tests such as T-tests assume normal distribution and should therefore be interpreted with caution as this study progresses to statistical significance testing. Additional descriptive statistics on the variables needed for calculation of the PCD statistics can be found in *Appendix F*.

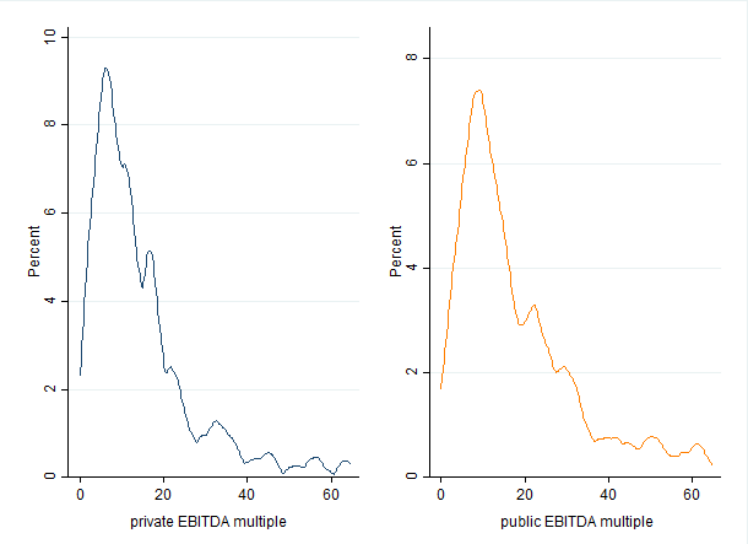

Figure 1 - Frequency distribution EBITDA multiple private & public firms

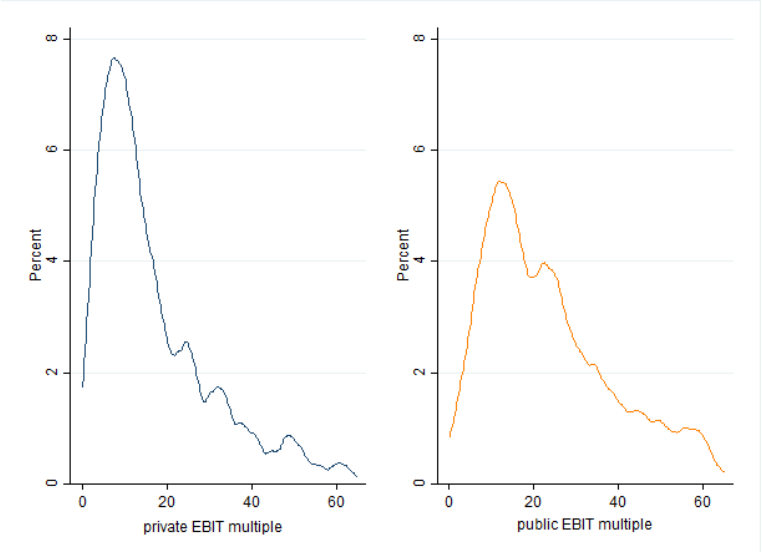

Figure 2 – Frequency distribution EBIT multiples private & public firms

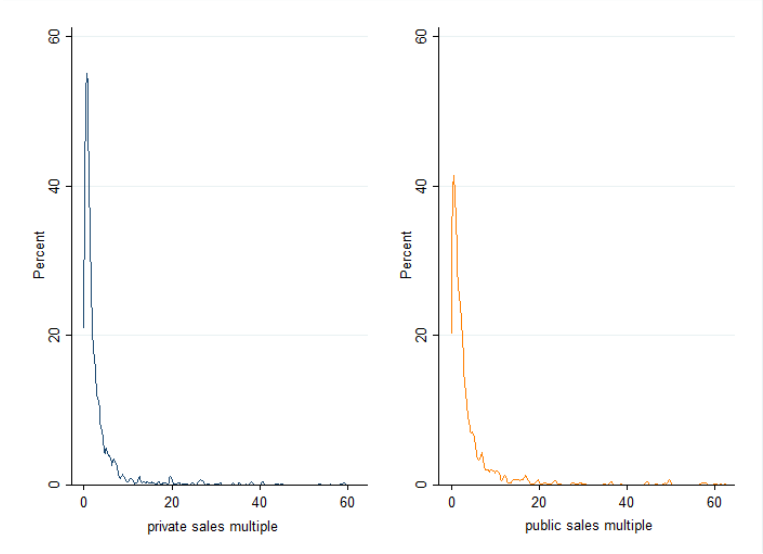

Figure 2 - frequency distribution sales multiples private & public firms

In addition to the visual inspection of the data, a Shapiro-Francia test was implemented to test whether the multiples are normally distributed. The results of the test as shown in *table 11* indicate that the p-value (prob>z) is low enough to reject the null hypothesis that the data is normally distributed, so this research assumes a non-normal distribution of the data.

Shapiro-Francia W' test for normal data

Variable	Obs	W'	V'	z	Prob>z
Private sales multiple	3,028	0.4189	1067.62	17.13	0.00001
Private EBITDA multiple	877	0.8040	116.67	10.82	0.00001
Private EBIT multiple	935	0.8370	102.76	10.58	0.00001
Public sales multiple	4,199	0.4715	1313.08	18.00	0.00001
Public EBITDA multiple	2,607	0.8306	271.12	13.64	0.00001
Public EBIT multiple	2,089	0.8992	131.77	11.72	0.00001

Table 11

Figure 4 shows the volume and value in $ millions of private and public M&A transactions included in the sample across the sample period 1985-2017. As can be seen when first inspecting the figure, the number and value of M&A transactions seem to follow a cyclical pattern. Another notable aspect is that total deal value of public firms seems to be considerably higher than total deal value of private firms. A more detailed overview of total value and number of transactions across years and industries can be found in *Appendix C* and *D* respectively.

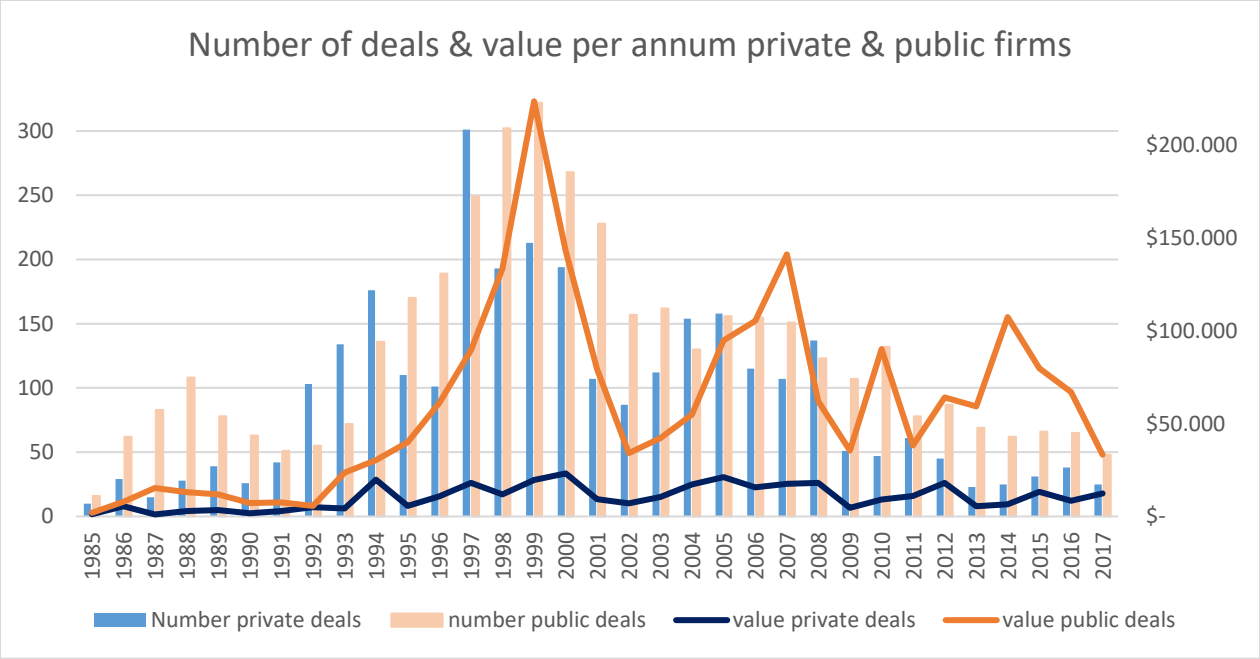

Figure 4

5.1.1 Univariate Analysis

The main focus of this research revolves around proving the presence of the Private Company Discount in private company transactions. This research will use several statistical tests to test the existence of the PCD against the null hypothesis of the non-existence of the PCD. *Table 12* provides an overview of the number of private and public multiples of the total sample. As shown in the table, the mean of the private and public multiples of the total sample are significantly different at the 0.01 significance level. Because the data set does not follow a normal distribution, in addition to the t-test a Mann-Whitney U-test was conducted which can used as a non-parametric analog to this test. As can be seen in the table the results are highly significant for the EBIT multiple, significant at the 0.1 level for the EBITDA multiple and not significant for the sales multiple, indicating there is no significant difference between the sales multiples of public and private companies. This method of proving the Private Company Discount was first used by (Koeplin, Sarin, & Shapiro, 2000) and modified by (Block, 2007) and can be referred to as the ‘’traditional method’’.

