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Assessing the Impact of COVID-19 on Private Equity Funds Performance: A Comparative Analysis of Fund Types

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ABSTRACT

In this thesis, I study whether COVID-19 had an impact on the performance of private equity funds and whether this performance depended on a fund type. To do so, the data is collected from Preqin, and the OLS models estimating the performance are created. I find that COVID-19 had a significant negative impact on the performance of most types of funds, but there were a few exceptions, namely Co-Investment and Secondaries. Moreover, I discovered that the pandemic had less severe impact on venture capital funds than the global financial crisis (GFC). However, the overall comparison between COVID-19 and the global financial crisis is not possible due to a lack of significant results for the GFC. While these findings suggest that the private equity market is vulnerable to various global crises, it provides insights to investors on which fund types are more resilient.

Keywords: Private Equity, COVID-19, Performance, Fund Types, Buyout

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CHAPTER 1 Introduction

In the early days of March 2020, World Health Organization (WHO) officially declared the outbreak of COVID-19 as a global pandemic. This announcement caused a lot of uncertainty in stock markets, economies, and business operations. It resulted in the undervaluation of assets, creating an opportunity for private equity investors to step in, and look for companies that could be purchased at a discount (Haarmeyer, 2020). Although professionals predicted defaults in private equity backed companies, and even the end of the industry, private equity funds leveraged their access to favorable credit terms, experienced managers, and proactive approach to risk, ensuring that their portfolio companies outperformed non-PE-backed firms (Haarmeyer, 2020). These observations would suggest a positive correlation between COVID-19 and the performance of the funds. However, access to favorable credit terms also led to excessive borrowing, and around 3.2% of PE backed companies declared insolvency (Zhang, 2023). Although it represents a small segment of PE backed firms, it highlights a contrasting perspective. Furthermore, PE managers believed that around 40% of their portfolio companies were reasonably affected by the pandemic, and around 10% were severely affected (Gompers et al., 2022). Accordingly, the relationship between the pandemic and fund performances remains unclear. This highlights the need for more detailed examination to fully understand this relationship in the private equity sector.

The question of whether and to what extent private equity adds value has been a topic of ongoing discussion. However, researchers have always been interested in the effect of crises on different industries. Research conducted by Manac et al. (2022) examined variations in the performance of diverse types of funds. The authors also investigated fund performance before, during, and after the 2007-2008 financial crisis by creating four vintage year brackets. Their results showed that the financial crisis had a negative impact on the performance of private equity. While their research focused on the general performance across various fund types, it inspired a deeper investigation into the impact of pandemics on the performance of private equity funds. Moreover, Gompers et al. (2022) conducted qualitative research where they surveyed 200 private equity managers about their portfolio performance. Their study concluded that almost half of the portfolio companies were adversely affected by the pandemic. Chen et al. (2021) investigated new challenges brought by the pandemic, and the private equity prospects under COVID-19. The relationship between COVID-19 and the performance of private equity funds has only been studied through qualitative methods, likely due to lack of data. This study aims to bridge this gap through quantitative analysis.

Although the performance of private equity funds was studied in the context of the 2007-2008 crisis (Manac et al., 2022), the exact relationship between the pandemic and the private equity industry performance still remains unknown. Given that a qualitative approach was mostly used, due to the lack of data after the pandemic, quantitative research on this topic is needed. In this study, I will replicate the research approach of Manac et al. (2022) in a different context, namely, controlling for the COVID-19

pandemic and comparing it to the impact of the stock market crash on the private equity industry. The COVID-19 outbreak had some characteristics similar to the financial crisis. Both triggered higher volatility in markets, led to economic downturns, and caused stress on financial institutions. However, there are significant differences between them too. The pandemic had a broader scope of impact, affecting not only the financial sector but also hospitality, and travel, among others. Moreover, the financial crisis started in the United States, and it affected this region more than others. Additionally, the impact of COVID-19 was more immediate, and the recovery from the pandemic was much faster than the recovery from the financial crisis. Thus, my main research question is as follows:

"How did COVID-19 impact the performance of various types of private equity funds?"

I will examine which types of funds performed better or worse. Moreover, I will investigate if different fund's characteristics like fund size, fund sequence or regions had an impact on the performance during the crisis. I examine the relationship between COVID-19 and the fund performance using a similar approach to what was utilized by Manac et al. (2022). The performance data of private equity funds between 1990 and 2024 will be collected from Preqin. Following their study, private equity funds would be grouped into nine categories to analyze the impact of the pandemic on particular types of funds. The original study used eleven categories of funds but due to the lack of observations in two categories, I had no choice but to omit them from the regression. Moreover, two models from Manac et al. (2022) are going to be used to estimate the baseline for private equity fund performance. To estimate the impact of COVID-19 on private equity performance, I will use the interaction term between vintage year bracket covering the COVID-19 period and each fund type. All models would be estimated with two different dependent variables, namely, the net internal rate of return (net IRR) and the multiple of invested capital (net multiple). Subsequently, the study will use an ordinary least squares (OLS) regression to analyze the fund performance measures (dependent variables) against relevant control variables. This approach sets the baseline for uncovering the detailed impact of COVID-19 on fund performance.

The results of this study indicate that the effect of COVID-19 on the performance of private equity varied significantly across different types of funds. While most of the funds significantly underperformed the benchmark, two funds significantly outperformed it, namely Co-Investment and Secondaries funds. Expansion & Turnaround funds performed worse than the average in the whole sample, while Venture funds raised during COVID-19 performed better by exhausting new opportunities that arose from the pandemic. The IRR coefficient of Balanced funds became insignificant, but their net multiple coefficients became significant, and decreased even more, indicating a general worse performance during the pandemic. These findings align with the opinion of general partners (GPs) that were surveyed by Gompers et al. (2022). The authors highlighted that not all the GPs felt affected by the pandemic, and some of the funds performed better than before, aligning with the authors' conclusion.

Furthermore, I compared the impact of COVID-19 with the global financial crisis (GFC) and concluded that the only funds that were raised during the GFC that outperformed the benchmark were Real Estate funds. Although this finding is related to the GFC, it reflects the point of view of Haarmeyer (2020) who mentioned that the undervaluation of assets creates the opportunity for investors to purchase companies at a discount. Expansion & Turnaround funds were affected to the same degree by both crises, while the Venture funds took a bigger hit compared to the COVID-19 period, due to the slower recovery of the economy. This study confirms that Buyout funds perform significantly better than most other types of funds. This finding aligns with those of Kaplan and Schoar (2005), Ljungqvist & Richardson (2003), and Higson and Stucke (2012), who concluded that Buyout funds (or leverage buyout) slightly outperform the other types of funds, especially Venture funds.

The remainder of the paper is structured as follows. Chapter 2 discusses the relevant existing literature on private equity, its performance, and the impact of COVID-19. Chapter 3 discusses and describes the data used in the regression. Chapter 4 discusses the empirical methodology and robustness checks performed. Chapter 5 presents the results and the discussion of the research. Chapter 6 provides the conclusion and summary of the study. Additional supportive materials can be found in Appendix A and B.

CHAPTER 2 Theoretical Framework

2.1 Introduction to Private Equity

To understand differences in the strategies of various private equity, it is essential to understand the way that these investment vehicles work. Private equity is a form of investment that involves raising funds from private or institutional investors, such as pension funds, and high-net-worth individuals. These funds are created to achieve abnormal returns that exceed traditional market returns, such as the S&P 500 index. Furthermore, private equity funds not only invest in private companies that are not listed on public stock exchanges, but also take companies private to restructure them and bring them public through IPOs. The private equity funds are structured as limited partnerships, meaning that general partners (GPs) are responsible for deal sourcing, operating activities and managing fund investments, while limited partners are responsible for providing capital to the fund (Fenn et al., 1997; Kalleberg, 2015). This form of an entity enables the incentivization of general partners to make decisions and align their interest with LPs. Therefore, the standard compensation in private equity industry follows the "2/20/1" rule, meaning 2% of the management fee, 20% of carried interest, and 1% of the total fund size (Robinson & Sensoy, 2012). The "2/20" rule was also described by Kalleberg (2015). According to the same authors, private equity funds typically have a lifespan between 10 and 13 years, making this form of investment illiquid for investors. However, there are mechanisms protecting the investors such as the hurdle rate, which defines a minimum return that LPs must receive before GPs can earn their interest (Stoff and Braun, 2014), or clawback provisions that allow LPs to reclaim the carried interest earned by GPs in cases where the GPs have received more compensation than was previously agreed upon (Shobe, 2016) Unfortunately, the main disadvantage in analyzing the performance of private equity is the lack of data. Since annual or quarterly reporting is not mandatory the data can only be provided voluntarily by the funds. Aggarwal and Jorion (2010) described a survivorship bias as a bias that occurs when funds that stop reporting the data are dropped from the database of "live" funds. This action generates an upward bias because liquidated funds are more likely to exhibit poor returns towards the end of their lives. This bias can be controlled for by including liquidated or closed funds in the study (Aggarwal & Jorion, 2010). This debacle can create significant upward bias in the analysis of the performance in this industry and can lead to the overestimation of private equity investments. As a result, the overall performance of the private equity industry is skewed, not representative, and leads to positive bias.

