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THE IMPACT OF COVID-19 ON VALUATION DIFFERENCES IN PUBLIC AND PRIVATE HEALTHCARE COMPANIES

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Abstract

Valuation discounts of privately-owned companies compared to publicly-listed ones are prevalent in many industries and are a commonly accepted concept. This paper studies valuation differences between public and private companies in the healthcare sector. Further, it examines whether such differences were impacted by the outbreak of the Covid-19 pandemic. In the sample studied herein, private companies are valued at a premium, but that difference is not statistically significant. In addition, the impact Covid-19 had on the valuation differences between public and private companies in the healthcare sector so far cannot be generalized according to the traits studied herein.

Keywords

Valuation, Public Market, Private Market, Covid-19, Healthcare

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1. Introduction

By nature, public and private markets possess unique characteristics that allow a clear distinction between both types of firms. Nevertheless, as both are subject to the same macroeconomic environment, interdependencies are present, and both types of companies should exhibit similar behavior and traits to a certain extent. Valuation-wise, the question occurs whether both types of company correlate and no difference in valuation levels may be observed or whether markets value them differently based on their public or private ownership, ceteris paribus.

Due to their prevalence, valuation differences in publicly-listed and privately-owned companies have been subject to extensive academic investigation. Koeplin, Sarin, and Shapiro (2000) conducted a cornerstone study, finding a considerable illiquidity discount for private companies. Kooli, Kortas, and L'Her (2003), Officer (2007), and Paglia and Harjoto (2010) extend the research on private company discounts, quantifying it somewhere between 15 and 40%. Martynova and Renneboog (2005), BCG (2020), and Magnanelli, Nasta, and Ramazio (2022) separately study the impact of economic downturns on public or private companies, distinctively though.

Major parts of those works, however, do not focus on a specific sector or industry, only analyzing broad markets and spreading samples across several industries. Valuation differences in specific industries are not explicitly analyzed, therefore differences between industries are not exposed. In addition, such works mostly analyze periods of homogenous macroeconomic conditions and do not precisely examine the matter of private company discounts in recent times. Little effort has been made on how public and private markets are interfering in a specific industry such as healthcare, and if and how the recent major economic disruptions caused by the Covid-19 pandemic had an impact on valuation differences.

This work aims to fill that gap in academic literature by analyzing valuation differences between publicly-listed and privately-owned companies in the healthcare sector. Recently, the

industry experienced a major shift into the world's spotlight with the outbreak of the Covid-19 pandemic in Spring 2020. Within weeks, the sector saw itself facing an unprecedented challenge it had to deal with in order to save lives. From today's perspective, with the World Health Organization having stated the pandemic as officially overcome in May 2023 (WHO 2023), the impact COVID-19 has had can be initially evaluated. That said, this work adds a layer to the question if differences in public and private market valuations exist in the healthcare sector, namely the aspect of whether and how the pandemic impacted those differences. Did the size difference of public and private companies play a role? Or did the fact that all major Covid-19 vaccine manufacturers are publicly listed impact valuation differences given the extraordinary importance of such vaccines?

The further course of the work is thereby as follows. Chapter two gives a broad overview of prevalent literature regarding valuation differences and reasons thereof, as well as how public and private companies are impacted by crises. Chapter three introduces the methodology of the data sampling and analysis undertaken and presents the findings of this study. Chapter four aims to provide explanations of the results described in chapter three and discusses reasons (or the absence thereof) for valuation differences in public and private healthcare markets. It briefly touches limitations of this work, while chapter five draws a succinct conclusion and describes related areas for further research.

2. Literature review

2.1 Valuation differences between public and private companies

Most studies carried out in this field stem from the 1990s and early 2000s and geographically cover North America. In terms of methodologies used, the studies either compare M&A transactions of public and private companies, differences in offer prices for public and private stock units, or pre- and post-IPO prices of a company's stock.

Koeplin, Sarin, and Shapiro (2000) are a cornerstone in the existing literature on public and private company valuation. They evaluate a private company discount based on revenue and

profitability multiples in private company transactions from 1984 until 1998. While accounting for different sizes and growth rates, they find that US-based private companies are subject to a discount of 20 to 30% when valued in terms of profitability (EBITDA or EBIT multiples) in comparison to public peers. In transactions outside the US, this discount is found to be between 44 and 54%. In terms of revenue multiples, the discount is not significant. They mainly assign such a discount to the illiquidity of private companies but acknowledge further possible reasons..

Similarly, Kooli, Kortas, and L'Her (2003) find discounts of 17% based on revenue, 34% based on profitability, and 20% based on cash flow multiples for private companies. Their approach is analyzing the financials in acquisitions of public and private target companies in the US between 1995 and 2002. They do differentiate between industries and find strongly differing extents of the private company discount. However, the healthcare industry is not studied.

Block (2007) extends the research of Koeplin, Sarin, and Shapiro (2000) in that he emphasizes the importance of differentiating discounts among various industries. Differences in the liquidity of a company's asset base are stated as an example of why such a separation is relevant. In fact, the discounts he observes in acquisitions between 1999 and 2006 vary greatly between industries. Exemplarily, the private company discount of financial institutions amounts to 13%, whereas manufacturing companies are subject to a 36% discount. This comes to the support of his theory that asset-heavy industries are subject to larger discounts than asset light ones. In the healthcare industry, the corresponding discounts for private companies amount to 23% based on EBITDA, and 24% based on revenue.

Officer (2007) studied acquisitions of public and private targets from 1979 until 2003 given the fact that private companies' access to liquidity is restricted compared to public peers. The median discount for private companies was found to be approximately 20% based on both, revenue and profitability. Among other reasons, Officer attributes this discount to the fact that public companies can readily access fresh capital in times of unexpected and unforeseen liquidity

shortages through public capital markets. In addition, they can do so at reasonable costs, in contrast to private companies. Due to liquidity being crucial for the continuation of business, private companies have to accept discounts to raise fresh capital in order to stay in business. This is especially prevalent in times of (unexpected) economic downturn when company distress is on the rise.