Overview of the private and public multiples (count, mean, difference) combined with an unpaired two-sample T-test and a Mann-Whitney U test

Variable	N		Mean		difference	Median		difference	t-statistic	Mann-Whitney test statistic
	private	public	private	public		private	public			
sales multiple	3,028	4,199	3.33	4.23	0.9	1.22	1.59	0.37	3.6749***	1.025
EBITDA multiple	877	2,607	14.32	18.01	3.69	9.35	11.07	1.72	3.8864***	1.681*
EBIT multiple	935	2,089	17	23.45	6.45	11.26	16.18	4.93	9.5045***	8.202***

*, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively

Table 12

Since this research uses the 'portfolio method' of matching private transactions to reference portfolios of public transactions, the PCD is calculated for each individual firm. A comprehensive overview of summary statistics of the individual PCD multiples is presented below in *table 13*. The development of the PCD multiples over time can be found in *Appendix F*.

	sales PCD	EBIT PCD	EBITDA PCD
N	3,028	596	650
mean	-1.12	0.05	-0.15
sd	5.96	0.93	1.27
min	-111.08	-5.81	-13.29
p10	-2.80	-1.04	-1.46
median	0.23	0.30	0.21
p90	0.85	0.80	0.77
max	0.9997	0.9980	0.9953
t-statistic	-3.0422***	1.2104	-10.3963***
Wilcoxon z-statistic	-1.027	2.734***	6.191***

*, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively

Table 13 – descriptive statistics of the PCD variables

As shown in the table, the mean PCD is negative for the sales and EBITDA multiples, meaning on average private companies are sold at a premium instead of a discount. This is confirmed by a T-test indicating private firms trade at a premium when comparing the sales and the EBITDA multiple at the 0.01 significance level. For the EBIT multiple the results were insignificant. However, when taking into account the non-normality of the dataset, looking at the median of the PCD multiples, these indicate private firms are sold at a 23%, 30% and 21% discount when comparing on sales, EBIT and EBITDA multiples respectively. When conducting a non-parametric Wilcoxon signed rank test for the PCD, the results are significant at the highest level for the EBIT and EBITDA multiple, and not significant for the sales multiple. When conducting a univariate quantile regression for the 50^{th} percentile, the median PCD statistics were significant at the 0.01 level for all multiples. The results of the quantile regression can be found in *table 14*. We can therefore reject the null hypothesis that on average private companies do not trade at a discount compared to public counterparts and accept H1. Since we want to measure the effect of the independent variables on the median PCD multiples, this research will conduct a quantile regression to test the hypotheses in chapter 5.2 [*Bivariate analysis*].

variable	discount	t-statistic
sales PCD	23%	10.76***
EBITDA PCD	21%	7.09***
EBIT PCD	30%	9.90***

*, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively

Table 14 – results quantile regression PCD stats

When looking at the benchmark analysis in *Appendix G*, it can be seen that the average PCD is much lower and even negative indicating a premium when comparing firms on the 4-digit SIC code level. A t-test confirms that the average PCD statistics indicate that private firms are sold at a premium compared to public firms when looking at the sales and EBIT PCD. When conducting a median quantile regression on the benchmark sample, the median discount is 8% for the sales PCD, -6% for the EBITDA PCD and 24% for the EBIT PCD. The quantile regression is only significant for the EBIT test statistic. Noticeable is that the median discount is significantly lower for all the PCD multiples when matching firms on the 4-digit SIC level, which would indicate private firms are sold at a lower discount when better matching peers are considered.

5.2 BIVARIATE ANALYSIS

In the previous chapter the descriptive statistics of the main variables of this research were tabulated and the existence of the Private Company Discount was confirmed. This research now progresses to the next stage of testing whether the independent variables have an economic and statistical significant effect on the Private Company Discount using median quantile regression.

5.2.1 Liquidity

As discussed in chapter 3.2 [*Liquidity*], one of the main value drivers of the PCD is expected to be liquidity. The different dimensions to liquidity and their effect on the PCD will be discussed in this section.

5.2.1.1 Market Liquidity

Firstly, the different proxies for market liquidity as decided on in chapter 3.2.2 [*Market Liquidity*] will be described and tested to see whether they significantly influence the PCD. Figures 5, 6, 7 and 8 display the development of the proxies for market liquidity over time.

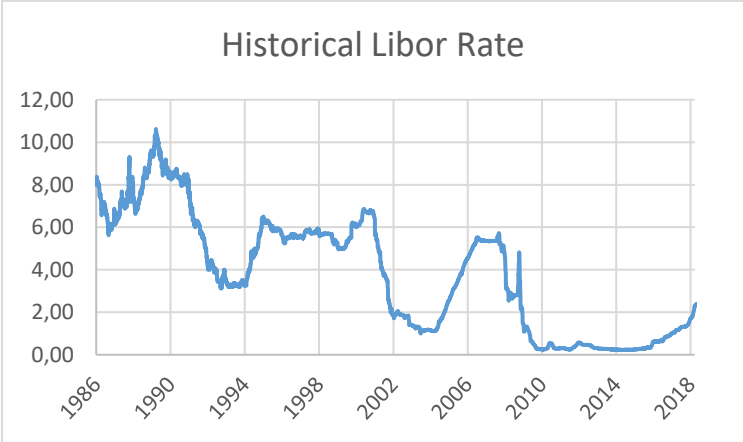

Figure 5

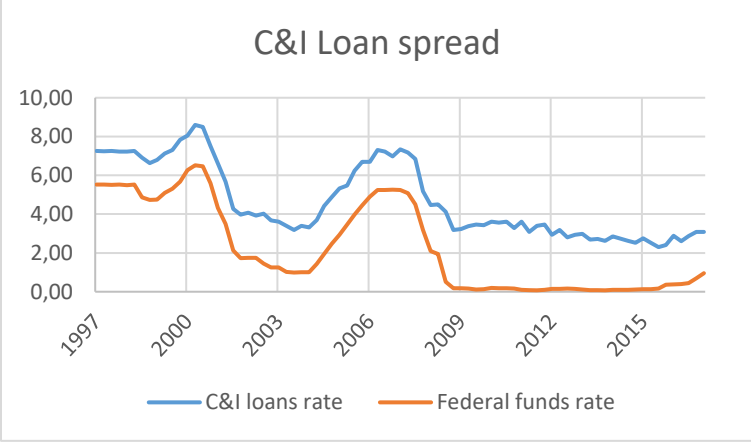

Figure 6

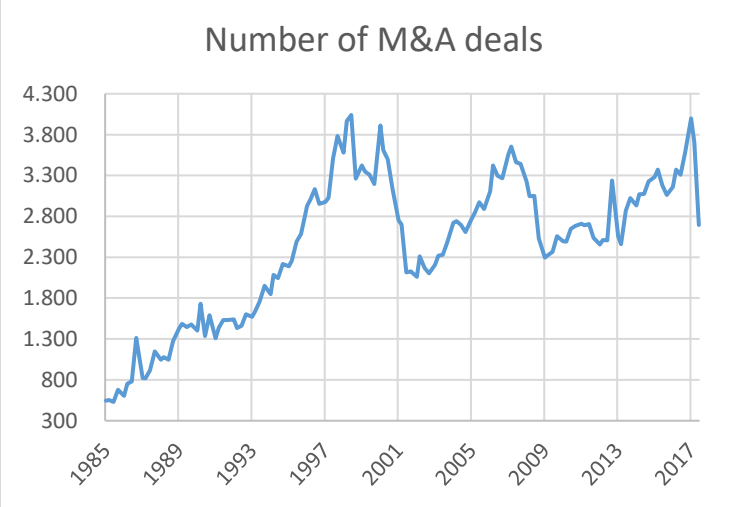

Figure 7

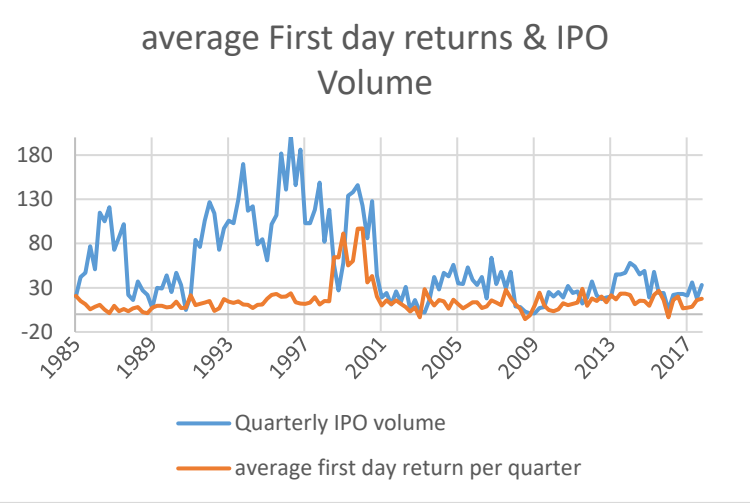

Figure 8

Table 15 below displays the bivariate quantile regression of each of the proxies for market liquidity on the PCD multiples.

	sales PCD			EBITDA PCD			EBIT PCD		
variable	N	Coefficient	T-statistic	N	Coefficient	T-statistic	N	Coefficient	T-statistic
Libor rate	2921	0.0376	3.62***	621	0.0183	1.17	573	0.0085	0.58
C&I loan spread	2124	-0.3587	-5.27***	447	-0.0363	-0.46	415	-0.0003	0
IPO volume	3028	0.0029	6.05***	650	0.0006	0.9	596	0.0002	0.32
Average first day returns	3028	0.0008	0.78	650	0.0016	-1.22	596	-0.0034	-2.14**
M&A volume	3023	0.0000	0.53	650	0.0000	0.52	595	0.0000	-0.38

*, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively

Table 15 – bivariate median quantile regression of the proxies for market liquidity on the PCD

Results of the quantile regression show that the Libor rate, C&I loan spread and IPO volume have a statistical significant effect on the sales PCD. A noticeable observation is that the coefficient of C&I loan spread is negative, indicating that on average when the spread between commercial and industrial loans and the federal funds rate decreases, the PCD increases. If the Commercial & Industrial loan rate and the federal funds rate are individually regressed on the sales PCD the coefficients are positive and significant at the highest 0.01 level. A possible explanation could be that from 2009 onwards the federal funds rate has been relatively low (*Figure 6)*, which in general indicates a healthy economy and thus a lower PCD, however the interest rate on C&I loans did not decrease with the same magnitude as the federal funds rate, causing the spread to be relatively high. This could possible explain the negative coefficient for this variable. When looking at the IPO volume the coefficient sign from the regression is positive, when the expected sign was negative. This could be due to the emission of a relevant variable which is correlated with IPO volume and the sales PCD. When looking at the multivariate regression of all the significant variables on the sales PCD in *appendix H*, it can be seen that the sign of the coefficient of IPO volume is indeed negative in the total regression, confirming this expectation. For the EBIT multiple, the average first day returns of IPO's indicating IPO underpricing was significant at the 0.05 significance level indicating that when average first day returns increase, the PCD decreases. For the EBITDA multiple, none of the proxies for market liquidity was found to have a significant effect on the PCD. Based on these results of the Libor rate for the sales PCD and the average first day returns for the EBIT PCD this study can reject the null hypothesis and accept H2A, stating the PCD is higher when market liquidity is low.