2.2 Performance Measures – PME, IRR and Net Multiple

Assessing the performance of private equity funds is essential to understand the way these funds are operating. However, it is not as straightforward as people may think since there are multiple performance measures used by private equity funds. Some funds are focused more on short-term performance, while others take long-term profitability as the most important metric. Firstly, I will discuss commonly used

performance measures and different views from the literature. This will be followed by considering the performance of private equity across different regions and fund types.

To begin with, it is essential to develop a benchmark when comparing the performance of private equity funds. One of these benchmarks that provides a comparison with the public market is the public market equivalent (PME) that compares investments in the private equity market with those in the public market. Kaplan and Schoar (2005) define PME as a discounted sum of capital contributions and distributions, where the interest rate is the return earned by the public equity benchmark, in this case the S&P500. The public market equivalent takes a value between 0 and 2, where a value greater than 1 implies that the fund outperformed the benchmark, while a value below 1 implies underperformance. Unfortunately, few funds in the Preqin database reported their performance as a public market equivalent, therefore this paper will focus more on the other measures.

Internal rate of return is another measure that is commonly used to measure performance in the private equity industry. Kaplan and Schoar (2005) highlighted that the median and average IRRs are significant measures of the performance and discovered that the equal-weighted median IRR at the end of a fund's lifetime is equal to 12%, while the average is 17%, suggesting that these funds achieve substantial returns. Moreover, they discovered a large correlation between PME and IRR, proving that both measures are reflective of the actual performance of the funds. The results of Ljungqvist and Richardson (2003) are in line with those of Kaplan and Schoar (2005), showing that the average IRR of the funds studied is 19.8%, and the median is 18.7%. Ljungqvist and Richardson (2003) deduced that the IRR of the average private equity fund is negative until eight years of its functioning, suggesting that calculating this performance measure before the fund is liquidated does not accurately reflect the performance. Despite this finding, they still used IRR as a performance measure for the active funds, similar to Kaplan and Schoar (2005). Moreover, they highlighted the fact that the private equity industry suffers from illiquidity, since most of the excess returns are realized at the end of a fund's lifetime. Furthermore, Ljungqvist and Richardson (2003), Kaplan and Schoar (2005) and Manac et al. (2022) measured the IRR net of carried interest and management fees and examined the performance of private equity both on active and liquidated funds, suggesting that IRR can still be used as an interim measure of performance. However, Kaplan and Sensoy (2015) highlighted important drawbacks in the IRR and the multiple of invested capital. They mentioned that both are absolute measures, and they do not consider relative performance.

The third performance measure used in private equity is the net multiple, also known as the multiple of invested capital (MIC) or "X multiple." The net multiple can be defined in a few ways – it represents the factor by which the initial investment was multiplied or the likelihood to receive invested money back (Manac et al., 2022), or as the ratio of the cumulative inflows/distributions to cumulative capital outflows/calls (Kaplan & Sensoy, 2015). Kaplan and Sensoy (2015) concluded that multiples of invested capital are strongly negatively correlated to the amount of capital raised by private equity firms,

especially for venture capital funds. Frequently, IRR or PME is used instead of the net multiple, therefore there is limited information available.

2.3 Types of Private Equity Funds

2.3.1 Buyout

To begin with, Kalleberg (2015) described the buyout (or leveraged buyout) fund as a private equity firm that focuses on acquiring companies using leverage. Buyout funds then develop the company through active management of its resources, with the goal of selling the company a few years later at a profit. Furthermore, Kalleberg (2015) highlighted the timeline of such investments, which is around 10 years, and also mentioned that leveraged buyout firms preceded private equity funds and operated in the 1970s and 1980s. Therefore, since buyout funds were active before the rise of private equity firms and are the most representative of the whole industry, the buyout strategy will be used as the benchmark in the analysis.

2.3.2 Balanced

As the name itself suggests, Balanced funds are the most diversified funds with respect to the types and stages of the companies they invest in. Diller and Kaserer (2007) described this strategy as one that invests in a large portfolio of companies at different stages of development, namely, seed stage, early stage, diversified and later stage.

2.3.3 Co-Investment

Co-Investment funds are focused on a type of investment where limited partners not only invest in the company, or other assets through the fund, but also commit to the direct investment into the asset. This requires two separate stakes in one company / asset (Preqin, 2024). Moreover, the most popular form of co-investment is one named syndicated co-investment where GPs sell some stakes to the LPs once the deal is closed (Manac et al., 2022).

2.3.4 Distressed & Turnaround

Shadab (2009) described distressed funds as funds that focus on buying debt securities of companies that are on the verge of bankruptcy. This allows funds to buy this debt at a fraction of face value, with the goal of improving the future of the company. The Turnaround strategy's aim is to help out and strengthen the companies that exhibit poor performance or trading difficulties (Preqin, 2024).

2.3.5 Expansion / Late Stage

Expansion / Late Stage funds are focused on companies that are mature and have increasing sales volume but do not necessarily need to be profitable. Its goal is to invest money in companies that can expand its

production, shipping, and sales volume (Diller & Kaserer, 2007). These funds are approached by companies that need additional capital, but do not want to give up control of the company (Manac et al., 2022). Furthermore, Preqin (2024) defines Expansion funds as ones that invest in companies in late venture stage cycles. Typically, these funds consist of short-term and mid-term positions.

2.3.6 Growth

According to Preqin (2024), growth funds invest their capital in profitable, but still maturing companies with a promising prospective of growth. They usually do not use leverage to take these positions. According to Song et al. (2015), growth funds are more likely to benefit from focusing on the strengths of their managers rather than diversification of their investments. Tommar et al. (2024) described a growth equity as investments that fall in between venture capital and buyout strategies and highlighted that these investments involve minority equity investments in fast-growing companies.

2.3.7 Secondaries

Secondary strategy focuses on sourcing deals that were already owned by private equity companies, and then acquiring stakes from the LPs (Lerner et al., 2011). Furthermore, secondary transactions offer a way for LPs to exit the investment before the fund's maturity and provide liquidity to the fund on the sell side.

2.3.8 Real Estate

As the name of the strategy suggests, the main pillar of real estate funds is investing in various real estate properties. Preqin (2024) defines this strategy as one that invests in properties, land, and other structures from residential buildings to commercial real estate.

2.3.9 Venture

According to Preqin (2024) Venture funds invest in growing, small companies with long-term growth potential. Shadab (2009) mentions that venture capital funds finance young companies and then actively manage them by leveraging the network of advisors and experts. Tommar et al. (2024) highlight that venture funds usually invest in companies that have negative cash flows or are not profitable but have huge growth potential.

2.4 Performance of Private Equity Across Different Fund Types

Regarding overall private equity performance, Higson and Stucke (2012) discovered that buyout funds in the U.S raised between 1980 and 2008 significantly outperformed the S&P 500 index. Furthermore, they found out that buyout funds from United States, which provided their performance measures as IRR, outperformed the S&P500 almost every year since 1980. The analysis of the sample of U.S funds discovered that the average IRR was equal to 8.6%. Furthermore, Kaplan and Schoar (2005) found that leverage buyout (LBO) funds slightly outperformed venture capital funds in their study. This finding is

similar to the one of Ljungqvist and Richardson (2003), and Higson and Stucke (2012) whose research resulted in the same conclusion. Phalippou (2013) not only discovered that buyout funds outperform the market in all vintage years analyzed but he also pointed out the performance cycles of buyout funds. Moreover, Harris et al. (2014) discovered that private equity funds outperform the S&P500 by 20% to 27% throughout a fund life, and by more than 3% per year. Kaplan and Schoar (2005) discovered that the performance of a fund is strongly correlated with the performance of the next fund raised by the same private equity fund. Thus, most the papers suggest that private equity should be able to "beat the market" and achieve positive excess returns. Furthermore, the fact that buyout funds usually outperform other funds provides justification for using it as a benchmark in the regressions.