Paglia and Harjoto (2010) compare valuation levels in public and private M&A transactions from 1993 to 2008 in the US and observe discount levels for different industries. Way larger than previous studies, they find private company discounts of up to 88%. For the healthcare industry, they observe discounts of approximately 44% when valued based on revenue, and 80% when valued in terms of EBITDA. Since there is no similar work on discounts in the healthcare industry, the meaningfulness of such a large discount must be assessed by keeping in mind that the research as a whole reports larger discount levels than prevalent literature. In addition, they find significant evidence that private firms where the risk of bankruptcy is low and which are relatively large and profitable, are valued at lower discounts. It must be noted that normally, public firms tend to exhibit such characteristics more often than private companies (think, for example, about size and bankruptcy probability rating requirements for listings in the public market, or the previously mentioned access to fresh capital).

De Franco et al. (2010) evaluate whether private companies whose financial statements are audited by one of the Big-4 auditors can ask for higher prices when selling (controlling) stakes in their company. First, they find a private company discount of between 20 and 40% based on either the revenue generation level or a company's profitability, respectively. Second, their main finding is that Big-4 audited private companies can indeed sell stakes at significantly higher prices. They conclude that investors judge Big-4 audited information as credible and of high quality, hence such companies are considered less risky in terms of quality and availability of information. Therefore, private company discounts are lower for companies where information

availability and quality are certain and testified.

Since researchers previously focused on the US when studying private company discounts, Klein and Scheibel (2012) apply Koeplin, Sarin, and Shapiro's approach to the European market. They analyze acquisitions of public and private targets between 1999 and 2009 based on EV/EBITDA multiples. For the European market, they can confirm the statistical significance of a private company discount, which is found to be approximately 5%.

Van den Cruijce (2022) acknowledges that private companies are subject to a discount mostly due to the missing marketability in comparison to public companies. Beyond, he finds the following variables having an impact on the discount: (1) whether the company allows outside parties to become shareholders or not, (2) whether the majority of revenues stem from operations or are exceptionally/financially generated, (3) whether share transfers are subject to restrictions, be it contractual clauses which allow certain parties to block a transfer or which define refusal rights at certain prices, (4) whether shares are subject to redemption rights or according instruments, and (5) whether controlling or non-controlling stakes are subject of a transaction. Those variables justify a discount for private companies since most of them rank unfavorable (from an investors' standpoint) compared to public companies in almost all of those categories.

In conclusion, researchers and practitioners define an appropriate discount rate to private companies of roughly between 15 and 40%. The discount depends on the time period studied, the geography, the industry a company operates in, and considerably varies between revenue- or profitability-based valuations. The main reasons for private company discounts can be summarized as (1) the illiquidity of private company shares, (2) private companies' more costly and less rapid ability to raise capital in times of distress, (3) the strict contractual restrictions of selling stakes in private companies, (4) the higher reluctance towards outside investors, (5) the uncertainty in terms of availability and quality of company information, and (6) the mostly

smaller size of private companies.

Apart from that prevalent opinion among academics, no academic research finds that the concept of applying a discount to private companies might not be as appropriate as ubiquitously assumed.[1] Therefore, it can be stated that academic literature agrees on a discount for private companies, however large it might be.

2.2 Impact of crises on public and private companies

Unfortunately, no previous research directly compares the impact of crises on public and private companies jointly, but only on one type or the other separately. Therefore, in the following, the scholars' (suspected) reason for a certain reaction of public or private companies can only be assessed regarding its applicability to the other form of ownership.[2]

Martynova and Renneboog (2005) study the M&A landscape in so-called merger waves. They find that all major merger waves were ended by times of major crisis (and a subsequent collapse of the stock markets). While crashes in public equity markets might predominantly impact public companies, the underlying cause of those crashes, the economic crisis, impacts both public and private companies alike. Public companies might, therefore, be hit in a more direct and quantifiable manner, but ultimately no major differences can be drawn.

Grave, Vardiabasis, and Yavas (2012) study the impact of the financial crisis 2008 on M&A activity in developed markets (and the activity of foreign investors). They state that, due to banks being cautious with lending to buyers and the overall economic uncertainty, M&A activity dropped sharply. Following Martynova and Renneboog (2005), Alexandridis, Mavrovitis, and Travlos (2011) confirm that the sixth big merger wave from 2003 until 2007 ended because of the unavailability of capital for acquisition due to banks' growing cautiousness and general macroeconomic uncertainty. Again, no difference is made between public and private

[1] This statement is formulated according to my best knowledge and thorough research.
[2] The limited scope of this work does not allow a comprehensive and detailed discussion of such applicability. Instead, an initial assessment based on previously presented findings takes place.

companies. Arguably, public companies could have had easier access to capital to fund acquisitions by the means of public equity capital markets, therefore presenting investors opportunities for return through anorganic growth. However, due to a drop in share prices during the crisis, funding acquisitions by raising stock was unattractive (because of the extreme dilution that comes with raising capital at low valuations, among other reasons). That argument, therefore, shall only hold to a limited degree.

In an early attempt to reflect the impact of Covid-19 on public markets and M&A Activity (not differentiating between public and private markets, though), BCG (2020) finds that (i) valuations plummeted at the beginning of 2020 when Covid-19 unfolded, (ii) the VIX, an index measuring volatility and uncertainty among investors, surged and reached former all-time highs as seen during the financial crisis 2008, and (iii) M&A activity moved in sync with stock indices from 2000 until 2019. In addition, the study finds that acquisitions executed during difficult economic periods tend to create more value for the buyer in the long term than acquisitions done in strong economic environments (i.e., in periods of higher valuation levels). Acquisitions are not unique to either public or private targets and neither is to benefit more than the other from such trends. Therefore, since the study did not differentiate between public and private companies, neither of those conclusions strongly indicate to be unique to either public or private companies.