5.2.1.2 Industry Liquidity

The descriptive statistics for the liquidity index can be found in *table 16*. As can be seen, the median liquidity index differs widely between industries, the lowest liquidity being in the Transportation & Public Utilities sector, and the highest liquidity in the services sector.

Industry name	SIC	industry	median liquidity index
Mining	10-14	1	6.41%
Manufacturing	20-39	2	5.50%
Transportation & Public Utilities	40-49	3	3.58%
Wholesale trade	50-51	4	8.29%
Retail trade	52-59	5	3.93%
Services	70-89	6	14.58%

Table 16 – descriptive statistics of the liquidity index

The total number of M&A deals within the United States in the period 1985-2017 per industry can be found in *Appendix F* [*Additional Descriptive statistics*]. As can be seen the industries Servicing and Manufacturing have substantially more M&A activity than the other industries. Three industries were excluded for analysis, for which explanation will be provided in chapter 5.2.2.1 [*Target Industry*].

	sales PCD			EBITDA PCD			EBIT PCD		
variable	N	Coefficient	T-statistic	N	Coefficient	T-statistic	N	Coefficient	T-statistic
liquidity index	3,028	0.11	0.44	650	0.60	1.31	596	0.35	0.78
industry M&A vol	3,028	0.00	-1.99**	650	0.00	2.85***	596	0.00	1.18

*, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively

Table 17 – results of the bivariate median quantile regression of the industry liquidity proxies on the PCD

The results of the bivariate median quantile regression of the industry liquidity proxies are presented in *table 17*. The liquidity index shows no significant influence on the PCD variables when considering the entire sample. When incorporating interaction variables with the industry dummies and the liquidity index into the model instead of considering the entire sample, this also does not provide for significant results. The M&A volume per industry is statistically significant at the 0.05 and 0.01 level for the sales PCD and EBITDA PCD respectively, however the variable is not economically significant since the coefficient is very close to zero. The null hypothesis can therefore not be rejected and the conclusion is made that the height of the PCD does not depend on the liquidity of the industry the firm operates in. This study can therefore not accept H2B.

5.2.2 Target characteristics

In this chapter the results of the individual target characteristics are presented and discussed. This section is split into two parts; section 5.2.2.1 [*Industry*] will discuss show the results regarding the differences within the Private Company Discount between industries, and section 5.2.2.2 [*other target characteristics*] will discuss the other firm characteristics and how they influence the Private Company Discount.

5.2.2.1 Target Industry

The first topic relates to the results of the differences within the PCD variables between industries. *Table 18* provides the findings on the PCD variables per industry. As can be seen in *appendix D,* no observations were present in the final sample for firms classified within the SIC codes 01-09 (agriculture, forestry and fishing), 15-17 (construction), 60-67 (finance, insurance & real estate), and 91-99 (public administration). Therefore only 6 industry categories were considered for analysis within this research. *Appendix D* also provides a comprehensive overview of deals per industry incorporated in this sample.

Industry category	Industry number	SIC	Sales PCD	EBITDA PCD	EBIT PCD
Mining	1	10-14	27%	-17%	13%
Manufacturing	2	20-39	25%***	22%***	33%***
Transportation & public utilities	3	40-49	36%***	9%	34%
Wholesale trade	4	50-51	15%	33%***	17%
retail trade	5	52-59	15%	-13%	-23%
services	6	70-89	21%***	25%***	32%***

*, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively

Table 18 – median PCD per industry

As shown in the table, the discount is statistically significant for firms within industry 2, 3, and 6 for the sales PCD, for industry 2, 4 and 6 for the EBITDA PCD and 2 and 6 for the EBITPCD. The results are all significant at the highest (0.01) level. Therefore the null hypothesis can be rejected that the PCD does not depend on the industry the firm operates in for all industries except retail trade and mining, and H3 can be accepted.

5.2.2.2 Other Target Characteristics

Table 19 presents an overview of the descriptive statistics of the other target firm characteristics subjective to explaining the cross-sectional difference in the PCD.

statistics	ln(BV assets)	ln(sales)	ROA	growth	Cash/TA ratio	Cash flow/ TA ratio	Current ratio
n	1472	3031	1425	513	1385	1082	1392
mean	2.67	3.19	-0.07	3.17	0.17	-0.04	1.89
sd	1.68	1.44	1.17	18.51	0.28	0.72	2.32
min	-1.61	-2.16	-18.00	-0.99	-0.02	-8.50	0
p10	0.59	1.43	-0.63	-0.12	0.01	-0.50	0.42
p50	2.54	3.09	0.06	0.35	0.09	0.08	1.35
p90	4.92	5.06	0.40	3.49	0.45	0.34	3.50
max	8.57	8.74	14.10	270.06	6.08	3.80	33.58

Table 19 – descriptive statistics of other target characteristics

A noticeable aspect is that for a number of variables not all observations report values. This is due lack of information provided by the SDC database on financial statement information of private companies and should especially be taken into account when analyzing the results.

The results of the bivariate median quantile regression of each variable of the target firm characteristics on the PCD multiples is presented in *table 20.*

	sales PCD			EBITDA PCD			EBIT PCD		
variable	N	Coefficient	T-statistic	N	Coefficient	T-statistic	N	Coefficient	T-statistic
ln(BV assets)	1,463	-0.08	-3.42***	626	-0.04	2.12**	540	-0.09	-4.98***
ln(sales)	3,028	0.45	2.93***	646	-0.02	-0.75	591	-0.07	-3.18***
ROA	1,416	0.23	5.89***	619	0.15	3.01***	530	0.25	5.08***
growth	512	-0.08	-25.50***	271	-0.02	-1.48*	241	-0.06	-4.69***
Cash/TA ratio	1,377	-2.11	-11.66***	601	0.01	0.06	541	-0.02	-0.11
CF /TA ratio	1,074	0.57	6.92***	477	0.27	1.92*	392	0.30	2.82***
Current ratio	1,384	-0.06	-3.52***	602	0.02	1.16	513	0.01	0.92

*, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively

Table 20 – results of the bivariate median quantile regression of the other target characteristics on the PCD

The results show that the natural logarithm of the book value of assets of a private firm has a negative and significant effect at the highest level on the Sales and EBIT PCD, and at the 0.05 significance level for the EBITDA PCD. This indicates that larger firms are sold at a lower discount compared to smaller firms. However the other proxy for size which is the natural logarithm of sales, displays the opposite relationship

in the sales PCD, which would indicate firms with higher revenues would trade at a higher discount when comparing the sales multiples. For the EBIT multiple the coefficient shows the expected negative sign which is significant at the highest level. The difference could be due to another (unobserved) variable affecting the Private Company Discount. However, since in general the earnings based multiples are more commonly used as benchmark for comparison by financial analysts and consultancy firms such as KPMG, this study relies on the EBITDA and EBIT PCD for interpretation. With these results we reject the null hypothesis and accept H4A that larger targets trade at a lower discount. In terms of profitability, it can be seen that ROA is significant at the highest level for all three multiples. Noticeable is however that when ROA increases, the sales PCD increases as well. This could be due to the fact that ROA measures how efficient a company is at using its assets to generate earnings. In case smaller companies on average have higher ROA's than larger targets, it could be that the size effect of smaller firms trading at a higher discount might have a stronger effect than profitability, causing the ROA to have a positive relationship to the PCD. This presumption is confirmed by inspection of the data. Around 60% of the firms in the highest 10^{th} percentile of ROA belong to the lowest 25^{th} percentile of total assets. However since the expectation of this research was that more profitable targets are sold at a lower discount, the null hypothesis cannot be rejected and H4B cannot be accepted. The next characteristic of the target considered is growth in revenues over the past three years. The results confirm the expectation that when the firm has experienced higher growth over the past three years, the private company discount is lower. This results are significant at the highest level for the sales and EBIT multiple, and significant at the 0.10 level for the EBITDA multiple. This research can therefore reject the null hypothesis and accept H4C that higher growth firms are sold at a lower discount.

The last hypothesis regarding target firm characteristics relates to the asset liquidity of the company. The cash-to-Total Assets ratio is negative and significant at the 0.01 level for the sales PCD, indicating that firms with higher cash balances are sold at a lower discount. The cash flow from operating activities to total assets ratio is significant at the highest level for the sales and EBIT PCD, and significant at the 0.10 level for the EBITDA PCD. However the sign of the regression coefficient is positive, indicating firms with a higher cash flows trade at higher discounts. This problem encountered in this variable could be similar to that of ROA, where smaller firms on average have higher cash flows from operating activities relative to the level of Total Assets. When inspecting the data it can be concluded that this is not the case. The other alternative explanation could be that there is another unobserved characteristic that affects the PCD causing firms with a higher cash flow ratio to trade at higher discounts. Unfortunately this falls outside the scope of this research. Finally, the current ratio has a significant effect on the sales PCD on the 0.01 significance level, indicating firms with a higher current ratio trade at a lower discount. Based on the results from the cash to Total Assets ratio and the current ratio H0 can be rejected and H4D can be accepted that firms with higher asset liquidity trade at a lower discount.

5.2.3 Deal characteristics

The descriptive statistics of the deal characteristics relating to the private company acquisitions are displayed below in *table 21 and 22*.

Number of target advisors	0 / unknown	1	2	≥3
N	1,965	963	92	17

Table 21 – descriptive statistics target advisors

Payment method	cash	other
N	978	2,059

table 22 – descriptive statistics payment method

The variable of number of target advisors is only available for a subset of the population. As can be seen the majority of the private firms hire no more than 1 advisor for the acquisition process. For the payment method data on all the transactions is present, and it can be seen that more than 2/3rd of the sample involved a mixed consideration structure. The results of the bivariate analysis of the deal characteristics is presented in *table 23.*

	sales PCD			EBITDA PCD			EBIT PCD		
variable	N	Coefficient	T-statistic	N	Coefficient	T-statistic	N	Coefficient	T-statistic
number target advisors	1,067	-0.07	-0.48	293	0.01	0.15	274	0.06	0.55
payment method	3,028	-0.07	-1.54	650	0.02	0.28	596	-0.06	-0.93

*, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively

Table 23 – bivariate median quantile regression deal characteristics on the PCD

Both the number of target advisors and the method of payment have no statistical significant effect on any of the PCD metrics. The null hypotheses can therefore not be rejected and H5 cannot be accepted. The conclusion can therefore be made that the level of information asymmetry does not significantly influence the Private Company Discount.