In this study, I expect to discover that Buyout funds indeed outperform other types of funds, therefore I expect the coefficient of fund types to be mainly negative. Since the data sample does not have enough entries on the public market equivalent (PME), I will not be able to check whether private equity funds could, on average, outperform the market. Furthermore, I expect to discover an adverse relationship between fund size and the performance of private equity funds. This is reasonable, since it is difficult to manage large private equity funds, given that most private equity funds have niches that they specialize in. This leads to following hypothesis:

H1: *Buyout funds outperform other types of private equity funds, positively affecting performance.*

2.5 Global Analysis of Private Equity Performance

Previously mentioned research showed that most of the funds analyzed in the literature are mainly from the United States or Europe because private equity funds firstly invested in developed regions that were familiar to them. Leeds and Sunderland (2005) mentioned that in the mid-1990s, when inflation and interest rates declined, investors were intrigued by many emerging markets due to capital shortages in those regions. Furthermore, they highlighted the fact that at first the development of private equity in emerging regions was difficult due to differing legal structures and regulations. Lerner et al. (2009) pointed out that emerging markets only account for a small share of private equity activity between 1990 and 2008, reflecting that capital typically goes to the wealthier and faster-growing countries. However, Leeds and Sunderland (2005) discovered that between 1992 and 1999, over five hundred funds were fundraised in emerging markets in Asia, accounting for more than $50 billion in assets under management. By the end of 1999, over one hundred funds were created with a focus on Latin America, whereas a decade earlier none had existed (Leeds & Sunderland, 2005). Furthermore, Tommar et al. (2024) highlighted that the Asia-Pacific region is the third largest in terms of the number of active Growth funds, and they concluded that Growth funds in this region outperform other regions significantly. Similar activity was seen in Eastern Europe where private equity exhibited rapid growth in the mid-1990s. However, in the late-1990s, the performance of private equity decreased and most of the funds underperformed (Leeds & Sunderland, 2005). These contrasting views suggest that the

performance of PE is not entirely clear, as various time periods and regions show differences. Therefore, the additional analysis of the effect of different regions is needed to provide us with new insights and to contrast with existing findings. This discussion leads to the following hypotheses:

H2: *Investing in Asia region positively affects the performance of private equity funds.*

H3: *Investing in emerging countries negatively affect the performance of private equity funds.*

2.6 Performance of Private Equity Funds during COVID-19

The COVID-19 pandemic that started at the very end of 2019 had a significant impact on the global economy. As the number of COVID-19 cases increased, the markets reacted, leading to economic disruptions and high volatility and uncertainty in the market. Because the pandemic happened few years ago, there was not enough quantitative data, with most of the studies on this topic being qualitative and consisting of surveys or overall analysis of the problem, rather than data-driven studies. Gompers et al. (2022) surveyed over 200 PE firms about their performance, decision-making and the overall effect of the pandemic on their operations. Around 40% of managers suggested that the pandemic had a significant negative effect on their performance and to some extent damaged their performance, while 50% claimed that they were unaffected by the pandemic. Furthermore, all performance measures, namely the internal rate of return and the net multiple, were negatively affected (Gompers et al., 2022). Haarmeyer (2020) points out important differences between the global financial crisis (GFC) that happened between 2007 and 2008, and the COVID-19 pandemic. The damage caused by the global financial crisis was mainly due to the introduction of assets like mortgage-backed securities (Sornette & Woodard, 2010) resulting in huge financial downturn, while the pandemic resulted in a short-term crisis that could be mitigated in the coming few years. Furthermore, Sornette and Woodard (2010) highlighted that the pandemic's negative impact on public equities interested private equity and resulted in significant investments in private investments in public equity (PIPES). This resulted the increase of the value of PIPES investments to $17 billion. Chen et al., (2021) highlighted issues with fundraising and investment caused by the pandemic. They mentioned that due to the stagnant demand in the real global economy, most of the LPs did not think it was a good time for investment. Regarding the effect on investments, the short-term effect was significant, while the long-term impact was not (Chen et al., 2021). This contrasts with the effect of global financial crisis that was significant during the next few years. Furthermore, they highlighted the opportunities that the pandemic created. Some industries failed, but some industries were created, hinting investors towards which industries they should remove their capital from, and which new industries they should focus on and explore. Mason (2020) introduced the 'denominator effect' observed during the pandemic period. This effect occurs when the value of VC investments goes down, causing an overallocation of an investor's capital in VC funds and encouraging GPs to pull back investments in this industry. This explains limited capital invested into private equity

during the crisis times. Moreover, Mason (2020) found out that funds were focused not on raising capital, but on keeping their existing funds and investments alive, which was their number one priority. In summary, the pandemic had a significant and negative, but mainly short-term effect, on economies, industries, and businesses. Overall, it not only posed challenges but also created opportunities showing investors new trends and where they should allocate their future capital. This showed a relationship between performance and the pandemic times, serving as a basis for future research.

I expect to find that the COVID-19 pandemic adversely affected the performance of the majority of the funds, but I expect that there would be outliers that outperformed the rest. Additionally, I expect to discover differences in the degree of impact across different types of funds. Manac et al. (2022) concluded that private equity funds underperformed during the financial crisis, therefore it is reasonable to believe that the same would happen during the COVID-19 pandemic. Furthermore, given rapid market recovery after the pandemic, I expect that the COVID-19 pandemic had a much less severe impact on private equity funds compared to the financial crisis. Therefore, I assume that the degree to which the pandemic affected the performance of private equity funds would be lower than for the stock market crash. This leads to the following hypotheses:

H4: *The COVID-19 pandemic adversely affected the performance of the majority of private equity funds.*

H5: *The COVID-19 pandemic had a less severe impact on private equity funds compared to the financial crisis.*

CHAPTER 3 Data

3.1 Description of Data

3.1.1 Data Collection

This dataset is provided by Preqin, one of the leading databases that provides information and data regarding the private equity, hedge fund, and venture capital industries, including its deals and performances. The information gathered by Preqin is voluntarily submitted by the funds or directly from the fund managers. The fund sample consists of the funds with a vintage year between 1990 and 2024. That range was used since Manac et al. (2022) used the data between 1990 and 2013, thus I want to expand their research. Moreover, I used the most recent data to explore the relationship between the COVID-19 pandemic and the performance of private equity funds across the different types. Unfortunately, due to the lack of valid data entries in the dataset, the data cleaning process reduced the sample, resulting in the vintage years ending in 2021. Furthermore, there are small differences in the fund strategies across funds, and the Natural Resources and Mezzanine strategies barely exist in this dataset, therefore I exclude these fund strategies from the sample. The following section is going to explain the details regarding the variables used in the study.

3.1.2 Fund Performance Measures

One of the most important measures of private equity performance is the net internal rate of return (IRR) and net multiple. The net IRR represents the money-weighted return of funds expressed as a percentage. It is calculated by taking the present sum of cash contributions, the sum of distributions, and the current value of unrealized investments. Moreover, it excludes any carry and performance fees earned by the general partners. The second performance measure is the net multiple or otherwise called the multiple of invested capital. It shows how many times investors have received their initial investment, or how likely they are to receive their money back, and then profit from the investments. Also, the net multiple could be expressed as the sum of DPI (distributions to paid in capital ratio) and RVPI (residual value to paid-in capital ratio). Both net IRR and net multiple are directly reported to Preqin by the funds. In this study, every model is going to be estimated twice, firstly with net IRR and secondly with the net multiple.

3.1.3 Fund Types Identification

The fund type variables will take a form of dummy variables. Therefore, the variable will take a value ‘1’ when a particular fund type is reported, and ‘0’ otherwise. To identify the main types of funds that are going to be used in the analysis, I am going to conflate them in the same way as in the research of Manac et al. (2022). In the newest dataset, Preqin distinguishes between twenty-nine fund types, while in the dataset used Manac et al. (2022), it was only twenty-seven types. Therefore, it can be seen that

the information in the dataset has changed, so the results are expected to slightly differ. Since using twenty-seven different strategies would be complex, they will be merged with respect to the nature of investment or investment stage of the fund. Firstly, the fund types are grouped into nine main strategies, which differs by two from the Manac et al. (2022). The dataset used in the study has two fund types less because after cleaning the data there were no observations considering Natural Resources as a strategy, and the Mezzanine strategy had only two observations. Thus, these strategies were not considered by the main fund types. I distinguished between Balanced, Buyout, Co-Investment, Distressed & Turnaround, Expansion / Late Stage, Growth, Real Estate, Secondaries, and Venture fund types. Table 1 displays how fund types were conflated. Then, eight fund types were deleted from the sample due to insufficient observations. These funds were: Fund of Funds, Real Estate Co-investment, Real Estate Secondaries, Real Estate Fund of Funds, Infrastructure Fund of Funds, Infrastructure Secondaries, Timber. After conflating fund types, I excluded all observations where the net IRR, net multiple, and fund size was missing. Then, to mitigate the effects of outliers, the dataset was trimmed of the top and bottom 1%, resulting in 5763 observations. To be precise, the funds were firstly ranked by their top and bottom 1% net IRR, and then the same was done for the net multiple. After ranking these funds, observations that were included in both groups were deleted. This approach prevented us from having biased results. Deleting funds with top and bottom 1% net IRR, and then funds with top and bottom 1% net multiple, would have resulted in biased database because more observations than intended would have been deleted. The Buyout fund type is going to be used as a benchmark in all the regressions, since the same one was used in Manac et al. (2022). Moreover, this type of fund is the most reliable representation of the private equity industry.