An analysis of S&P Global Market Intelligence Data by Dholakia and White (2020) reports the value of scrapped M&A deals in the first half of 2020 at nearly USD 103 bn, not considerably up from approximately USD 95 bn in 2019. The number of deals called off until that point in time is even smaller than in 2019, which might indicate that M&A activity proved resilient. However, analysts estimate both, the value and the number of deals called off, at much higher figures if it wasn't for the FED to allow such low cost of liquidity by keeping interest rates low. And again, this analysis does not state any difference in the number and value of deals called off

between public and private targets. The prevalently cited reason of buyers for pulling out of deals was the uncertain and downwards pointing economic environment. This rationale applies to public and private companies since both were subject to the same harsh economic conditions.

Recently, Magnanelli, Nasta, and Ramazio (2022) studied the impact of the Covid-19 pandemic on M&A activity. Their research shows that the bid premia in takeovers of public companies increases in times of crisis. Even though their research is limited to public companies only, the reason for that increase may pertain to private companies, too. Based on findings by BCG (2009), they argue that shareholders refer to pre-crisis price levels as fair values and refuse to lower their price expectations in order to avoid losses due to temporary undervaluation. Even though shareholders of private companies do not have such an omnipresent reference as a publicly quoted share price at hand, the same rationale applies to their price expectations, too. This approach is another indication that there is no difference in price expectation shifts in public and private companies during healthcare crisis times.

Although this section does not yield a dedicated comparison of how public and private company valuations are differently impacted in times of crisis, there is no strong evidence that they do. On the contrary, especially given that they are always still subject to the same macroeconomic environment, the indication is strong that valuations react in the same (or at least in a very similar) manner when facing disruptive crises.

3. Methodology and Statistical Observations

3.1 Data sampling

Before digging into the specific sampling methods of public and private markets, general parameters that are applicable to both categories are briefly described.

Timeline: In terms of the examined period, this work focuses on the period from February 2015 until September 2023. The period from February 2015 until the Covid-19 outbreak in March 2020 serves for the examination of pre-Covid-19 data. Consequently, the time from March 2020 until September 2023 is labeled as the period where a Covid-19 impact is prevalent.

Geography: This work focuses on the markets in the developed western world (more precisely the US, Canada, and Europe) since the biggest healthcare players and main vaccine developers are based there.

Sector: Given its surging importance during a global healthcare crisis, this research is limited to the healthcare sector, whereas the "healthcare sector" is broadly defined. It comprises, for example, drug manufacturers, equipment producers, hospitals, and the like. I refrain from a narrow definition to reflect the broader influence of some subsectors of the industry on others. So, for example, to get a broad picture of the blended valuations of drivers such as Covid-19 vaccine-producing companies and companies in adjacent subsectors.

Valuation: In order to observe a specific value assigned to a company, the commonly used EV/EBITDA multiple is drawn on. EV is commonly appreciated as a reliable metric to reflect a company's comprehensive value, free from capital structure distortions. EBITDA is a relatively balanced metric between the top and the bottom line, while still reflecting the profitability of a company. Further, this multiple is readily available for both publicly listed companies and many transactions of private targets.

3.1.1 Data sampling in the public market

Even though it might be difficult to capture and measure comprehensive valuations in the whole public healthcare market, a company sample that is sufficiently representative of the market needs to be drawn. An appropriate vantage point to make such a selection is the MSCI World Healthcare ETF which aims to represent the public healthcare market in 23 developed countries (MSCI 2023a). The following companies are the Top 10 constituents of the Index, making up for approximately 43% of the global world healthcare market capitalization: UnitedHealth Group, Eli Lilly & Company, Johnson & Johnson, Novo Nordisk, Merck & Co., AbbVie, AstraZeneca, Novartis, Roche Holding, Pfizer Inc. (MSCI 2023). There exists no similar index to comprehensively reflect the public healthcare market in the regions of interest

in this work (Europe, the US, and Canada) altogether. However, since those companies are all based in the regions mentioned above, the selected companies implicitly make up for an even greater proportion of the healthcare market in those regions. Two companies shall be excluded from the set due to the focus of their business model. UnitedHealth Group is operating in the health insurance business, while a major revenue source of Merck & Co is animal health. Both are not part of the definition of the healthcare sector made for the purpose of this work. Instead, the following companies are the six next biggest public companies according to their Market Capitalization (S&P Capital IQ 2023, Appendix 1): Thermo Fisher Scientific Inc. (US), Abbott Laboratories (US), Amgen Inc. (US), Danaher Corporation (US), Sanofi (France), and Bristol-Myers Squibb Company (US). They are therefore as well included in the sample. So shall be, in addition, Moderna Inc. (UK) and BioNTech SE (Germany), both major manufacturers of Covid-19 vaccines. Therefore, they might have driven the healthcare market even though their Market Capitalization is much lower than the companies mentioned (S&P Capital IQ 2023, Appendix 1) and are included in the sample. For the final company set, the EV and the EV/EBITDA multiples were pulled from the S&P Capital IQ platform for the last trading day of every month of the period studied to properly reflect the changes in valuation on a monthly basis.

3.1.2 Data sampling in the private market

As for the private market, the acquisition prices of private companies serve as an appropriate way to determine the valuations of private companies. Therefore, MergerMarket data on acquisitions of private companies announced between February 2015 and October 2023 in the healthcare sector with disclosed financial terms (i.e. EV/EBITDA multiple is publicly known) serves as an initial basis to determine valuation levels in the private market. Those 314 identified transactions are checked for targets where MergerMarket's categorization does not precisely fit the needs of this work, for example companies that are primarily operating in the animal health business. The exclusion of such companies results in a final data set of 280 suitable transactions.