5.2.4 Macroeconomic variables

Figure 9 and *10* present an overview of the merger waves within the United States and a plot of the GDP-based recession indicator index. The merger waves can be clearly identified by the peaks in deal activity across time. It can be argued that another wave started around 2013, but since this wave is not clearly identified within the existing literature it is excluded for this research. *Table 24* presents an overview of all private transactions which fall within one of the three waves.

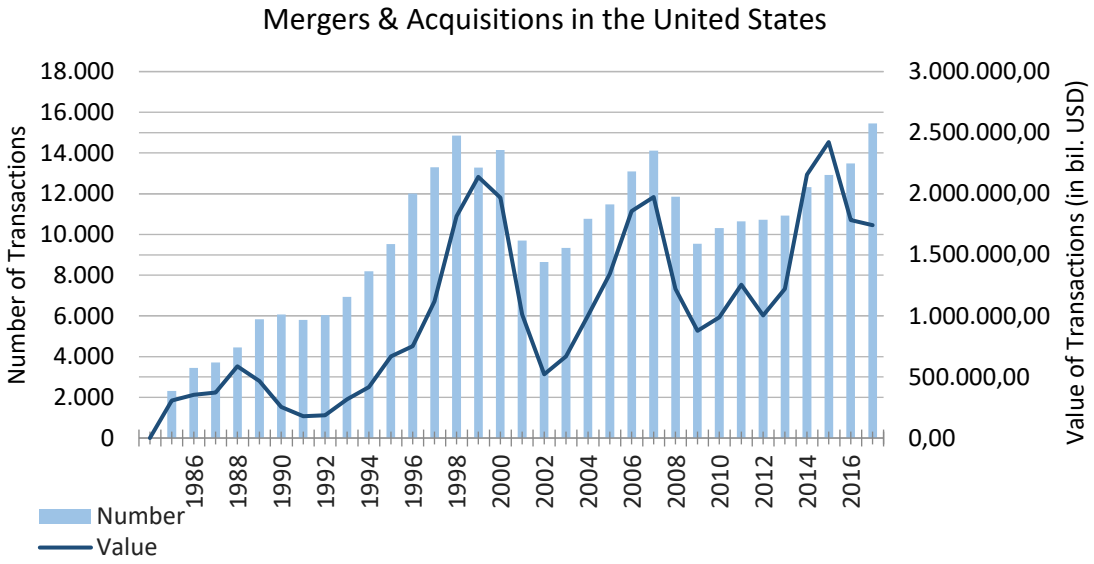

Figure 9 – M&A activity United States 1984-2017

Wave	Number of transactions in sample
1 – 1981-1989	121
2 – 1993-2000	1,422
3 – 2003-2007	646

Tabel 24 – transactions in the sample that occurred during a merger wave

The GDP-based recession indicator is a scale that runs from zero to hundred and is used as an identifier for periods of economic downturn. The peaks in the graph indicate periods of high recession. As can be noticed in the two graph, the merger waves seem to be characterized by periods of low recession, indicating these two phenomena's could be inversely related.

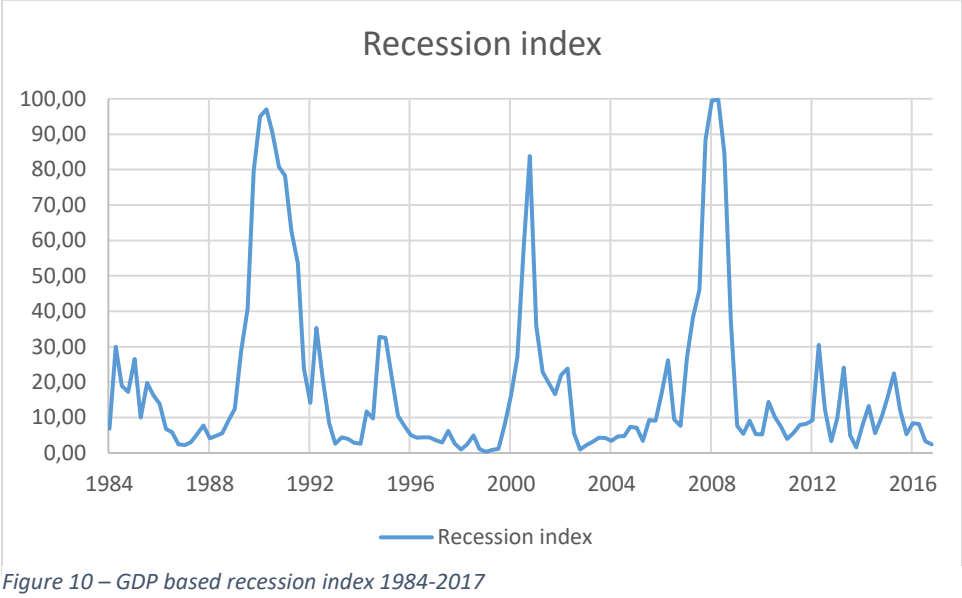

Figure 10 – GDP based recession index 1984-2017

In *table 25* the results of the bivariate regression of the macroeconomic variables on the PCD parameters are presented, which will be discussed below.

	sales PCD			EBITDA PCD			EBIT PCD		
variable	N	Coefficient	T-statistic	N	Coefficient	T-statistic	N	Coefficient	T-statistic
wave 1	3,028	-0.32	-2.99***	650	-0.04	-0.26	596	0.03	0.22
wave 2	3,028	0.33	7.42***	650	0.03	0.42	596	0.04	0.62
wave 3	3,028	-0.16	-3.13***	650	0.01	0.07	596	-0.03	-0.42
recession index	3,023	0.00	-3.34***	650	0.00	1.00	595	0.00	0.59

*, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively

Table 25 – bivariate median quantile regression of the macroeconomic variables on the PCD

All three merger waves are statistically significant on the 0.01 level on the sales PCD. Noticeable is that while merger wave one and three show the predicted negative sign, indicating market optimism and high liquidity of the market driving the Private Company Discount down, the second waves showing transactions in the period 1993-2000 show that firms in that period trade at a larger discount. This could be interpreted as another unidentified potential factor during that period influencing the Private Company Discount driving it upwards. The recession index has a high statistical significant effect on the sales PCD, unfortunately the economic significance is very close to zero, indicating the recession index does not influence the PCD. To conclude, based on the results of the merger waves the null hypothesis can be rejected and H6 can be accepted that the PCD is higher when market sentiment is low.

5.2.5 Control Variables

The results of the bivariate median quantile regression of each variable of the control variables on the PCD multiples is presented in *table 26*.

	sales PCD			EBITDA PCD			EBIT PCD		
variable	N	Coefficient	T-statistic	N	Coefficient	T-statistic	N	Coefficient	T-statistic
Acquirer type	3,028	0.24	2.90***	650	-0.11	-1.21	596	-0.08	-0.79
ln(BV assets acquirer)	2,356	-0.12	8.48***	500	-0.06	-3.12***	454	-0.06	-3.7***
ln(sales acquirer)	2,399	-0.06	-4.14***	506	-0.05	-2.64***	461	-0.06	-3.5***
public status acquirer	3,028	-0.03	-0.49	650	-0.15	-1.66*	596	-0.04	-0.42
Same industry acquirer dummy	3,028	-0.03	-0.70	650	-0.14	-2.19**	596	-0.03	-0.50
Acquirer advisors	863	-0.06	-0.39	238	-0.10	-0.68	251	0.06	0.38

*, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively

Table 26 – bivariate median quantile regression of the control variables on the PCD

As can be seen by the results of the bivariate regressions, the size of the acquirer has a significant negative effect on the Private Company Discount for all three proxies, which confirms the expectation that larger firms are more likely to overpay for acquisitions (Moeller, Schlingemann, & Stulz, 2004). Acquirer type is significant for the sales PCD, but contrary to the prediction of strategic buyers being more likely to overpay for an acquisition due to synergies, this result indicates strategic buyers are better informed acquirers and do not overpay for acquisitions. Public status has a negative significant effect on the EBITDA PCD on the 0.10 level, which contradicts the expectation of public buyers being 'bad' acquirers, and when the acquiring firm operates within the same industry as the target this decreases the EBITDA PCD which is significant at the 0.10 level, confirming the expectations that acquirers in the same industry are willing to pay more for an acquisition due to synergy opportunities. Acquirer advisor did not prove to have a significant effect on one of the PCD variables.

5.3 MULTIVARIATE ANALYSIS

After testing the significance of the individual variables on the Private Company Discount multiples and confirming the influence of certain variables, this study now progresses to build a multivariate regression model explaining the cross-sectional variation in the PCD. Since not all variables prove to be significant for each PCD statistic, three regression models will be built for the sales, EBITDA, and EBIT PCD. The correlation matrix of the variables for each final regression model can be found in *Appendix H*. The concern in building a multivariate model is that this research aims at determining a regression model which is as complete and realistic as possible, so it aims to include every variable that is related to the dependent variable to improve the goodness of fit of the model (R^2). However, the model also aims at including as few regressors as possible as each variable added to the model will increase the standard errors of the other coefficients. This section will discuss how this study approached these challenges in determining the final multivariate regression model for each PCD statistic.

Sales PCD

Firstly, all the variables that prove significant when individually regressed on the sales PCD were incorporated in the model. However, when incorporating all significant variables into the model, the majority of the variables lost their significance, as can be seen in the regression in *Appendix H*. The cause of this is that the number of observations for which all data is available decreases significantly as more variables are included in the model. This research will therefore conduct a backward stepwise regression, where the model begins with all the candidate variables included, and works its way down by removing the least significant variable each time until (almost) no insignificant variables remain. The result of multiple stepwise regression runs are presented in *table 27* model (a). As can be seen not all variables incorporated in model (a) are significant, referring to the industry dummies. However they are included in the model, since it is not possible to only include one or two significant industries and leave the other ones outside the scope of the model. To correct for unobserved heteroscedasticity and possible serial correlation bootstrapped standard errors are used in model (b), which causes growth to lose its significance and industry 4 to obtain significance in the new model.