Table 1: Fund Conflation.

	Fund Types	**Conflation of Preqin-defined fund classes**					
1	Balanced	Balanced					
2	Buyout	Buyout					
3	Co-Investment	Co-Investment	Co-investment Multi-Manager				
4	Distressed & Turnaround	Distressed Debt	Special Situations	Turnaround			
5	Expansion/Late Stage	Expansion/Late Stage					
6	Growth	Growth					
7	Real Estate	Real Estate	Infrastructure Core	Infrastructure Core Plus	Infrastructure Opportunistic	Infrastructure Value Added	
8	Secondaries	Secondaries	Direct Secondaries				
9	Venture	Venture	Early Stage	Early Stage: Seed	Early Stage: Start-up	Venture Debt	Venture (General)

Notes: Table 1 shows how various Preqin-defined fund classes were merged. The first column indicates the name of each fund type, and each row shows what particular fund classes were merged. I distinguished between nine different fund types, maintaining original fund classes names provided by Preqin.

3.1.4 Vintage Year

The Vintage Year variable specifies the first year in which a fund makes their initial investment. The variable will be represented as a dummy variable which takes values of '1' for a particular vintage year, and '0' otherwise. The vintage years between 1990 and 2024 are included in the raw dataset. The Vintage Year 2006 is going to be used as a benchmark in the models that require using vintage years dummies. As in the Manac et al. (2022) the year that falls in the middle of the sample was chosen as a benchmark, so I did the same. The vintage year 2007 was considered as a potential benchmark but due to the fact that the financial crisis happened that year, the vintage year 2006 was the more appropriate choice.

3.1.5 Vintage Year Brackets for the COVID-19 and the Global Financial Crisis

Manac et al. (2022) used vintage year's brackets related to the financial crisis to control for the effect of the crisis on the performance across different private equity fund types. In this study two vintage year brackets would be created. The COVID-19 vintage year bracket consists of years 2020 and 2021, which suffered from the pandemic the most. Although the WHO established the date of the 5th of May 2023, as the official end of the COVID-19 pandemic, this date is not the date that is used in this study. The end of 2021 will be used as the end of the COVID-19 pandemic because at that time over 70% of the global population was vaccinated, leading to the risk of most of the population being very small (Ioannidis, 2022). Furthermore, this aligns with the constrained dataset that has observations until 2021. The next vintage year bracket accounts for the global financial crisis and consists of the years 2007, 2008, and 2009. Since the global financial crisis had a long-lasting impact, one more year than in the case of the pandemic was considered. The vintage year brackets are represented as dummy variables taking a value '1' when vintage years falls within the bracket, and '0' otherwise.

3.1.6 Size Variables and Size Brackets

Fund size is the total value of investments of a fund, or in other words, the total commitment of the limited partners to the fund. It is expressed in millions of United States dollars. Firstly, in order to smoothen out the distribution a new variable which takes the natural logarithm of the fund size was created. Using the natural logarithm helps with addressing issues related to heteroskedasticity and enable to create more reliable and robust models. Then, to compare the performance of different types of funds six different brackets were created: fund size less than $100mn (< $100mn), fund size between $100mn and $250mn ($100mn - $250mn), fund size between $250mn and $500mn ($250mn - $500mn), fund size between $500mn and $1bn ($500mn - $1bn), fund size between $1bn and $3bn ($1bn - $3bn), and fund size greater than $3bn (> $3bn). The fund size brackets are represented as a dummy variable, taking value '1' when fund size falls within the bracket, and '0' otherwise. In all the models using the vintage year brackets variable Fund Size < $100mn will be used as a benchmark.

3.1.7 Region Focus

The primary region is represented as a dummy variable, taking value '1' when the fund operates primarily in the specific region, and '0' otherwise. The North America region will be used as a benchmark in all models because it is the region that most of the funds are focused on. The private equity funds operate around the world, but mainly in North America where 57.16% of funds are allocating their resources. Furthermore, 22.44% of funds operates mainly in Europe, and 12.56% in Asia. In this sample, not many funds operate in regions like Africa, Americas (excluding North America), Australasia, Middle East and Israel, and those regions take values 1.13%, 2.39%, 2.24%, 1.65%, respectively. Only 0.43% of private equity funds are diversified and belong to Diversified & Multiregional strategy.

3.1.8 Fund Sequence

The fund sequence indicates the position of a particular fund within the overall series of funds managed by a private equity firm. The first fund raised by the firm takes the value of '1', while the subsequent funds are numbered sequentially.

3.2 Descriptive Statistics of Funds Performance

To provide an overview of the data collected, two descriptive statistics tables were created. Tables 2, 3, and 4 present means of net IRR, net multiple, fund size, and other statistical measures like standard deviation, and minimum and maximum values across different type funds, while Table 5 shows the variation across the vintage years.

When analyzing the variation across fund types, Table 2, 3, and 4 show that Venture and Buyout strategies have the highest number of observations – 2108 and 1838, respectively. Real Estate and Distressed & Turnaround are the least represented with 14 and 41 observations, respectively. However, the Distressed & Turnaround has the highest net IRR mean, equal to 22.86%. It is possible that due to the lack of observations this value is significantly inflated. Funds that outperform the average net IRR are Buyout, Co-Investment, Distressed & Turnaround, and Secondaries with the net IRR equaling 17.99%, 17.53%, 22.86%, and 18.88%, respectively. Apart from the Buyout fund type, the others have a significantly lower number of observations, making it probable that the lower number of observations can lead to inflated means of net IRR. The Expansion / Late Stage fund type is the one that performs the worst in terms of net IRR. The highest and the lowest net IRR achieved was by funds from Venture. Moving on to net multiple, the average mean across the funds is 1.12x, with most of the funds outperforming this mean. The only funds that underperform it are Real Estate, Secondaries, and Expansion / Late Stage with net multiples equal to 1.54x, 1.65x, and 1.66x, respectively. The highest mean of the net multiple was achieved again by Distressed & Turnaround, while the lowest was exhibited by Real Estate. This suggests that values in this data may be biased since both fund types have significantly smaller numbers of observations. In terms of fund size, where mean values are expressed in millions of USD, the average mean is the highest for the Buyout funds ($347.43 million), and for

Real Estate ($360.29 million), while the lowest is for Venture ($167.39 million). Both Buyout and Venture are the most represented in terms of numbers of observations implying that those numbers are not upward biased. The average fund size across fund types is equal to $263.13 million, and only Buyout, Venture, and Co-Investment fund type outperform the mean, while others underperform.

As shown in Table 5, the number of private equity funds fluctuates across the years reflecting the different levels of fundraising activity throughout the years. Until 1995 the number of funds was constant, and later there were a few significant increases. The first one was in 2000 (232 funds), suggesting that the dot-com bubble caused an increase in fundraising activity in the private equity industry. The second one was just before the financial market crash in 2007 (256 funds). In both cases the peak was followed by a significant crash a few years later. After 2009, the number of active funds steadily increased, achieving its peak in 2019 (339 funds), followed by a small decrease in the later years. The net IRR also varied across the years. Table 5 displays that during the times when the fundraising activity was the highest, and thus the number of active funds increased, the net IRR was the lowest – 6.42% in 1999, and 7.53% in 2006. The highest net IRR was achieved in 1993 and was equal to 28.49%. The net multiple also fluctuated across the years, achieving the highest values between 1990 and 1996 and then between 2011 and 2018. There is a significant decrease in the mean net multiple between 2019 and 2021 implying that due to COVID-19 there was less activity on the private equity market. The net multiple decreased from 1.90x in 2018 to 1.25x in 2021. Moreover, the same is shown when looking at net IRR where the mean value decreased from 20.73% in 2019 to 13.96% in 2021. However, the fund values steadily increased across the time span of the data analyzed, reaching a peak of $300.34 million in 2019.

Table 2: Descriptive Statistics by Fund Type Net IRR (%).

	Net IRR (%)				
Fund Type	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
Balanced	112	14.514	17.547	-15	76.15
Buyout	1838	17.990	15.933	-27.61	93.85
Co-Investment	313	17.593	16.639	-22	92.5
Distressed & Turnaround	41	22.867	17.787	-6.6	69
Expansion / Late Stage	189	11.686	16.154	-29.66	93.6
Growth	822	15.700	17.089	-27.05	98.91
Real Estate	14	14.695	9.508	-4.15	32.7
Secondaries	326	18.886	13.886	-13.19	78.2
Venture	2108	13.128	18.050	-31.3	98.18
All Funds	5763	16.340	15.844	-31.3	98.91

Notes: Table 2 shows descriptive statistics for nine types of funds. The data was provided by Preqin and covers the period from 1990 to 2021. It presents the number of funds that reported performance with the net internal rate

of return (Net IRR). It also displays the average net IRR (mean), standard deviation (Std. Dev.), and minimum and maximum values (Min, Max).