In comparison to the literature, the data sampling method needed adaptation to the special circumstances of this work. On the one hand, this is due to the relatively short timeframe studied, e.g. the Covid-19 period which entails only a little over three years. On the other hand, limiting the scope to only one sector reduces the sample number drastically compared to studies analyzing the broad market. Therefore, data on private transactions is gathered as described, allowing a greater data sample to be collected than considering private stock units offered.

3.2 Statistical framework and observations

3.2.1 Valuation differences between public and private healthcare companies

Based on the literature review in section 2.1, it can be inferred that private healthcare companies are valued at a considerable and significant discount compared to public companies. To account for differences among companies, every monthly closing price on a firm level is considered as a separate data point in a first approach. The variables extracted from S&P Capital IQ and MergerMarket are the company's EV to account for size, and the EV/EBITDA multiple to denote the valuation. Now, three dummy variables are introduced:

PUBLIC: 0 = private company, and 1 = public company, to account for the public/private company characteristic.

COVID: 0 = data point lies before February 2020 when Covid-19 was still nonexistent, and 1 = data point is sampled after the outbreak of Covid-19 in March 2020.

VACCINE: 0 = company is no Covid-19 vaccine manufacturer, and 1 = company is a Covid-19 vaccine manufacturer (i.e. Pfizer, BioNTech, Moderna, and AstraZeneca).

For public companies, the average valuation level was 15.0x before and 16.2x during Covid-19 (with a median of 13.9x and 13.7x, respectively). For private companies, the average valuation level was 25.2x before and 41.3x during Covid-19 (with a median of 13.7x and 13.3x, respectively; see Appendices two to five). Considering averages, that means a private company premium of 68.0% and 154.9% before and after Covid-19, respectively. At median values, this

denotes a private company discount of 1.4% before and 2.9% after Covid-19, which would be in line with literature. The statistical significance of these premia/discounts and the impact of the specified variables are tested in the following.

For the above-mentioned variables, the following hypotheses are stated to evaluate the statistical significance of those aspects' impact on valuation differences:

H0: The valuation in public and private healthcare companies is not impacted by the company being public or private or whether Covid-19 was prevalent or not.

H1: The valuation in public and private healthcare companies is impacted by the company being public or private or whether Covid-19 was prevalent or not.

In the regression model, MULTIPLE (i.e. the valuation level) shall now be the dependent variable. To evaluate the statistical significance of the impact of PUBLIC, COVID, SIZE, and VACCINE (PUBLIC and COVID are independent variables, SIZE and VACCINE are control variables), the following multivariate regression model is tested:

(1) $MULTIPLE_{k,t} = \beta_1(PUBLIC)_{k,t} + \beta_2(COVID)_{k,t} + \beta_3(SIZE)_{k,t} + \beta_4(VACCINE)_{k,t} + \gamma_k + \delta_t + \varepsilon_{k,t}$

Where $\beta_{1,2,3,4}$ = regression coefficient of the respective variable, γ_k = time-invariant, fixed firm effects, δ_t = time-variant effects, and $\varepsilon_{k,t}$ = error term.

Number of observations	1,775	**R^2**	0.019

Variable	SIZE	PUBLIC	COVID	VACCINE	Constant
Coefficient	0.000	-13.614	2.872	-1.993	23.007
p-value	0.896	0.000	0.133	0.428	0.000

Table 1: R*egression results of Equation (1). See Appendix six for details*

Only the p-value of the PUBLIC variable is smaller than 0.1, 0.05, and 0.01 (which are the common significance levels). Therefore, H0 cannot be reasonably rejected at every significant level for all other variables. This means that neither the size of a company, nor the point in time (before or after the Covid-19 outbreak), nor the characteristic whether the company is a Covid-

19 vaccine producer or not, has a statistically significant impact on valuation differences. Regarding a company's characteristic of being public or private, H1 can be accepted at every significance level, i.e. this characteristic has an impact on valuation differences. The coefficient is -13.6, which can be interpreted as a companies' EV/EBITDA multiple being lower when it is publicly listed, on average. Contrary to pertinent literature, this indicates a private company premium.

The R^2 metric equals 0.019, which is relatively close to 0. That acknowledges the impact the tested variables have on valuation differences, but the low figure indicates a rather bad goodness of fit of the model introduced above to describe that impact.

To gain an impression of the impact of Covid-19 on the valuation on a firm-specific level in public companies, the regression detailed in equation (1) is run for every public company separately. However, for this purpose, the variables SIZE, PUBLIC, and VACCINE can be omitted. H0 and H1 is now, for every company:

H0: The valuation is not impacted by Covid-19 being prevalent or not.

H1: The valuation is impacted by Covid-19 being prevalent or not.

For private companies, such analysis is not feasible since valuation levels over time are not available for the private company sample. For BioNTech and Moderna, no valuation multiples are available for the period before Covid-19 so both are excluded here as well.

Company	**Coefficient**	**p-value**	**R^2**
Eli Lilly and Company	11.988	0.000	0.553
Novo Nordisk A/S	7.438	0.000	0.334
Johnson & Johnson	1.126	0.000	0.125
AbbVie Inc.	-1.729	0.000	0.127
Roche Holding AG	0.224	0.334	0.009
AstraZeneca PLC	6.810	0.000	0.258
Novartis AG	-1.905	0.000	0.168
Pfizer Inc.	-0.635	0.285	0.011
Thermo Fisher Scientific Inc.	2.498	0.000	0.147
Abbott Laboratories	0.821	0.324	0.010
Amgen Inc.	1.344	0.000	0.200

Danaher Corporation	8.473	0.000	0.359
Sanofi	-0.269	0.242	0.013
Bristol-Myers Squibb Company	-6.946	0.000	0.348

Table 2: *Detailed regression results on firm-specific level*

Table two shows the statistical results of the regression. For 12 companies, the impact of Covid-19 is statistically significant at all commonly accepted levels and H0 can be rejected. Of those 12 companies, the impact of Covid-19 was negative in only three of those companies. All the others enjoyed higher valuations during Covid-19 than before. The magnitude of that increase in valuation varies greatly, however. This shows that valuations in the private market mostly rose and that company-specific aspects seem to play a role in the magnitude of that rise.