To correct for multi-collinearity, the correlation matrix of the independent variables incorporated in the model can be found in *Appendix H*. A quick look at the correlation matrix shows that there only exists a high correlation between ln(sales) and ln(TA), which can be logically explained due to the fact that these two variables are both used as proxies for the size of the company. *Appendix H* provides an overview of the test used to check for multi-collinearity. The results of the test indeed shows that multi-collinearity is present between the two variables, therefore the regressor ln(sales) and ln(TA) were removed in model (c) and (d) respectively. However when removing these regressors from the model, consequently other

regressors lost their significant influence on the PCD, as well as the constant which becomes insignificant as can be seen in model (c) and (d). The correction made for this and the final regression model (e) can also be found in *table 27*. As can be seen in the models, the number of observation is reduced significantly from the initial sample of 3,028 observations on the sales PCD when incorporating more variables, which causes a sample selection problem. The pseudo R-squared corresponding to this regression is 11.92% before correcting for multi-collinearity, and below 10% after. This indicates that there are still many unobserved factors explaining the cross-sectional variability in the sales PCD.

	Sales PCD				
	(a)	(b)	(c)	(d)	(e)
Industrydummy 1	0.9954***	0.9954***	0.0888	0.1276	
	(0.3757)	(0.2612)	(0.3622)	(0.1889)	
Industrydummy 2	0.0159	0.0159	-0.0734	-0.1300	
	(0.1541)	(0.0877)	(0.0983)	(0.1641)	
Industrydummy 3	0.5919**	0.5919***	0.4868*	0.3094	
	(0.2456)	(0.1761)	(0.2903)	(0.2564)	
Industrydummy 4	-0.3689	-0.3689**	0.2904	0.1914	
	(0.3498)	(0.2019)	(0.3910)	(0.2188)	
Industrydummy 5	-0.4919	-0.4919	0.0642	-0.0724	
	(0.3961)	(0.4518)	(0.1993)	(0.2226)	
ln(TA)	-0.6947***	-0.6947***	0.0664		
	(0.0882)	(0.0931)	(0.0465)		
ln(sales)	0.9487***	0.9487***		0.2766***	0.2868***
	(0.0963)	(0.1110)		(0.0407)	(0.0542)
growth	-0.0434***	-0.0434	-0.0528	-0.0759***	-0.0759**
	(0.0043)	(0.0312)	(0.0329)	(0.0212)	(0.03299)
ln(salesacq)	-0.145***	-0.1458***	-0.1076**	-0.1887***	-0.2068***
	(0.0415)	(0.0303)	(0.0480)	(0.03615)	(0.0310)
constant	-0.7189***	-0.7189***	0.2647	-0.1441	-0.0888
	(0.2165)	(0.2804)	(0.1957)	(0.2302)	(0.2479)
observations	405	405	405	419	419
Pseudo R2	0.1192	0.1192	0.0352	0.0858	0.0806
adj. Multicoll.	No	No	Yes	Yes	Yes
Robustness	No	Yes	Yes	Yes	Yes

*, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively. Standard deviations are displayed in brackets below the coefficient

Table 27

EBITDA PCD

The same measure applied to the sales PCD was conducted by first regressing all significant variables in one multivariate model to explain the cross-sectional variation in the EBITDA PCD. The results of this

regression can be found in *Appendix H*. in this model only the 3-year sales growth proves to be a significant influencer on the EBITDA PCD. When conducting backward stepwise regression, removing variables from the model does not increase significance of the other variables, and the final model only incorporates growth and ln(sales) as independent variables explaining the EBITDA PCD, since adding more variables to the model causes the constant to be insignificant. This can be partly explained by the low number of observations left when incorporating multiple independent variables in the model. The final number of observations is 271, as opposed to 650 in the original sample. The variable ln(sales) is incorporated as growth only shows a significant influence whenever ln(sales) is included. When checking the correlation between the variables, there is no concern for multi-collinearity as the correlation between the variables is very low. After testing for this phenomenon the conclusion can be made that no adjustment for multi-collinearity is needed. The results of this test as well as the correlation matrix can be found in *Appendix H*. As can be seen by very low pseudo R-squared (0.04%), this study refrains from accepting this model as final model explaining the cross-sectional differences in the EBITDA PCD. The results from the final regression can be found in *table 28*. After controlling for possible unobserved heteroscedasticity and serial correlation in model (b) using bootstrap standard errors, none of the variables other than the constant remain significant.

	EBITDA PCD	
	(a)	(b)
growth	-0.0347***	-0.0347
	(0.0127)	(-0.0437)
ln(sales)	-0.0302	-0.0302
	(0.0347)	(0.0355)
constant	0.3645**	0.3645**
	(0.1566)	(0.1819)
observations	271	271
Pseudo R2	0.004	0.004
adj. Multicoll.	No	No
Robustness	No	Yes

*, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively. Standard deviations are displayed in brackets below the coefficient

Table 28

EBIT PCD

The last parameter for the PCD discussed within this research is the EBIT PCD. As with the other two PCD parameters, the significant regressors for this variable are incorporated in a multivariate model, of which the results can be found in *Appendix H*. When conducting the backward stepwise regression, the final regression model is displayed in *table 29*. What is noticeable in the model is that the slope coefficient is relatively high in this model as opposed to the values in the sales and EBITDA model, indicating the height of the EBIT PCD is 49% when all the other independent variables equal zero. This could be explained by the fact that within this model only a subset of 232 firms of the total sample of 596 EBIT PCD's in the original sample is considered, which can distort the slope coefficient of the EBIT PCD parameter. After correcting for possible unobserved heteroscedasticity and serial correlation in model (b) and (c) the slope coefficient decreases. The correlation matrix of the independent variables can be found in *Appendix H*. As can be seen in the correlation matrix, the independent regressors are not highly correlated with one another, so multi-collinearity issues are unlikely. When testing for multi-collinearity it shows that there is indeed no multi-collinearity across independent variables. The results of this test can be found in *Appendix H*. Model (a) displays the original multivariate model without correcting for possible unobserved heteroscedasticity and serial correlation. Model (b) and (c) incorporate these issues. As seen in model (b), when correcting for possible heteroscedasticity, the growth coefficient loses its significance in the model.

	EBITPCD		
	(a)	(b)	(C)
Industrydummy 1	-0.1151	-0.1558	
	(0.2340)	(0.2622)	
Industrydummy 2	-0.0525	-0.061	
	(0.1180)	(0.1223)	
Industrydummy 3	0.1226	-0.1175	
	(0.2665)	(0.1182)	
Industrydummy 4	0.0049	-0.1403	
	(0.2535)	(0.1631)	
Industrydummy 5	-0.5450*	-0.5855	
	(0.3039)	(0.4644)	
ROA	0.4967**	0.4542***	0.5351***
	(0.2393)	(0.1774)	(0.2035)
growth	-0.0748***	-0.0375	-0.0475
	(0.0129)	(0.0420)	(0.0494)
constant	0.4923***	0.2659***	0.2051***
	(0.1854)	(0.0770)	(0.0789)
observations	232	232	232
Pseudo r2	0.0461	0.0461	0.0409
adj. Multicoll.	No	No	No
Robustness	No	Yes	Yes

*, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively
Standard deviations are displayed in brackets below the coefficient

Table 29

6. CONCLUSION & RECOMMENDATION

The aim of this research was providing business analysts and firms such as KPMG an extensive comprehension of the driving factors of the phenomenon known as ‘’The Private Company Discount’’, the discount applied to private firms in M&A transactions. Getting a more in depth understanding of why this discount is often applied when considering private firms and what determines the height of the discount is essential for developing an alternative to the small firm premium which is currently applied when valuating small and private firms. The main finding of this research is that US private firms on average trade on a discount of 23%, 21% and 30% for the sales, EBITDA and EBIT multiple respectively. The main research question is answered with these findings. In the second part of the research a bivariate analysis was conducted to find the driving factors of the Private Company Discount. The results of this analysis show that the sales PCD is significantly influenced by the liquidity of the market, the industry the target operates in, as well as by firm specific characteristics (size, profitability, asset liquidity and growth). Macro-economic events also had a significant influence on the sales PCD, indicating the PCD depends on the general health of the economy. For the EBITDA PCD the target’s industry and firm characteristics had a significant influence, for the EBIT PCD the target’s industry, market liquidity, and firm characteristics were significant. From the bivariate regression this study can conclude that the structure of the deal indicating information asymmetry issues and liquidity of the target’s industry do not influence the height of the Private Company Discount. The strongest results are found in the target’s industry and firm characteristics. However when constructing the multivariate regression models for each PCD proxy, due to loss of data the majority of the variables lose their significance. The final model incorporates size of the target, growth and size of the acquirer for the sales PCD, growth and target size for the EBITDA PCD and profitability and growth for the EBIT PCD.

6.1 LIMITATIONS

The biggest limitation of this research lies in the scarcity of the data. As the final dataset only incorporates less than 10% of the original private transactions obtained from the SDC database, the generalizability of the results is a serious concern, as the quality of the output decreases significantly when the number of inputs decrease, as can be clearly seen in the results of the multivariate regression models. Due to scarcity of data a sample selection bias arises, since transactions with undisclosed deal value cannot be considered in this research. This causes issues when interpreting the sign of some of the independent variables. Another limitation is the availability of comparable public companies. As stated in section 4.2.1 [*Acquisition multiples*], in order to construct comparable reference portfolio’s, an important condition which should be satisfied is size. From the initial dataset of around 8,000 public company deals, the majority is discarded

due to the comparability in terms of size. The other limitation related to comparability of firms is the subjectivity in choosing comparable firms. Several assumptions are made in determining when public firms are deemed comparable, and changing the assumptions could change the outcome of this research as can be seen in the benchmark analysis of the reference sample in *Appendix G*. A limitation in the use of multiples for comparison lies in the fact that only positive multiples can be interpreted, which biases the sample towards profitable firms. Since the multiple method uses the financial statement information of the company in the year of the transaction, firms with negative earnings for that particular year are automatically discarded from the sample. The last limitation of this research lies in the non-normality of the data, causing this study to use non-parametric tests, which generally have less statistical power than tests for normally distributed data since they are based on fewer assumptions.