Table 3: Descriptive Statistics by Fund Type - Net Multiple.

	Net Multiple				
Fund Type	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
Balanced	112	1.829	1.056	0.41	6.42
Buyout	1838	1.899	0.884	0.27	7.82
Co-Investment	313	1.811	0.919	0.40	7.25
Distressed & Turnaround	41	1.921	0.972	0.67	5.92
Expansion / Late Stage	189	1.657	0.932	0.46	6.72
Growth	822	1.806	0.925	0.28	7.26
Real Estate	14	1.536	0.450	0.86	2.32
Secondaries	326	1.651	0.504	0.66	3.81
Venture	2108	1.820	1.198	0.27	7.6
All Funds	5763	1.770	1.127	0.27	7.82

Notes: Table 3 shows descriptive statistics for nine types of funds. The data was provided by Preqin and covers the period from 1990 to 2021. It presents the number of funds that reported performance with the net internal rate of return (Net IRR). It also displays the average net IRR (mean), standard deviation (Std. Dev.), and minimum and maximum values (Min, Max).

Table 4: Descriptive Statistics by Fund Type – Fund Size.

	Fund Size				
Fund Type	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
Balanced	112	206.551	199.893	1.3	860
Buyout	1838	347.427	251.365	0.5	995
Co-Investment	313	226.900	216.190	1.23	876.2
Distressed & Turnaround	41	328.396	259.507	13.54	900
Expansion / Late Stage	189	221.380	183.949	5.8	852.5
Growth	822	250.408	235.960	0.47	998.5
Real Estate	14	360.291	317.781	10.03	978.8
Secondaries	326	259.433	237.145	2.2	966.8
Venture	2108	167.394	181.777	0.5	950
All Funds	5763	263.131	231.507	0.47	995

Notes: Table 4 shows descriptive statistics for nine types of funds. The data was provided by Preqin and covers the period from 1990 to 2021. It presents the number of funds that reported performance with the net internal rate of return (Net IRR). It also displays the average net IRR (mean), standard deviation (Std. Dev.), and minimum and maximum values (Min, Max).

Table 5: Descriptive statistics by vintage year.

Vintage Year	Fund Observations	Fund mean IRR (%)	Fund Mean Net Multiple (x)	Fund Mean Size (USD mns)
1990	43	21.701	2.564	111.161
1991	22	27.598	2.893	138.762
1992	46	21.896	2.340	110.400
1993	55	28.499	2.648	145.661
1994	65	24.584	2.494	177.901
1995	71	21.299	2.032	142.639
1996	90	18.548	1.944	192.399
1997	115	17.564	1.715	200.551
1998	151	8.935	1.485	258.812
1999	161	6.420	1.483	281.871
2000	232	7.665	1.498	251.022
2001	157	14.009	1.804	244.624
2002	110	13.303	1.695	190.896
2003	111	14.062	1.673	225.751
2004	139	10.863	1.619	222.746
2005	201	11.103	1.678	283.160
2006	239	7.526	1.600	271.658
2007	256	10.048	1.792	255.728
2008	239	11.057	1.751	239.085
2009	127	14.724	1.919	250.813
2010	169	15.456	1.987	252.176
2011	203	14.992	2.107	227.313
2012	206	16.188	2.105	259.844
2013	211	16.039	2.126	233.811
2014	257	17.441	2.181	241.209
2015	282	17.501	2.073	244.367
2016	300	20.618	2.221	272.712
2017	287	21.677	2.000	253.235
2018	311	23.579	1.900	248.402
2019	338	20.733	1.556	300.343
2020	282	17.081	1.387	280.175
2021	287	13.962	1.247	293.154
Total	**5763**	**16.458**	**1.922**	**228.199**

Notes: Table 5 presents summary statistics for the sample by vintage year. The data is provided by Preqin and covers the period from 1990 and 2021. The first column indicates the vintage year. The second column shows the number of observations in the sample. The third column presents the average fund IRR per vintage year, while the fourth column shows the average net multiple per vintage year. The fifth and final column presents the average fund size per vintage year, expressed in the millions of United States dollars. The last row displays the total number of funds, and averaged means values of net IRR, net multiple, and fund size.

CHAPTER 4 Methods

To analyze performance across various types of private equity funds, I utilized Ordinary Least Squares (OLS) regressions as the main statistical method of this study. Following the methodology of Manac et al. (2022), I focused on estimating the performance through the OLS regression, using the same control variables as in their models. The models will concentrate on estimating the effect of different fund types, and global crises like COVID-19 or the global financial crisis, on the performance of private equity funds, measured by the net IRR and the net multiple.

OLS is a widely used linear regression model in the fields of economics and finance due to its simplicity and easy interpretation of the relationships between variables. It allows the use of both continuous and categorical variables enabling the use of a wide range of control variables that influence fund performance. The goal of the OLS is to find the one best-fitting line through the data by minimizing the sum of squared differences between observed values and predicted values of residuals. Furthermore, it comes with various diagnostic tools to check if the following OLS assumptions hold:

1. The relationship between the dependent and the independent variable is linear.
2. The observations are independent of each other.
3. The variance of residuals (errors) is constant across all levels of the independent variables.
4. The residuals are normally distributed.
5. There is no multicollinearity among the independent variables.
6. There is no endogeneity, meaning the independent variables are not correlated with the error term.

The last section of this chapter will discuss the validity of the assumptions in previously mentioned models and will discuss the diagnostic tests used to ensure that the assumptions hold.

In this study the main dependent variables are private equity performance measures, namely net internal rate of return (net IRR) and net multiple. The main independent variable that I will focus on is the fund type, which takes the form of a dummy variable, followed by the vintage year brackets that would address the effect of the COVID-19 pandemic. Moreover, the other control variables like vintage year, fund size, regional focus and fund sequence would be used in the models. All models will be estimated twice, once for the net IRR, and then for the net multiple. This approach would ensure that the analysis captures the performance of private equity considering both types of performance measure.

The first two models are focused on estimating the effect of fund types throughout all the vintage years in the sample, and they are the same as the ones used by Manac et al. (2022). At first glance, the models look the same. However, the main difference between Model 1 and Model 2 is the variable accounting for the size of the fund. In the first model, a continuous variable of the natural logarithm of the fund size was used, whereas in the second model the fund size brackets were used. Moreover, the

second model takes the Size bracket <$100mn as a benchmark. The rest of the control variables, namely fund types, region focus, and fund sequence do not change across these two models.

Model 1:

$$Fund\ Performance_i = \propto_i + \beta_1 \times Fund\ Types_i + \beta_2 \times Vintage\ Years_i + \beta_3 \times \ln(fund\ size)_i + \beta_4 \times Region\ Focus_i + \beta_5 \times Fund\ Sequence_i + \varepsilon_i$$

Model 2:

$$Fund\ Performance_i = \propto_i + \beta_1 \times Fund\ Types_i + \beta_2 \times Vintage\ Years_i + \beta_3 \times Fund\ Size\ Brackets_i + \beta_4 \times Region\ Focus_i + \beta_5 \times Fund\ Sequence_i + \varepsilon_i$$

The two following models are the most important since they help answer the main point of research, namely, the effect of COVID-19 on the performance of private equity funds. To do so, interaction terms were used in the models. The interaction terms allow us to analyze whether the effect of one independent variable (Fund Type) varies depending on the level of another (Vintage Year Bracket). In this study, both models will be estimated firstly accounting for the effect of the pandemic, and then accounting for the impact of the global financial crisis on the performance of private equity. The interaction term between Fund Type and COVID-19 will consist of years 2020 and 2021, while the one with the global financial crisis will consist of years 2007 – 2009. As in the first two models, the control variables stay the same apart from the fund size variables, which differ across these models.

Model 3:

$$Fund\ Performance_i = \propto_i + \beta_1 \times Fund\ Types_i \times Crisis\ Vintage\ Bracket + \beta_2 \times \ln(fund\ size)_i + \beta_3 \times Region\ Focus_i + \beta_4 \times Fund\ Sequence_i + \varepsilon_i$$

Model 4:

$$Fund\ Performance_i = \propto_i + \beta_1 \times Fund\ Types_i \times\ Crisis\ Vintage\ Bracket + \beta_2 \times Fund\ Size\ Brackets_i + \beta_3 \times Region\ Focus_i + \beta_4 \times Fund\ Sequence_i + \varepsilon_i$$

4.1 Robustness Checks and Assumption Testing for OLS Regression Models

In this section, I will discuss the diagnostics tests performed to ensure that models used in this study fulfill the OLS assumptions. Conducting these tests ensures that the regression results are reliable and valid. Firstly, it is important to mention that not every assumption of the OLS has a diagnostic test to check whether the assumption holds, meaning that some of the assumptions would be assumed to hold.