3.2.2 Impact of Covid-19 on valuation differences between public and private healthcare companies

In order to confirm the statistical insignificance of Covid-19 on valuation differences given the above results, data is now aggregated to reflect broad market valuation levels over time. For the public market, an "Index" is constructed by weighing companies' valuations with their respective EVs to account for their size. That is, every company's EV/EBITDA multiple is weighted according to the share of its EV in the total EV of the index, and a value-weighted EV/EBITDA multiple of the index is derived. This generalization does not allow to account for the impact of the other variables tested with the first regression.

For the private transactions, an EV value-weighted monthly average is built to reflect a monthly valuation level of those transactions similar to the public market. The private company discount (PCD), can now be calculated as follows:

(2) $PCD_t\ (\%) = \frac{PrivateMarketMultiple_t - PublicMarketMultiple_t}{PublicMarketMultiple_t}$

Where t = point in time.

Months where no transactions of private targets were observed as well as two supposed outliers (private company premia of more than 1,000%) were eliminated.

Again, the private company discount turns out to be a private company premium of 50.5%

on average and 20.1% median (see Appendices seven and eight), confirming findings on a company-specific level.

Of interest is now whether Covid-19 changed that with statistical significance or not. Given that public and private companies were equally affected by the Covid-19 crisis (and section 2.2 yields strong evidence for both types of companies to behave the same way), no change is expected, i.e. the private company premium shall not change. However, section 3.2.1 indicates that premia changed with Covid-19 (not statistically significant, though) and valuations of public companies mostly rose. On this valuation level, this premium turned into a median discount of -11.4% (but stayed at a 29.5% premium on average; see Appendix eight). To evaluate this change on its statistical significance on a broad market level, the following hypotheses are tested:

H0: The valuation differences in public and private healthcare companies did not change with Covid-19.

H1: The valuation differences in public and private healthcare companies changed with Covid-19.

In the regression model, PCD shall now be the dependent variable. To evaluate the impact of Covid-19 on the PCD, the independent variable shall be COVID. The regression model is therefore set up by the following formula:

(3) $PCD_t(\%) = \beta_1(COVID)_t + \varepsilon_t$

Where β_1 = regression coefficient of COVID, and ε_t = error term (on a broad market level).

Number of observations	80	**R^2**	0.010

Variable	COVID	Constant
Coefficient	-0.230	0.525
p-value	0.372	0.001

Table 3: R*egression results of Equation (3). See Appendix nine for details.*

The p-value equals 0.3723 which considerably exceeds the common significance levels. Therefore, H0 cannot be reasonably rejected. That means Covid-19 (may have) changed the

difference in valuations in public and private markets, but this change is again not statistically significant.

The coefficient for COVID is -0.2302. This implies that when Covid-19 is prevalent, the private company discount drops by 23%, but this finding is again not statistically significant at all commonly accepted levels.

The low R^2 metric of 0.010 acknowledges again the impact Covid-19 has on the PDC, but the low figure indicates a bad goodness of fit by the model to describe that impact.

Before discussing the findings in this sample in the next chapter, a brief summary shall take place. Data analysis on a firm-specific level found a statistically significant private company premium. Factors like company size, whether Covid-19 was prevalent or not, and whether the company was one of the main Covid-19 vaccine manufacturers had no statistically significant impact on valuations. Further quantification of this premium and whether it changed with Covid-19 or not could not be confirmed with statistical significance on a broad market level.

4. Result discussion

4.1 Valuation differences between public and private healthcare companies before Covid-19

Drawing on the literature review in chapter 2.2, possible explanations for the private company premium only being statistically significantly impacted by the company's trait of being public or private are discussed.

The widely accepted main reason for the private company discount is the illiquidity of stakes in private companies. Contrary to some of the following aspects which impact private company discounts, and which might differ heavily from industry to industry, there is no indication that stakes in private companies are more or less liquid in healthcare companies than in other sectors. Academic literature on illiquidity does not yield indications in that direction. An "over-liquidity" of stakes in private healthcare companies is therefore presumably no driver behind the unexpected private company premium observed herein.

In terms of the liquidity of assets, which Block (2007) identified as a factor influencing the private company discount, healthcare should range in the middle of the scale. On average, companies' assets in the sector are not as liquid as for example in financial services, but asset-heavy industries such as industrial manufacturing, mining, or energy & infrastructure are way less liquid. This factor, consequently, cannot be the determining reason for a private company premium in the healthcare industry.

The more difficult access to new capital by private companies was cited as one of the reasons for the private company discount by Officer (2007). Since large parts of the healthcare industry are dependent on the outcome of their research, immediate and continuous access to capital is pivotal. But there is no significant characteristic of private companies which would indicate easier access to additional capital in comparison to other industries. Hence, from that standpoint, a reduction of the private company discount is not justified.

Recall that Paglia and Harjoto (2010) found lower discounts for private firms where the risk of bankruptcy is low and which are relatively large and profitable. There is no ground to generalize that all those aspects are exceptionally strongly expressed in healthcare companies (size was even found to be statistically insignificant in the analysis). On the contrary, due to the large R&D expenditures and the relatively long time it takes to recoup these investments through revenues (which is why the tenure of patents is so important to this industry), young companies take longer than in other industries to break even. This points even more towards a discount for private healthcare companies than the premium observed.