6.2 RECOMMENDATIONS FOR FUTURE RESEARCH

During the process of writing this thesis potential areas of future research were identified, which will be discussed in this section. The first recommendation for future research is in addition to identifying the PCD in the target, an event study could be conducted to analyze the relationship of public acquirer returns and the height of the Private Company Discount. Another interesting topic of investigation could be relating the Private Company Discount to research on the small firm premium, and trying to incorporate it as a substitute for the small firm premium in the weighted average cost of capital calculation. Another area of analysis could be replicating this study and incorporating cross border acquisitions to identify potential differences in acquiring a domestic or a foreign firm. Lastly, there are still many unobserved driving factors which could explain the height of the Private Company Discount. Research on identifying these factors is still rather young, with much room for improvement. Another approach to the PCD could instead of analyzing the differences across private firm transactions to identify driving factors of the PCD, focus on examining differences in characteristics between the private firm transaction and the reference portfolio of public transactions they are matched to, to identify fundamental differences which could influence the height of the PCD.

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APPENDIX A DEFINITION OF VARIABLES

Within this table a description of the calculation of each variable used within this research can be found.

Variable name	Calculation
Private Company Discount	$1 - \frac{private\ company\ multiple}{median\ public\ company\ multiple}$
Cash to total assets ratio	$\frac{(cash\ +\ marketable\ securities)}{total\ assets}$
Cash flow to total assets	$\frac{cash\ flow\ from\ operating\ activities}{total\ assets}$
Current ratio	$\frac{current\ assets}{current\ liabilities}$
Historical Libor rate	$Quarterly\ average\ historical\ 3-month\ US\ dollar\ libor\ rate$
C&I loan rate spread	$Quarterly\ interest\ rate\ on\ C\&I\ loans - average\ quarterly\ federal\ funds\ rate$
IPO volume	$\frac{four\ quarter\ moving\ average\ of\ number\ of\ IPOs\ per\ quarter\ US}{number\ of\ firms\ listed\ on\ CRSP\ at\ the\ start\ of\ each\ quarter}$
IPO underpricing	$the\ quarterly\ average\ of\ the\ first\ day\ returns\ for\ all\ IPOs\ per\ qu\ within\ the\ US$
M&A Volume	$the\ number\ of\ quarterly\ M\&A\ transactions\ within\ the\ US$
M&A volume per industry	$Number\ of\ deals\ for\ an\ industry\ in\ a\ particular\ year$
Liquidity index	$\frac{Value\ of\ all\ deals\ in\ a\ year\ in\ an\ industry}{total\ assets\ industry}$
Natural logarithm of book value of assets	$Ln(book\ value\ of\ assets)$
Natural logarithm of sales	$Ln(sales)$
Return on assets (ROA)	$\frac{net\ income}{total\ assets}$
Acquirer type	$1 = strategic\ buyer, 0 = financial\ buyer$
Public status acquirer	$1 = public\ acquirer, 0 = other\ type\ of\ acquirer$
Payment method	$1 = all\ cash\ deal, 0 = stock\ \&\ other\ payment\ methods$

Number of financial advisors	$Absolute\ number\ of\ financial\ advisors\ hired\ by\ the\ firm$
Merger waves	$1\ if\ announcement\ date\ falls\ within\ the\ period\ 1985 - 1989, 1993 - 2000, 2003 - 2007, 0\ otherwise$
Business cycle	$GDP\ quarterly\ recession\ indicator\ index\ which\ takes\ the\ value\ 0 - 100\ where\ 0\ is\ no\ recession\ and\ 100\ high\ recession$
Deal value / sales multiple	$\frac{\left(\frac{transaction\ value}{\%\ of\ shares\ acquired} * 100\right)}{Sales\ LTM}$
Deal value / EBITDA multiple	$\frac{\left(\frac{transaction\ value}{\%\ of\ shares\ acquired} * 100\right)}{EBITDA\ LTM}$
Deal value / EBIT multiple	$\frac{\left(\frac{transaction\ value}{\%\ of\ shares\ acquired} * 100\right)}{EBIT\ LTM}$

APPENDIX B INDUSTRY CLASSIFICATIONS

Overview of all SIC codes with corresponding industry classification used within this study. The numbers refer to the first two numbers of the 4-digit SIC code. Industry codes were retrieved from the SDC Platinum One database and classified following the industry classification's provided by the US securities & exchange commission

SIC Code	Industry classification
01-09	Agriculture, Forestry, Fishing
10-14	Mining
15-17	Construction
20-39	Manufacturing
40-49	Transportation & Public Utilities
50-51	Wholesale Trade
52-59	Retail Trade
60-67	Finance, Insurance, Real Estate
70-89	Services
91-99	Public Administration

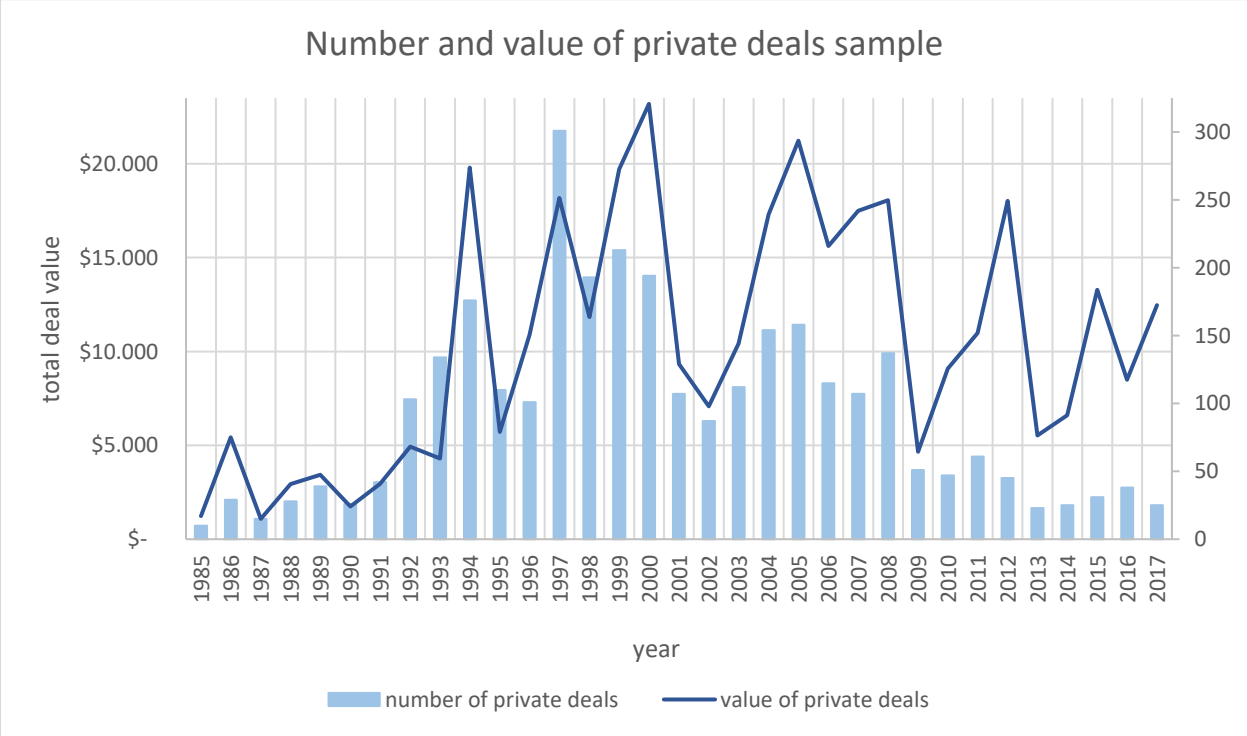
Source: US securities & exchange commission

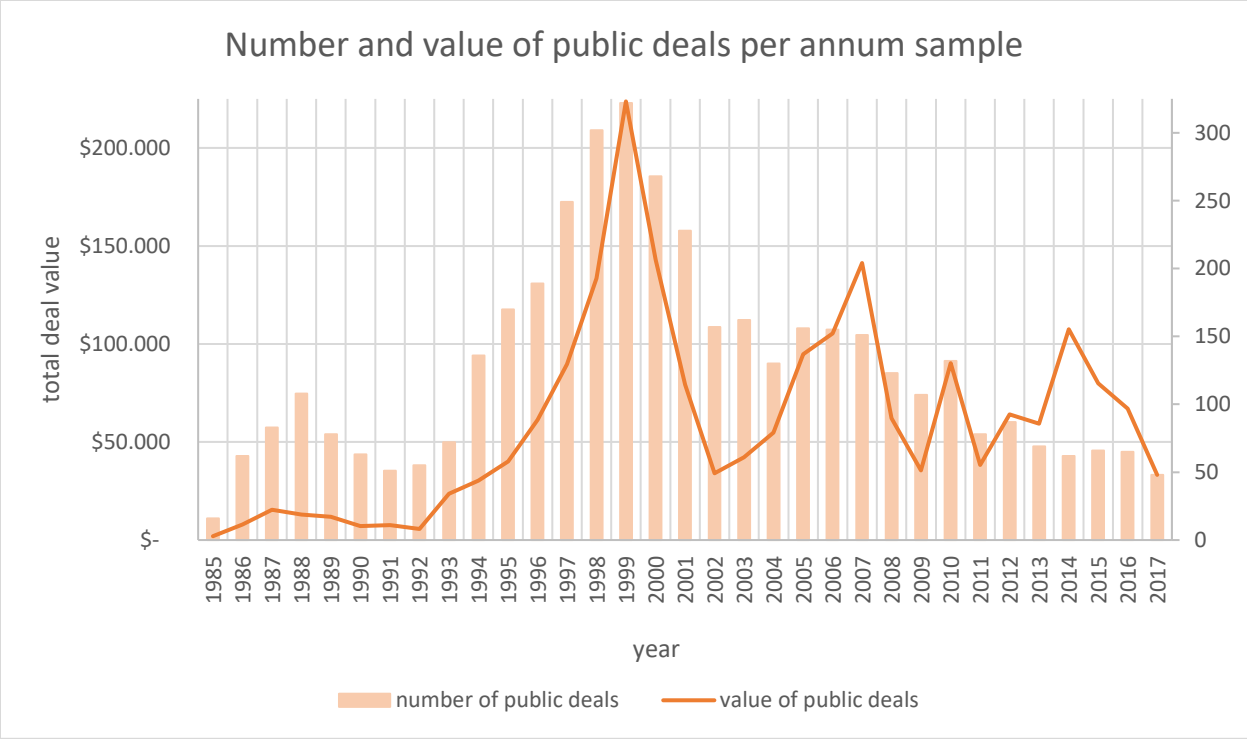
APPENDIX C NUMBER OF DEALS & VALUE PER ANNUM

This table provides the number of deals and their corresponding value per annum of the total sample used within this research. Value is displayed in $ millions, and corresponding percentages of the total number of transactions and deal value are displayed on the right. The total number of private observations yields 3,037 transactions with a corresponding total deal value of $343,049 million. The total number of public observations yields 4,200 transactions with a corresponding total deal value of $2,004,783 million dollar.