The first assumption that requires the relationship between variables to be linear was accepted, since the residuals plotted against fitted values do not show any systematic pattern (Appendix B, Figure 1 and 2). Furthermore, the previous study of Manac et al. (2022) showed a linear relationship between the performance and fund type of private equity funds. Therefore, the provided evidence ensures that the first assumption holds. The second assumption, which requires the observations to be independent

of each other, is ensured by the Preqin data collection process which guarantees that there is no overlap in observations. Referring to the last assumption of no endogeneity, this assumption is crucial to obtain consistent and unbiased estimates. Unfortunately, there are no diagnostics tests to confirm that this assumption holds. I used the same control variables, as in the Manac et al. (2022) research, which could partially prove that this assumption holds. However, since it is still not enough to accept this assumption, I conclude that there is no causality since it is probable that this assumption does not hold. Even without causality the results of the research can provide many key insights into possible relationships and mechanisms in the private equity industry.

The first diagnostic test run was to check if the OLS assumption of homoskedasticity holds. This assumption requires the variance of errors to be constant across all levels of the independent variables, and if it does, this is known as homoskedasticity. To verify this property, I performed both a graphical and statistical test. Firstly, I plotted the residuals of Model 1 and 2's regressions against the fitted values, and it revealed that the errors are heteroskedastic, and therefore the assumption does not hold. The results from the regression using the net multiple as a dependent variable showed a clear funnel shape of errors, while in those using the net IRR the shape was not that clear. To see these graphs please refer to Appendix B: Figure 1 and 2. Moreover, I performed a statistical test, namely, the Breusch-Pagan test, to see whether the variance of the residuals is related to the independent variables. After evaluating it for both models, and both performance measures, every test resulted in a p-value equal to 0.00, implying that the null hypothesis should be rejected, and confirming that the data is heteroskedastic. Furthermore, I performed a second test – the White Test, which once again confirmed that the data is heteroskedastic. Please refer to Appendix B, Tables 12 – 15 to see the White Tests results. Therefore, to account for the heteroskedasticity, all models will be estimated with robust standard errors since there are no other fixes available.

The second testable OLS assumption was the one that refers to the normal distribution of residuals. To check if it is valid I plotted residuals on a histogram to see if they follow a normal distribution. Both models estimated with net IRR and the net multiple displayed a histogram that depicted a bell-shaped curve that roughly follows the normal distribution. To see those figures, please refer to Appendix B, Figures 3 and 4. By looking at these graphs, I can see that the bell-shape curve is clearly followed by the data points, therefore I can conclude that this assumption holds.

The final OLS assumption tested was the one that requires no multicollinearity between variables in the regression model. Therefore, I performed a diagnostics test named the Variance Inflation Factor (VIF). Multicollinearity occurs when two or more independent variables are highly correlated, resulting in inflated parameters and unstable models. To ensure it does not happen to the models used in this study, the VIF was calculated for each of the independent variables. A VIF value greater than ten indicates multicollinearity between variables. Therefore, the lower the value of VIF, the better chances that there is no multicollinearity. Table 10 and 11 in Appendix B display the VIF values estimated for Model 1 and 2, respectively. As shown in the tables, the highest values were equal to 2.25 in both

models, and the mean VIF was 1.49 and 1.50, respectively. Therefore, it can be concluded that the independent variables do not exhibit multicollinearity, and that this assumption holds too.

In summary, these robustness checks were conducted to ensure that OLS assumptions hold. These tests revealed heteroskedasticity in the data which was accounted for by using the robust standard errors. Moreover, the residuals were found to be normally distributed, and the last test confirmed that there is no multicollinearity between variables in the dataset.

CHAPTER 5 Results & Discussion

5.1 Performance Analysis of Private Equity Funds Across Fund Types and Vintage Years

This section presents the results of the regression analyzing how various fund types affect the performance of private equity funds across all sample vintage years. These results serve as a baseline for comparison with the effects of the COVID-19 pandemic that will be discussed in the next sub-chapter.

Column 2 and 4 in Table 6 display two models estimated with the IRR while Column 3 and 5 present ones estimated with the multiple of invested capital. In these models, the Buyout strategy was used as a benchmark, so all fund strategies' coefficients must be interpreted in relation to this strategy. To begin with, the Expansion / Late Stage, Growth and Venture were the ones that significantly underperformed Buyout funds regardless of performance measure used. In the models estimated with net IRR, their coefficients were equal to -7.26, -4.27, and -7.12 respectively, with all of them being significant at the 1% level. Keeping other variables constant, on average, these funds had a lower IRR by -7.25, -4.27, -7.12 percentage points respectively, compared to the benchmark. The balanced strategy significantly underperformed in models estimated with net IRR, while its performance in models estimated with net multiple was not significant at all. The Balanced fund type's coefficient was equal to -3.95 and was significant at the 5% level. This coefficient indicates that, on average, Balanced funds have an IRR of 3.95% (percentage points) lower than the benchmark, keeping all variables constant. The double asterisks next to the coefficient implies that the coefficient is statistically significant at the 5% level. Furthermore, this statistical significance was checked by performing a t-test. The null hypothesis that the coefficient is equal to zero was rejected, and therefore it can be concluded that there are significant differences between Balanced and Buyout funds (the benchmark). The number in parentheses displays the standard deviation of the coefficient which in this case was 1.58. The same reasoning can be used when talking about any coefficient estimated in this model. Regarding the remaining fund types and its effect on the performance of the funds, the Secondaries strategy was the only one that significantly underperformed the benchmark in models that were estimated with the net multiple. The findings align with those of Kaplan and Schoar (2005), Ljungqvist and Richardson (2003), and Higson and Stucke (2012) who concluded that Buyout funds significantly outperform Venture funds and other types of funds. Therefore, again these results confirmed that the choice of Buyout funds as a benchmark was justified, and there exist no funds that significantly outperform the benchmark. The results provided from these regressions confirms the first hypothesis that Buyout funds outperform other types of funds.

Regarding the control variables, several of them were used in the regressions, namely the vintage years, size variables like size brackets and the natural logarithm of fund size, and fund number. The vintage year of 2006 served as a benchmark of all models, since it falls exactly halfway through the

sample. Most of the vintage years were significant at 5%, apart from years 1998 – 2000, and 2004 – 2007 (See Appendix A, Table 9). The years 1991 and 1993 were the years which significantly outperformed the most, achieving the highest increase in net IRR, namely between 19 and 20 percentage points respectively compared to 2006. That increase would be hard to beat since those years correspond to the beginning of the private equity industry, and now the market is highly saturated. The vintage year of 2001 also significantly outperformed the benchmark, mainly because funds raised after the dot-com bubble burst had big opportunities to invest in underpriced assets and companies that suffered from this crisis. In all the models, size variables were negative and significant at a 1% level, implying that the larger the size of the fund, the more adverse the effect on the performance. Furthermore, regions of focus had a significant impact compared to the benchmark (North America). Asia and the Middle East and Israel outperformed North America significantly (measured by the net IRR), while Diversified & Multiregional (measured by net IRR), Americas and Europe (measured by the net multiple) significantly underperformed the benchmark. From this initial analysis of the funds' performance, it can be concluded that the second hypothesis that Asia region can positively affect the performance of private equity funds is valid. However, it is going to be checked in the following models too. Furthermore, the third hypothesis that investigate if investing in emerging countries negatively affect performance of funds cannot be neither accepted nor rejected, since the results were ambiguous. The fund sequence had a negative and significant effect for all the models, meaning that the next fund raised by the same private equity fund was expected to perform significantly worse. Although the coefficients were negative, they oscillated around zero implying that the effect of fund sequence is weak with respect to changing the performance of the private equity fund. This finding contrasts with one finding of Kaplan and Schoar (2005) who concluded the opposite.

Table 6: Comparison of Model 1 and Model 2 Regression Results.