An argument for a lesser discount in private healthcare companies can be found in the aspect of information reliability and availability which impacts the extent of the discount (De Franco et al. 2010). Healthcare subsectors such as drug research and manufacturing are subject to regulatory scrutiny and influence due to their cruciality for people's health and ethical aspects. Nevertheless, this would at best justify a private company discount at the lower end of the range

quantified around 20% by De Franco et al. (2010), but not a considerable premium.

Recall the additional factors that determine private company discounts according to Van den Cruijce (2022): (1) whether the company allows outside parties to become shareholders or not, (2) whether revenues are (mostly) operating or stem from an exceptional/financial generation, (3) whether share transfers are subject to restrictions, (4) whether shares are subject to redemption rights, and (5) whether controlling or non-controlling stakes are subject of a transaction. No reference point indicates a particularly strong positioning of healthcare companies in any of those aspects, making a private company premium even more unexpected.

The aspects discussed above focused on highlighting why there is no indication of a private company premium in the healthcare industry based on private company characteristics. Considering the public companies' side, a private company premium might occur if public companies trade at a very low level for some reason not applicable to private companies. But such a (fairly unlikely and exceptional) scenario is not the case in the healthcare industry. Taking EV/Book Value multiples as an example, Block (2007) finds that healthcare companies trade well within the range of all studied industries. Further, MSCIs World Healthcare Index, which forms the basis for the public market data studied herein, trades at Price/Book Value levels way above the broad market (MSCI 2023a).[3] Consequently, there is no indication that a mispricing of public healthcare companies causes a private company premium.

4.2 Impact of Covid-19 on valuation differences between public and private healthcare companies

According to the academic consensus described in section 2.2, there was no reason that the existing valuation differences in the healthcare industry should have changed. Even though statistically not significant, the private company premium shrank in both analysis approaches. It would have been in line with literature findings that public and private companies' valuations

[3] Here, the MSCI World Index (which captures 85% of the market capitalization in developed countries; MSCI 2023b) serves as a benchmark for the broad market.

move in sync in times of crisis, so the private company premium observed before Covid-19 should have stayed at its former level. However, not even all public companies experienced the same impact of Covid-19 in terms of valuation changes. Even though most of them enjoyed higher valuations, some rose more than others (and some were even valued lower, even though lacking significance). Company-specific factors apart from the ones tested herein seem to play important roles even within one homogenous group of either public or private companies.

Interestingly enough, one possible explanation for why the public market seemed to enjoy more optimistic valuations might have been the fact that all Covid-19 vaccine producers in the western world are publicly listed. Namely, Pfizer is listed on the NYSE, AstraZeneca is listed on LSE, Moderna and BioNTech on the NASDAQ. Those companies were the companies in which the world placed its hope to find a cure against the virus, and subsequently governments subsidized an accelerated development process with capital and resources (also reinforcing the discrepancy in access to capital of public and private companies). Relatively quickly (given usual research and test phase duration), vaccines against Covid-19 were available. Due to shortages in pharmaceutical material, disruptions in global supply chains, the urgency of spreading the vaccine as fast as possible to as many people as possible, demand initially exceeded supply by far. Consequently, those companies saw their revenues surge at high margins. Exemplarily, Pfizer's revenues grew from USD 42 bn in 2020 to USD 82 bn in 2021 and USD 100 bn in 2022, of which Covid-19 vaccine and antivirus pill accounted for 45% and 56% in 2021 and 2022, respectively (Pfizer Inc. 2021; 2022). Despite those surges in revenue, being a Covid-19 vaccine manufacturer was proven to have no significant impact on valuation differences. It seems like the public market did not price in growth expectations through the knowledge and technique gained by the development of the Covid-19 vaccine. At least such an effect was not strong enough to significantly reduce private company premia.

Another aspect where public companies might have an advantage over private companies is

them being of larger size. The biggest healthcare players are all publicly listed, since at some point in a company's development the capital from public markets is necessary to grow further. Being a large institution might have helped with a severe challenge the healthcare sector faced a couple of months into the pandemic. During the first months of the pandemic, many healthcare workers quit their jobs. Reasons were mainly the elevated exposure to the virus, physical and psychological constraints due to increasing pressure, and salaries not reflecting that additional workload and risk (US Department of Health and Human Services 2023). However, employment numbers in the healthcare sector are recovering and are projected to account for approximately 45% of all jobs created in the US until 2032, making it the fastest-growing sector (US Department of Labor 2023). Since the biggest companies in the healthcare sector are publicly listed and big players might have an edge in tight employment markets (better financial means for bigger salaries, reputation, deeper pockets in terms of R&D financing and consequently more stable growth projections), this might transfer in the market assigning large companies (i.e., the publicly listed ones) better chances to find suitable and highly qualified employees. Again, since the size was found to have no statistically significant impact on valuation differences, this effect seemed not to be as influential as might have been expected.

Lastly, it must be acknowledged that another fact is the combination of this unique crisis and its impact on the directly linked healthcare sector. Unlike, for example in the financial crisis 2008 where the immediately and most adversely impacted sector was hit only negatively, the immediately affected sector was affected both positively and negatively this time. The broad financial sector did not benefit from the financial crisis, at least not in the short- to medium-term (Chang 2011; maybe apart from selected professions such as restructuring advisors, shortsellers, or distressed asset investors). The crisis stemming from inside the financial sector might be either a symptom or a reason for/of that. The healthcare sector, on the other hand, benefitted from the Covid-19 crisis as well (as can be seen in the briefly discussed increase in Pfizer's revenues 2021

and 2022). However, there is little indication that public companies in a sector benefit from a related crisis (which was not caused by the sector itself) while private companies do not benefit from it.

Most importantly, the absence of private company transactions is as strong an argument as a statistically significant private company discount. It is the epitome of the illiquidity of private company stakes. This fact must be taken into account before discarding results due to insignificance or absence of data since the absence of private transactions is a qualitative observation itself.