Year	number		Value		percentage of total (number)		percentage of total (value)	
	Private	Public	Private	Public	Private	Public	Private	Public
1985	10	16	$ 1,228	$ 1,957	0.3%	0.4%	0.4%	0.1%
1986	29	62	$ 5,428	$ 7,857	1.0%	1.5%	1.6%	0.4%
1987	15	83	$ 1,085	$ 15,374	0.5%	2.0%	0.3%	0.8%
1988	28	108	$ 2,938	$ 13,038	0.9%	2.6%	0.9%	0.7%
1989	39	78	$ 3,436	$ 11,892	1.3%	1.9%	1.0%	0.6%
1990	26	63	$ 1,738	$ 7,202	0.9%	1.5%	0.5%	0.4%
1991	42	51	$ 2,953	$ 7,630	1.4%	1.2%	0.9%	0.4%
1992	103	55	$ 4,938	$ 5,630	3.4%	1.3%	1.4%	0.3%
1993	134	72	$ 4,297	$ 23,632	4.4%	1.7%	1.3%	1.2%
1994	176	136	$ 19,793	$ 30,286	5.8%	3.2%	5.8%	1.5%
1995	110	170	$ 5,720	$ 40,044	3.6%	4.0%	1.7%	2.0%
1996	101	189	$ 10,893	$ 61,230	3.3%	4.5%	3.2%	3.1%
1997	301	249	$ 18,175	$ 89,703	9.9%	5.9%	5.3%	4.5%
1998	193	302	$ 11,841	$ 133,431	6.4%	7.2%	3.5%	6.7%
1999	213	322	$ 19,708	$ 223,717	7.0%	7.7%	5.7%	11.2%
2000	194	268	$ 23,192	$ 142,934	6.4%	6.4%	6.8%	7.1%
2001	107	228	$ 9,337	$ 79,309	3.5%	5.4%	2.7%	4.0%
2002	87	157	$ 7,076	$ 34,075	2.9%	3.7%	2.1%	1.7%
2003	112	162	$ 10,428	$ 42,249	3.7%	3.9%	3.0%	2.1%
2004	154	130	$ 17,301	$ 54,802	5.1%	3.1%	5.0%	2.7%
2005	158	156	$ 21,222	$ 94,798	5.2%	3.7%	6.2%	4.7%

2006	115	155	$	15,623	$	105,331	3.8%	3.7%	4.6%	5.3%
2007	107	151	$	17,493	$	141,289	3.5%	3.6%	5.1%	7.0%
2008	137	123	$	18,062	$	62,121	4.5%	2.9%	5.3%	3.1%
2009	51	107	$	4,661	$	35,566	1.7%	2.5%	1.4%	1.8%
2010	47	132	$	9,098	$	90,183	1.5%	3.1%	2.7%	4.5%
2011	61	78	$	10,980	$	38,299	2.0%	1.9%	3.2%	1.9%
2012	45	87	$	18,017	$	64,111	1.5%	2.1%	5.3%	3.2%
2013	23	69	$	5,530	$	59,332	0.8%	1.6%	1.6%	3.0%
2014	25	62	$	6,603	$	107,482	0.8%	1.5%	1.9%	5.4%
2015	31	66	$	13,289	$	79,896	1.0%	1.6%	3.9%	4.0%
2016	38	65	$	8,494	$	67,080	1.3%	1.5%	2.5%	3.3%
2017	25	48	$	12,473	$	33,298	0.8%	1.1%	3.6%	1.7%
Total	**3037**	**4200**	**$**	**343,049**	**$**	**2,004,783**	**100%**	**100%**	**100%**	**100%**





APPENDIX D NUMBER OF DEALS & VALUE PER INDUSTRY

In this table the number of deals and value are classified per industry. Industry classification is based on the 4-digit Industry SIC code as can be found in Appendix A. Firms with SIC-code 6 and 49 classified within the industries finance, insurance, real estate and transportation & public utilities were excluded from this research.

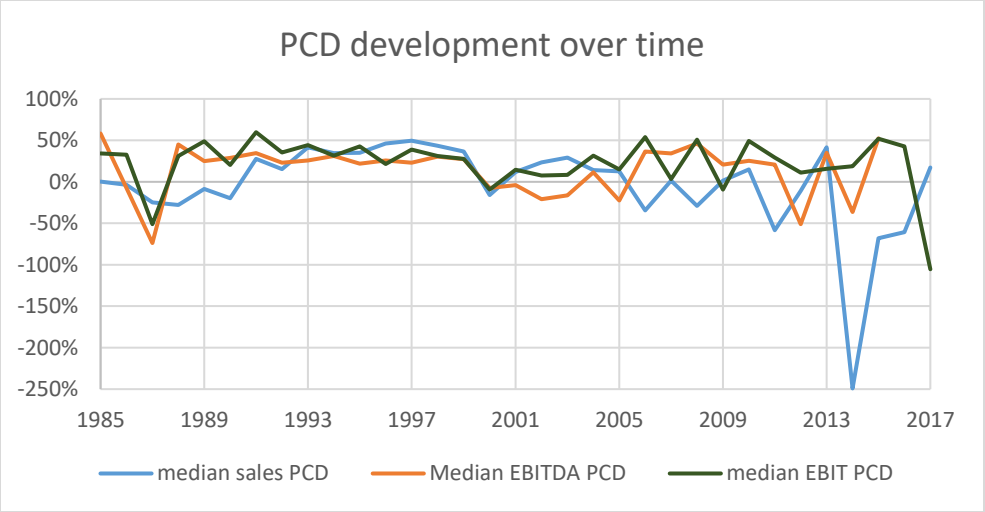
Industry	Number of transactions		Value of transactions (in mln $)		Percentage of total (number)		Percentage of total (Value)	
	Private	Public	Private	Public	Private	Public	Private	Public
Agricultulture, Forestry, Fishing	-	-	$ -	$ -	-	-	-	-
Mining	82	191	$ 17,620	$ 77,666	3%	5%	5%	4%
Construction	-	-	$ -	$ -	-	-	-	-
Manufacturing	1090	1924	$ 139,008	$ 872,051	36%	46%	41%	43%
Transportation & Public Utilities	132	238	$ 26,311	$ 188,840	4%	6%	8%	9%
Wholesale Trade	140	126	$ 8,898	$ 29,158	5%	3%	3%	1%
Retail Trade	60	134	$ 4,542	$ 16,390	2%	3%	1%	1%
Finance, Insurance, Real Estate	-	-	$ -	$ -	-	-	-	-
Services	1533	1587	$ 146,669	$ 820,679	50%	38%	43%	41%
Public Administration	-	-	$ -	$ -	-	-	-	-
Total	**3037**	**4200**	**$343,049**	**$ 2,004,784**	**100%**	**100%**	**100%**	**100%**

APPENDIX E EXAMPLE PRIVATE COMPANY DISCOUNT CALCULATION

This table displays a graphic example of how the comparable portfolios are compiled and how the Private Company Discount is calculated. The private target transaction is matched to a portfolio of comparable public target transactions that are comparable in terms of size, industry and time. Subsequently the median of each multiple of the comparable transactions is calculated and used as input in the formula to calculate the PCD.

	Sales Multiple	EBITDA multiple	EBIT multiple
Private target	0.60	4.96	6.95
Public target A	3.01	10.56	15.08
Public target B	0.57	5.96	10.08
Public target C	1.06	5.08	7.71
Public target D	0.65	5.27	6.50
Public target E	0.67	4.43	7.53
Median reference portfolio	0.67	5.27	7.71
PCD	**10.45%**	**5.88%**	**9.86%**

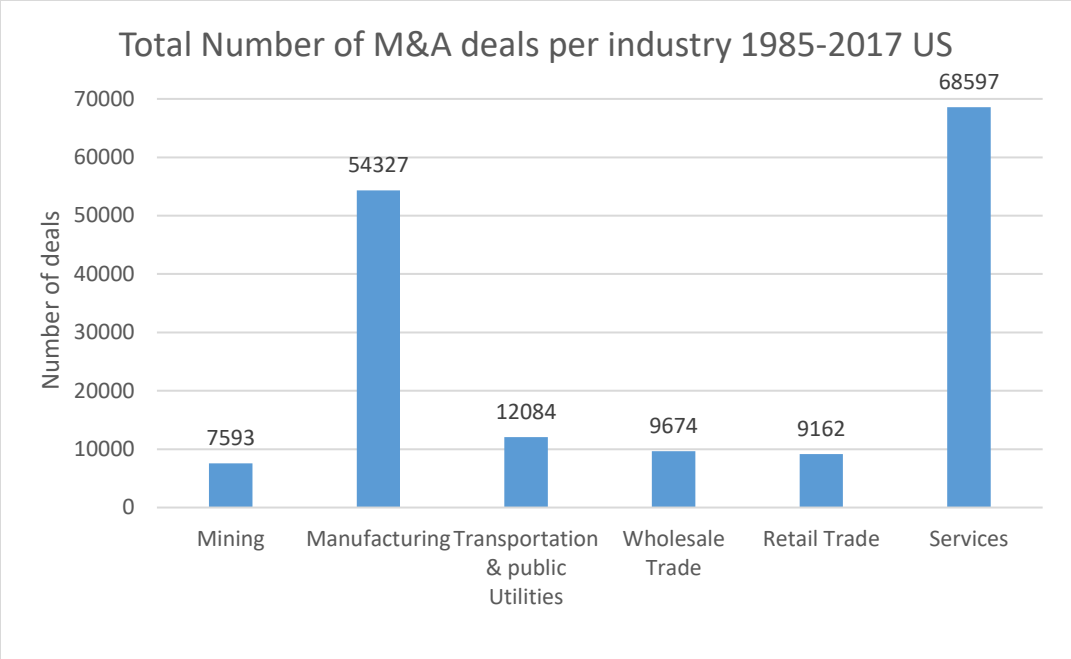
APPENDIX F ADDITIONAL DESCRIPTIVE STATISTICS