	Model 1		Model 2	
Independent Variables	Net IRR (%)	Net Multiple	Net IRR (%)	Net Multiple
Fund Types (benchmark: Buyout)				
Balanced	-3.947**	-0.123	-3.867**	-0.111
	(1.580)	(0.0986)	(1.594)	(0.0980)
Co-Investment	2.205	-0.00634	2.075	-0.00254
	(5.911)	(0.141)	(4.582)	(0.144)
Distressed & Turnaround	4.456*	0.0306	4.414	0.0290
	(2.531)	(0.144)	(2.698)	(0.147)
Expansion / Late Stage	-7.255***	-0.263***	-7.220***	-0.252***
	(1.269)	(0.0737)	(1.240)	(0.0744)
Growth	-4.271***	-0.181***	-4.177***	-0.169***
	(0.726)	(0.0418)	(0.739)	(0.0417)
Secondaries	-0.00601	-0.297***	0.118	-0.283***
	(0.985)	(0.0377)	(0.872)	(0.0377)
Real Estate	-2.868	-0.166	-2.855	-0.164
	(4.302)	(0.113)	(3.277)	(0.119)
Venture	-7.122***	-0.195***	-6.884***	-0.167***
	(0.566)	(0.0348)	(0.564)	(0.0348)
Vintage Year (benchmark: 2006)				
Vintage Years (See Appendix A, Table 9)	Yes	Yes	Yes	Yes
Size Brackets (benchmark: <$100mn)				
Size 100mn - 250mn			-3.112***	-0.209***
			(0.608)	(0.0368)
Size 250mn - 500mn			-2.911***	-0.196***
			(0.634)	(0.0386)
Size 500mn - 1bn			-4.263***	-0.260***
			(0.668)	(0.0389)
Size 1bn - 3bn			-	-
Size > 3bn			-	-
Ln(Fund Size)	-1.365***	-0.0981***		
	(0.188)	(0.0128)		
Region (benchmark: North America)				
Africa	-3.087	-0.222**	-2.838*	-0.198*
	(2.044)	(0.108)	(1.712)	(0.111)
Asia	1.689**	0.128***	1.771**	0.138***
	(0.709)	(0.0477)	(0.744)	(0.0478)
Australasia	-0.0998	-0.0859	-0.121	-0.0797
	(1.468)	(0.0845)	(1.466)	(0.0859)
Diversified & Multiregional	-7.518**	-0.293	-7.526***	-0.295*
	(3.519)	(0.182)	(2.581)	(0.179)
Europe	-0.328	-0.0660**	-0.353	-0.0633**
	(0.555)	(0.0311)	(0.540)	(0.0314)
Middle East & Israel	5.644***	0.145	5.690***	0.153
	(1.684)	(0.116)	(1.947)	(0.116)
Americas	-4.677***	-0.284***	-4.464***	-0.263***
	(1.485)	(0.0921)	(1.618)	(0.0923)
Fund Sequence				
Fund Number (Overall)	-0.0712***	-0.00286**	-0.0721**	-0.00300**
	(0.0202)	(0.00131)	(0.0322)	(0.00132)
Constant	18.36***	2.265***	13.63***	1.903***
	(1.566)	(0.0961)	(0.936)	(0.0687)
Observations	5,398	5,398	5,398	5,398
R-squared	0.129	0.122	0.129	0.118

Notes: Table 6 explores the relationship between fund types and different performance measures. Each model was estimated for the net IRR and the net multiple. The first model uses the natural logarithm of fund size as a size measure, while the second one uses various size brackets. Both models use the same control variables (except size variable), namely the fund types (except Buyout which serves as a benchmark), vintage years (except 2006 which serves as a benchmark), region (except North America which serves as a benchmark), and fund sequence. Moreover, Model 2 in size brackets uses funds below $100mn as a benchmark. The significance levels are: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, and standard deviations are shown in parentheses.

5.2 Impact of COVID-19 on Private Equity Fund Performance Across Fund Types

This section will examine the effect of COVID-19 on the performance of private equity funds across various fund types. To ensure that the impact is accurately measured, the interaction effect between the fund types and the vintage year bracket, accounting for the pandemic years (2020 and 2021), was used. Then, the same models as Models 1 and 2 were estimated, but with one exception – instead of vintage years, the models included interaction variables that incorporated the vintage years. The results of the regression can be seen in Table 7.

The first significant difference between the estimated models is that there are two types of funds that significantly outperformed the benchmark fund during the COVID-19 period – Co-Investment and Secondaries – but only when measured by the IRR. On average, keeping all other variables constant, funds raised during the COVID-19 period significantly outperformed Buyout funds by 26.81 and 8.625 percentage points in net IRR, both at 1% significance level. This is a surprising fact, given that in Models 1 and 2 there was no fund that outperformed the benchmark. Co-Investment funds typically participate in deals after a company's takeover (Manac et al., 2022), while Secondaries focus on acquiring companies that are already owned by private equity (Lerner et al., 2011). Thus, it suggests that those funds probably capitalized on lower valuations of companies who suffered from COVID-19 and acquired them at a discounted price. After the market recovered, they sold previously bought companies and profited from the investment they made during the pandemic. This aligns with the findings of Chen et al. (2021) that noticed the new opportunities that the COVID-19 pandemic had created. As in Models 1 and 2, Expansion & Turnaround and Venture funds significantly underperformed the benchmark during the COVID-19. Moreover, the Expansion & Turnaround's coefficient decreased, implying an adverse effect of the pandemic on this type of fund, while the Venture's coefficient increased suggesting that Venture funds raised during the COVID-19 period performed better than ones raised throughout the rest of the sample. This may be due to the new opportunities that arose on the technological market after the needs of people during lockdown were observed. Regarding the Balanced fund types, which invest in companies in various stages of development (Diller & Kaserer, 2007), their coefficient estimated with IRR became insignificant, while their coefficient estimated with the net multiple became significant and decreased even more. Furthermore, in the models estimated with net multiple these funds' coefficients also decreased significantly: Distressed & Turnaround, Expansion, Secondaries, Real Estate, and Venture. These findings suggested that most of the fund types suffered during the times of the pandemic. This aligns with the findings of Gompers et al. (2022), who concluded that almost half of the surveyed funds were negatively affected during the COVID-19 pandemic. These findings can confirm that the fourth hypothesis, stating that COVID-19 adversely affect most of private equity funds, is valid, but there are outliers that performed better during that time.

The control variables used in Models 3 and 4 were the same as in Models 1 and 2, and their significance did not change much. Regarding the size variables, as in Models 1 and 2, the coefficients were negative and significant at 1% level. Also, the coefficients of size brackets implied that the bigger the fund, the bigger the impact on the fund performance, except for Model 4 estimated with IRR. The impact of the region also changed during the COVID-19 period. Funds with primary focus on Africa performed worse during the pandemic, while Diversified & Multiregional funds performed a bit better due to its coefficient becoming less negative (measured by the net IRR). Furthermore, funds focused on Asia performed significantly better regardless of the performance measure chosen, and their coefficients were positive and significant at the 1% level. This finding, once again, confirms the second hypothesis, and shows that investing in Asia significantly improves performance of private equity funds. Funds that focused on Europe, and were measured by the net IRR, performed significantly better than the benchmark, and this finding aligns with superior performance of Co-Investment and Secondaries funds during the pandemic. The Middle East & Israel region performed worse during the pandemic (not significant), while the coefficient of Americas became less negative implying better performance during COVID-19 than in the whole sample. As in the previous models, the fund sequence had a negative and significant impact, but their coefficients were oscillating around zero, suggesting only a small impact on the fund performance.

Table 7: Comparison of Models 1 and 2 with Models 3 and 4: Impact of COVID-19.