4.3 Limitations

Approaches of data sampling and statistical methods employed always entail disadvantages and make results subject to certain limitations. The main limitation this work faces is the low number of observations, especially the absence of relevant transactions of private targets after Covid-19 hit. A larger number of observations might increase the meaningfulness of the results and could lead to statistically significant results and a better goodness of fit of the model introduced (R^2). Also, this work focused on the healthcare sector as a whole, but studies focusing on specific subsectors may find different results. In addition to that, there are no comparable studies conducted in this recent timeframe to compare whether findings differ wildly or are mostly in sync to draw a uniform and consistent picture. Lastly, including further aspects by accounting for them with further variables might determine the reasons for valuation differences in the healthcare sector. Especially firm-specific variables might enable new findings.

5. Conclusion

These concluding thoughts shall be started with a succinct recapitalization of the main points and findings of every chapter of this work.

Chapter two presented an overview of pertinent literature regarding valuation differences in public and private companies as well as regarding the reaction of public and private companies

in times of crises. It summarizes that private companies in every industry are subject to a discount of roughly between 15 and 40%. Furthermore, public and private companies are expected to be impacted in the same way by economic disruptions and crises such as the Covid-19 pandemic. The analysis in chapter three found an actual private company premium which is only significantly impacted by the fact of a company being public or private. The other tested variables had no significant influence on valuation differences. In that sense, the effects of the Covid-19 pandemic impacted valuation differences, however not significantly. Chapter four discusses that the contradicting findings of a private company premium before Covid-19 cannot be explained based on the current standing of literature and the scope of this work. Also, the reduction of the premium company discount cannot be explained by the extraordinary importance of vaccine development through public drug manufacturers, public healthcare companies being of larger size and having more financial means, or because the sector itself was not the primary root cause of the Covid-19 crisis. Chapter four closes with an assessment of the significance of the findings in the context of statistical and economic limitations.

It can only be reiterated that the findings of a private company premium for the healthcare sector are not only unique to the sector but to the literature on valuation differences in public and private companies in general. With the observed reduction of the premium during Covid-19, the valuation differences in the healthcare industry conformed more towards what the literature proposes. However, this approach was not statistically significant, so the findings stay in contrast to pertinent academia. This is particularly interesting since the Covid-19 pandemic was an unprecedented and unique disruption, not only in economic terms, and such an event may well have an unprecedented impact on all aspects of the economy. For the future, this means that crises may impact specific areas or sectors differently and may not only tear down what is considered “standard” but may also lead to approximations to the consensus, such as a private company discount.

Furthermore, the findings and discussions presented herein show a great deal of potential for further research. First, researchers may observe valuation differences in a more recent time frame in order to update the data which was mainly sampled at the end of the 1990s and early 2000s. Of interest are the discounts across a broad field of industries, but also industry-specific differences are not to be neglected. Examinations of those specific discounts in the healthcare industry as a whole or even sub-sectors might confirm or challenge the findings herein. Second, it would be of interest to academia whether other industries exhibited a private company premium previous to Covid-19. Third, scholars might then examine whether the Covid-19 crisis had a similar impact on those sectors. Last, the impact of company-specific variables such as growth expectations, profitability, or financing costs, might be statistically examined regarding their influence on valuation differences among public companies as well as between public and private companies.

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7. Appendix

List of Abbreviations

bn	billion
EBIT	Earnings before Interest and Taxes
EBITDA	Earnings before Interest, Taxes, Depreciation, and Amortization
ETF	Exchange-traded funds
EV	Enterprise Value
IPO	Initial Public Offering
i.e.	id est
LSE	London Stock Exchange
m	million
MSCI	Morgan Stanley Capital International
M&A	Mergers & Acquisitions
NASDAQ	National Association of Securities Dealers Automated Quotations
NYSE	New York Stock Exchange
PCD	Private Company Discount
R&D	Research & Development
S&P	Standard & Poors
US	United States
USD	US-Dollar
VIX	Chicago Board Options Exchange Volatility Index

List of Tables

Company	Geography	Market Capitalization (in USD m)	% of MSCI World Healthcare Index
Eli Lilly and Company (NYSE:LLY)	United States and Canada	527,395.95	6.71%
UnitedHealth Group Incorporated (NYSE:UNH)	United States and Canada	491,136.25	7.49%
Novo Nordisk A/S (CPSE:NOVO B)	Europe	439,158.05	4.70%
Johnson & Johnson (NYSE:JNJ)	United States and Canada	364,975.95	5.36%
Merck & Co., Inc. (NYSE:MRK)	United States and Canada	262,963.32	3.91%
AbbVie Inc. (NYSE:ABBV)	United States and Canada	256,390.68	3.74%
Roche Holding AG (SWX:ROG)	Europe	213,888.27	2.71%
AstraZeneca PLC (LSE:AZN)	Europe	198,550.95	2.89%
Novartis AG (SWX:NOVN)	Europe	197,114.37	2.86%
Pfizer Inc. (NYSE:PFE)	United States and Canada	173,500.34	2.59%
Thermo Fisher Scientific Inc. (NYSE:TMO)	United States and Canada	169,456.45	n.a.
Abbott Laboratories (NYSE:ABT)	United States and Canada	162,377.45	n.a.
Amgen Inc. (NASDAQGS:AMGN)	United States and Canada	145,578.71	n.a.
Danaher Corporation (NYSE:DHR)	United States and Canada	142,354.31	n.a.
Sanofi (ENXTPA:SAN)	Europe	134,093.98	n.a.
Bristol-Myers Squibb Company (NYSE:BMY)	United States and Canada	118,264.12	n.a.
Moderna, Inc. (NASDAQGS:MRNA)	United States and Canada	29,214.29	n.a.
BioNTech SE (NASDAQGS:BNTX)	Europe	22,838.20	n.a.
		Total	**42.96%**