PCD statistics over time 1

Descriptive statistics on the variables needed for the construction of the PCD statistics. Distinction is made between the private and public target firms.

statistics	Deal value		total value 100% stake		Total assets target		Net sales target		EBITDA target		EBIT target		sales multiple		EBITDA multiple		EBIT multiple	
	private	public	private	public	private	public	private	public	private	public	private	public	private	public	private	public	private	public
n	3037	4200	3037	4200	1472	4198	3031	4200	1277	4200	1470	4200	3028	4199	877	2607	935	2089
mean	113.0	477.3	114.6	492.3	71.1	250.1	80.4	207.8	9.1	22.8	5.2	8.1	3.0	3.5	13.1	14.9	15.3	20.3
sd	294.7	1197.2	300.1	1250.3	245.3	600.0	254.0	395.5	41.5	79.8	39.5	71.7	6.1	6.5	11.4	12.1	12.5	13.7
min	0.01	0.01	0.01	0.1	0.2	0	0.1	0.1	-239.7	-1775.4	-301.8	-2175.8	0.001	0.001	0.1	0.01	0.03	0.03
p10	4.2	11.0	4.2	12.3	1.8	11.7	4.2	11.2	-5.1	-12.0	-6.3	-19.9	0.3	0.3	3.3	4.0	4.1	6.6
p50	29.0	121.6	29.5	127.5	12.7	84.2	22.0	82.1	1.5	6.0	1.1	2.2	1.2	1.6	9.4	11.1	11.3	16.2
p90	278.0	1161.6	280.0	1191.8	136.6	588.6	157.7	505.3	26.6	76.1	16.7	45.1	5.9	7.7	27.9	30.9	32.6	41.3
max	4693.0	21423.0	4693.0	21423.0	5279.9	15654.1	6240.9	6808.8	669.9	1384.5	856.0	979.4	61.9	62.6	64.6	64.9	65.0	65.0


Total Number of M&A deals per industry 1985-2017 US
Number of deals
70000
60000
50000
40000
30000
20000
10000
0
7593
54327
12084
9674
9162
68597
Mining
Manufacturing
Transportation & public Utilities
Wholesale Trade
Retail Trade
Services

APPENDIX G BENCHMARK ANALYSIS PRIVATE COMPANY DISCOUNT

This appendix contains a benchmark analysis following sample set 1, where firms are matched on the 4-digit SIC level, 3-year window and size.

Descriptive statistics on sample 1 – 4-digit SIC, 3-year window

	sales PCD	EBITDA PCD	EBIT PCD
N	874	130	110
mean	-1.67	-0.49	-0.07
sd	7.95	1.99	1.09
min	-144.59	-17.18	-5.46
p10	-4.42	-2.21	-1.22
p50	0.08	-0.05	0.25
p90	0.84	0.73	0.82
max	1.00	0.99	0.97
T-statistic	-6.22***	-0.63	-2.78***
Wilcoxon Z-statistic	-4.455***	-1.189	1.323

Results of a median quantile regression on sample 1 – 4-digit SIC, 3-year window

variable	Discount	T-statistic
sales PCD	8%	1.53
EBITDA PCD	-6%	-0.53
EBIT PCD	24%	2.41**

APPENDIX H – MULTIVARIATE REGRESSION STATISTICS

Results of the multivariate median quantile regression of all initial significant regressors on the sales PCD statistic. Pseudo R2 indicates approximately 13.19% of the variation in the sales PCD can be explained by this model. *, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively

	Sales PCD			
	Coef.	Std. Err.	t	P>|t|
Libor rate	0.0046	0.3711	0.01	0.99
C&I spread	-0.9755	1.1159	-0.87	0.384
IPO volume	-0.0061	0.0137	-0.45	0.657
number of deals per industry	-0.0010	0.0015	-0.66	0.513
industry dummy 1	-2.0759	3.5987	-0.58	0.565
industry dummy 2	-0.3536	1.3293	-0.27	0.791
industry dummy 3	-1.5628	3.5677	-0.44	0.662
industry dummy 4	-2.7097	3.9150	-0.69	0.49
industry dummy 5	-3.9933	3.9519	-1.01	0.314
ln(TA)	-1.0225***	0.3298	-3.1	0.002
ln(sales)	1.4165***	0.3574	3.96	0
ROA	0.2375	0.3954	0.6	0.549
growth	-0.0441***	0.0113	-3.9	0
cash / TA ratio	0.5391	1.5735	0.34	0.732
CF / TA ratio	0.4555	0.9240	0.49	0.623
current ratio	-0.0520	0.1370	-0.38	0.705
merger wave 2	0.1380	1.8165	0.08	0.94
merger wave 3	-0.1274	1.0840	-0.12	0.907
recession index	0.0019	0.0180	0.11	0.915
buyer type	-0.5587	0.8704	-0.64	0.522
ln(TA acq)	-0.2484	0.3212	-0.77	0.441
ln(sales acq)	-0.1282	0.3297	-0.39	0.698
constant	5.2873	4.2657	1.24	0.217
observations	155			
Pseudo R2	0.1319			

Correlation matrix of the variables incorporated in the final multivariate median quantile regressions on the PCD statistics

	Industrydummy 1	Industrydummy 2	Industrydummy 3	Industrydummy 4	Industrydummy 5	Industrydummy 6	ln(TA)	ln(sales)	growth	ln(salesacq)	ROA
Industrydummy 1	1										
Industrydummy 2	-0.15	1									
Industrydummy 3	-0.06	-0.24	1								
Industrydummy 4	-0.04	-0.16	-0.07	1							
Industrydummy 5	-0.04	-0.13	-0.06	-0.04	1						
Industrydummy 6	-0.18	-0.65	-0.29	-0.19	-0.16	1					
ln(TA)	0.11	0.07	0.07	-0.02	0.05	-0.15	1				
ln(sales)	-0.01	0.09	-0.02	0.07	0.13	-0.14	0.84	1			
growth	0.03	-0.06	0.08	-0.03	-0.03	0.04	-0.05	-0.13	1		
ln(salesacq)	-0.06	0.15	-0.05	-0.05	0.06	-0.09	0.52	0.55	-0.18	1	
ROA	0.02	0.06	0.02	0.02	0.03	-0.09	0.20	0.23	-0.04	0.22	1

test of multicollinearity between the independent regressors in the multivariate regression model for the sales PCD. A VIF value >10 indicates multicollinearity between variables.

	VIF	1/VIF
ln(sales)	30.3	0.033006
ln(TA)	24.27	0.041195
ln(salesacq)	9.01	0.110939
industrydummy 2	1.74	0.573114
industrydummy 3	1.2	0.831683
industrydummy 1	1.12	0.890015
industrydummy 4	1.12	0.891548
industrydummy 5	1.11	0.901012
growth	1.04	0.960681

Results of the initial multivariate quantile regression on the EBITDA PCD. Pseudo R2 indicates approximately 4.63% of the variation in the EBITDA PCD can be explained by this model. *, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively

	EBITDA PCD			
	Coef.	Std. Err.	t	P>|t|
industry dummy 1	-0.1100	0.4400	-0.25	0.803
industry dummy 2	-0.0398	0.1869	-0.21	0.832
industry dummy 3	-0.0243	0.4006	-0.06	0.952
industry dummy 4	0.4074	0.5512	0.74	0.461
industry dummy 5	-0.2625	0.4668	-0.56	0.575
number of deals per industry	0.0000	0.0001	0.29	0.77
ROA	0.6052	0.6925	0.87	0.384
growth	-0.0781***	0.0175	-4.46	0
CF / TA ratio	-0.2353	0.6438	-0.37	0.715
ln(TA)	-0.0019	0.0704	-0.03	0.979
ln(TA acq)	0.0715	0.1052	0.68	0.498
ln(sales acq)	-0.1050	0.0979	-1.07	0.285
public status acquirer	-0.3174	0.3967	-0.8	0.425
same industry dummy	0.0654	0.1999	0.33	0.744
constant	0.6208	0.6406	0.97	0.334
observations	150			
Pseudo R2	0.0463			

Test for multicollinearity between the independent regressors in the multivariate regression model for the EBITDA PCD. A VIF value >10 indicates multicollinearity between variables.

	VIF	1/VIF
growth	1.05	0.9500
ROA	1.05	0.9500

Results of the initial multivariate quantile regression on the EBIT PCD. Pseudo R2 indicates approximately 9.77% of the variation in the EBIT PCD can be explained by this model. *, **, *** indicate the statistical significance at the 0.1, 0.05 and 0.01 level respectively

	EBIT PCD			
	Coef.	Std. Err.	t	P>|t|
IPO volume	-0.0012	0.0017	-0.71	0.479
industry dummy 1	-0.0424	0.3183	-0.13	0.894
industry dummy 2	0.0112	0.1559	0.07	0.943
industry dummy 3	-0.0274	0.3495	-0.08	0.938
industry dummy 4	-0.0380	0.4141	-0.09	0.927
industry dummy 5	-0.4968	0.4110	-1.21	0.229
ln(TA)	-0.0604	0.0944	-0.64	0.524
ln(sales)	0.1043	0.0861	1.21	0.228
ln(TA acq)	-0.0372	0.0897	-0.41	0.679
ln(sales acq)	-0.0574	0.0869	-0.66	0.51
ROA	0.8866	0.6320	1.4	0.163
growth	-0.1048***	0.0151	-6.93	0
CF / TA ratio	-0.3657	0.5820	-0.63	0.531
constant	0.6622*	0.3500	1.89	0.061
observations	125			
Pseudo R2	0.0977			

Test for multicollinearity between the independent regressors in the multivariate regression model for the EBIT PCD. A VIF value >10 indicates multicollinearity between variables.

	VIF	1/VIF
growth	1.15	0.8667
ROA	1.14	0.8797
industry dummy 1	1.14	0.8805
industry dummy 2	1.11	0.9004
industry dummy 3	1.02	0.9840
industry dummy 4	1	0.9952
industry dummy 5	1	0.9987