Appendix 1: The biggest public healthcare companies according to S&P Capital IQ (2023)

multiple

	Percentiles	Smallest		
1%	9.164949	8.287742		
5%	9.844022	8.28788		
10%	10.36098	8.352073	Obs	854
25%	11.70589	8.452868	Sum of wgt.	854
50%	13.86511		Mean	15.04275
		Largest	Std. dev.	4.405856
75%	17.35762	32.36889		
90%	21.50677	32.49362	Variance	19.41156
95%	23.72769	32.65751	Skewness	1.116131
99%	27.43712	33.06248	Kurtosis	4.231224

Appendix 2: Average and median valuation level for public companies before Covid-19

multiple

	Percentiles	Smallest		
1%	1.113263	.7220145		
5%	3.429791	.9302211		
10%	8.05215	.9510536	Obs	641
25%	10.88645	.9836045	Sum of wgt.	641
50%	13.74161		Mean	16.23087
		Largest	Std. dev.	8.473677
75%	20.78259	43.22036		
90%	28.77816	44.54709	Variance	71.8032
95%	30.99505	48.28841	Skewness	.7945432
99%	38.51175	49.77525	Kurtosis	3.530346

Appendix 3: Average and median valuation level for public companies during Covid-19

multiple

	Percentiles	Smallest		
1%	3.1202	1.9726		
5%	5.8333	2.8835		
10%	6.9145	3.1202	Obs	221
25%	10.24	3.6373	Sum of wgt.	221
50%	13.6855		Mean	25.21746
		Largest	Std. dev.	47.16249
75%	20.5279	167.0133		
90%	42.2833	173.3063	Variance	2224.3
95%	89.1076	221.3991	Skewness	7.837633
99%	173.3063	568.2266	Kurtosis	83.07545

Appendix 4: Average and median valuation level for private companies before Covid-19

multiple

	Percentiles	Smallest		
1%	3.2129	3.2129		
5%	4.1313	3.6516		
10%	7.1429	4.1313	Obs	59
25%	8.5884	4.1853	Sum of wgt.	59
50%	13.3333		Mean	41.33422
		Largest	Std. dev.	172.1754
75%	19.2308	58.882		
90%	32.1892	59.1218	Variance	29644.38
95%	59.1218	240	Skewness	7.144814
99%	1320	1320	Kurtosis	53.38256

Appendix 5: Average and median valuation level for private companies after Covid-19

Source	SS	df	MS	Number of obs	=	1,775
				F(4, 1770)	=	8.64
Model	44500.8066	4	11125.2016	Prob > F	=	0.0000
Residual	2279576.46	1,770	1287.8963	R-squared	=	0.0191
				Adj R-squared	=	0.0169
Total	2324077.26	1,774	1310.07737	Root MSE	=	35.887

multiple	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
size	1.58e-06	.000012	0.13	0.896	-.0000221	.0000252
public	-13.61426	3.023657	-4.50	0.000	-19.54457	-7.683942
covid	2.872183	1.910433	1.50	0.133	-.8747582	6.619124
vaccine	-1.99292	2.515738	-0.79	0.428	-6.927049	2.941209
_cons	28.00741	2.181676	12.84	0.000	23.72848	32.28634

Appendix 6: Detailed Regression results of Equation (1)

pcd

	Percentiles	Smallest		
1%	-.465535	-.465535		
5%	-.3410371	-.4513193		
10%	-.2179141	-.3410371	Obs	53
25%	-.0220264	-.3000086	Sum of wgt.	53
50%	.2098026		Mean	.5249604
		Largest	Std. dev.	1.07733
75%	.714077	1.86637		
90%	1.293743	2.575611	Variance	1.160641
95%	2.575611	4.572519	Skewness	2.907
99%	5.373545	5.373545	Kurtosis	12.38659

Appendix 7: Descriptive statistic parameters for the time period before Covid-19

pcd

	Percentiles	Smallest		
1%	-.8355796	-.8355796		
5%	-.4805648	-.4805648		
10%	-.4639608	-.4639608	Obs	27
25%	-.2988887	-.4633777	Sum of wgt.	27
50%	-.1136527		Mean	.2947377
		Largest	Std. dev.	1.100271
75%	.3944992	1.17627		
90%	2.710663	2.710663	Variance	1.210596
95%	2.766564	2.766564	Skewness	2.000746
99%	3.785817	3.785817	Kurtosis	6.110502

Appendix 8: Descriptive statistic parameters for the time period where Covid-19 was prevalent

Source	SS	df	MS	Number of obs	=	80
				F(1, 78)	=	0.81
Model	.948082372	1	.948082372	Prob > F	=	0.3723
Residual	91.8288132	78	1.17729248	R-squared	=	0.0102
				Adj R-squared	=	-0.0025
Total	92.7768956	79	1.17439108	Root MSE	=	1.085

pcd	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
covid	-.2302227	.2565472	-0.90	0.372	-.7409691	.2805236
_cons	.5249604	.1490405	3.52	0.001	.2282436	.8216772

Appendix 9: Detailed Regression results of Equation (3)

Variable	Specification
COVID	Independent variable, Dummy. 0 = data point lies before February 2020 where Covid-19 was still nonexistent, 1 = data point is sampled after the outbreak of Covid-19 in March 2020, and Covid-19 was prevalent.
MULTIPLE	Dependent variable. The EV/EBITDA multiple at which a private or public company is valued at.
PCD	Dependent variable. Private Company Discount in %. The discount in EV/EBITDA multiple valuation of private companies compared to public companies.
PUBLIC	Independent variable, Dummy. 0 = company is a private company, 1 = company is a public company (publicly listed on a stock exchange).
SIZE	Control variable. The EV of a company as a measure of its size.
VACCINE	Control variable, Dummy. 0 = company is no Covid-19 vaccine manufacturer, 1 = company is a Covid-19 vaccine manufacturer (i.e. Pfizer, BioNTech, Moderna, and AstraZeneca).

Appendix 10: Table of variable specifications