	Model 1		Model 3		Model 2		Model 4	
Independent Variables	IRR (%)	Net Multiple	IRR (%)	Net Multiple	IRR (%)	Net Multiple	IRR (%)	Net Multiple
Fund Types (benchmark: Buyout)								
Balanced	-3.947**	-0.123			-3.867**	-0.111		
	(1.580)	(0.0986)			(1.594)	(0.0980)		
Co-Investment	2.205	-0.00634			2.075	-0.00254		
	(5.911)	(0.141)			(4.582)	(0.144)		
Distressed &Turnaround	4.456*	0.0306			4.414	0.0290		
	(2.531)	(0.144)			(2.698)	(0.147)		
Expansion / Late Stage	-7.255***	-0.263***			-7.220***	-0.252***		
	(1.269)	(0.0737)			(1.240)	(0.0744)		
Growth	-4.271***	-0.181***			-4.177***	-0.169***		
	(0.726)	(0.0418)			(0.739)	(0.0417)		
Secondaries	-0.00601	-0.297***			0.118	-0.283***		
	(0.985)	(0.0377)			(0.872)	(0.0377)		
Real Estate	-2.868	-0.166			-2.855	-0.164		
	(4.302)	(0.113)			(3.277)	(0.119)		
Venture	-7.122***	-0.195***			-6.884***	-0.167***		
	(0.566)	(0.0348)			(0.564)	(0.0348)		
Fund Types x COVID-19 (benchmark: Buyout)								
Balanced x COVID-19			-2.094	-0.501***			-2.524	-0.538***
			(3.558)	(0.0174)			(3.663)	(0.0239)
Co-Investment x COVID-19			26.81***	0.839			26.95***	0.807
			(4.892)	(0.893)			(5.001)	(0.900)
Distressed x COVID-19			15.40	-0.267**			14.81	-0.322**
			(9.742)	(0.136)			(9.743)	(0.141)
Expansion x COVID-19			-10.76***	-0.712***			-10.94***	-0.731***
			(2.169)	(0.0524)			(2.147)	(0.0508)
Growth x COVID-19			-0.608	-0.544***			-0.665	-0.553***
			(2.058)	(0.0452)			(2.070)	(0.0457)
Secondaries x COVID-19			8.625***	-0.443***			8.700***	-0.437***
			(2.917)	(0.0657)			(2.908)	(0.0632)
Real Estate x COVID-19			-0.930	-0.619***			-1.073	-0.614***
			(2.384)	(0.0352)			(2.228)	(0.0498)
Venture x COVID-19			-3.339**	-0.565***			-3.258**	-0.559***
			(1.442)	(0.0503)			(1.446)	(0.0509)
Size Variable								
LN(Fund Size)	-1.365***	-0.0981***	-0.749***	-0.0933***				
	(0.188)	(0.0128)	(0.187)	(0.0123)				
Vintage Years	YES	YES			YES	YES		
Vintage Years								
Size Brackets (benchmark <$100mn)								
size100mn - 250mn					-3.112***	-0.209***	-2.098***	-0.211***
					(0.608)	(0.0368)	(0.624)	(0.0373)
size250mn - 500mn					-2.911***	-0.196***	-1.469**	-0.198***
					(0.634)	(0.0386)	(0.639)	(0.0383)
size500mn - 1bn					-4.263***	-0.260***	-1.800***	-0.250***
					(0.668)	(0.0389)	(0.657)	(0.0382)
Region (benchmark: North America)								
Africa	-3.087	-0.222**	-4.464**	-0.242**	-2.838*	-0.198*	-4.307**	-0.223**
	(2.044)	(0.108)	(1.807)	(0.0998)	(1.712)	(0.111)	(1.815)	(0.102)
Asia	1.689**	0.128***	2.025***	0.154***	1.771**	0.138***	2.131***	0.165***
	(0.709)	(0.0477)	(0.720)	(0.0460)	(0.744)	(0.0478)	(0.727)	(0.0462)
Australasia	-0.0998	-0.0859	2.250	-0.0485	-0.121	-0.0797	2.285	-0.0477
	(1.468)	(0.0845)	(1.471)	(0.0833)	(1.466)	(0.0859)	(1.477)	(0.0847)
Diversified & Multiregional	-7.518**	-0.293	-5.940**	-0.224	-7.526***	-0.295*	-5.970**	-0.227
	(3.519)	(0.182)	(2.848)	(0.185)	(2.581)	(0.179)	(2.812)	(0.182)
Europe	-0.328	-0.0660**	1.184**	-0.0260	-0.353	-0.0633**	1.202**	-0.0278
	(0.555)	(0.0311)	(0.564)	(0.0313)	(0.540)	(0.0314)	(0.566)	(0.0315)
Middle East & Israel	5.644***	0.145	4.009*	0.113	5.690***	0.153	4.196**	0.124
	(1.684)	(0.116)	(2.129)	(0.123)	(1.947)	(0.116)	(2.125)	(0.123)
Americas	-4.677***	-0.284***	-3.431**	-0.228***	-4.464***	-0.263***	-3.238**	-0.210**
	(1.485)	(0.0921)	(1.577)	(0.0880)	(1.618)	(0.0923)	(1.584)	(0.0881)
Fund Sequence								
Fund Number (Overall)	-0.0712***	-0.00286**	-0.0507***	-0.00459***	-0.0721**	-0.00300**	-0.0530***	-0.00470***
	(0.0202)	(0.00131)	(0.0156)	(0.00120)	(0.0322)	(0.00132)	(0.0156)	(0.00119)
Constant	18.36***	2.265***	19.14***	2.348***	13.63***	1.903***	16.64***	2.030***
	(1.566)	(0.0961)	(1.029)	(0.0696)	(0.936)	(0.0687)	(0.512)	(0.0333)
Observations	5,398	5,398	5,398	5,398	5,398	5,398	5,398	5,398
R-squared	0.129	0.122	0.016	0.043	0.129	0.118	0.016	0.040

Notes: Table 5 displays comparison of Model 1 and 2 with Models 3 and 4. Models 1 and 2 are estimated in the same way as in Table 4. Models 3 and 4 uses interaction effects between the fund type and the COVID-19 vintage year bracket. All the models have almost the same control variables, namely the fund types (except Buyout which serves as a benchmark), region (except North America which serves as a benchmark), and fund sequence. The difference between the models is that Model 1 and 3 uses the natural logarithm of a fund size as a size variable, while others use the size brackets, where the fund sizes below $100mn are used as a benchmark. Moreover, Models 1 and 2 use vintage years (except 2006 which serves as a benchmark), while Models 3 and 4 implement selected vintage years in the interaction effect. The exact values for vintage years variables in Models 1 and 2 are shown in Table 9 in Appendix A. The significance levels are: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, and standard deviations are shown in parentheses.

5.3 Comparing the Impact of COVID-19 with the Global Financial Crisis

This results section will aid in the comprehension of the difference between the impact of COVID-19 and the global financial crisis on the performance of private equity funds across fund types. Table 8 displays Models 3 and 4 estimated for the COVID-19 period and the GFC period, respectively.

Regarding the fund types that outperformed the benchmark in the times of crises, the Real Estate funds that were raised during the GFC significantly outperformed the benchmark but are only significant in models that measured performance with the net multiple. It contrasts with the funds that outperformed the benchmark during the pandemic, namely, Co-Investment and Secondaries. Since the possible reason for this outperformance during COVID-19 was discussed before, I will focus on the Real Estate funds. The combination of mortgage-backed securities and the real estate bubble was a cause of the global financial crisis. The bubble burst resulted in economic downturn and significantly lowered real estate prices (Sornette & Woodard, 2010). Therefore, the Real Estate funds raised in that period had a superior opportunity to buy real estate at a discount, and then sell it few years later, after the economy recovered from the crisis. Furthermore, Expansion & Turnaround funds were negatively impacted by both the global financial crisis and COVID-19 to the same degree, with coefficients for both events being around -10 and significance at 1% level. However, the coefficient of Venture funds is more negative for the GFC than the COVID-19. This suggests that the global financial crisis had a larger impact on Venture capital funds than the pandemic. Block and Sandner (2009) pointed out that VC-backed firms had problems with generating sufficient revenue due to the long-term recession. Moreover, they highlighted the importance of the initial public offering (IPO) market which exhibited low activity after the financial crisis. The last difference is that the global financial crisis significantly and negatively affected fund types with performance estimated by the IRR, while COVID-19 mainly affected the models measured by the net multiple. In the case of the GFC, the Growth and Secondaries fund significantly underperformed the benchmark fund, while in the case of COVID-19 the following funds significantly underperformed the buyout fund: Balanced, Distressed & Turnaround, Expansion / Late Stage, Secondaries, Real Estate, Growth and Venture. Therefore, these findings and coefficients displayed in Table 8 neither prove nor deny that the fifth hypothesis, stating that COVID-19 had less severe impact compared to the GFC, is valid. Moreover, the results indicate that some funds raised during COVID-19 performed better, while others performed better during the GFC.

Regarding the control variables, both models used the same ones, except for the size variable. Model 3 used the natural logarithm of the fund size, while Model 4 used the size brackets, where the funds below $100mn were used as a benchmark. As in previous models, all the size coefficients were negative and significant at the 1% level. The negative effect of the size on the performance was bigger during the GFC than during the COVID-19 for both performance measures. The effects of primary region did not significantly differ between the GFC and COVID-19. The coefficients for the models estimated for the GFC were roughly the same as the ones of COVID-19. Moreover, as in the previous

regressions, the fund sequence had a negative and significant impact which was roughly the same during both crises.

Table 8: Impact of COVID-19 and the GFC on Private Equity Fund Performance

	Model 3 COVID-19		Model 3 GFC		Model 2 COVID-19		Model 4 GFC	
Independent Variables	IRR (%)	Net Multiple	IRR (%)	Net Multiple	IRR (%)	Net Multiple	IRR (%)	Net Multiple
Fund Types x COVID-19								
Bracket (benchmark: Buyout)								
Balanced x COVID-19	-2.094	-0.501***			-2.524	-0.538***		
	(3.558)	(0.0174)			(3.663)	(0.0239)		
Co-Investment x COVID-19	26.81***	0.839			26.95***	0.807		
	(4.892)	(0.893)			(5.001)	(0.900)		
Distressed x COVID-19	15.40	-0.267**			14.81	-0.322**		
	(9.742)	(0.136)			(9.743)	(0.141)		
Expansion x COVID-19	-10.76***	-0.712***			-10.94***	-0.731***		
	(2.169)	(0.0524)			(2.147)	(0.0508)		
Growth x COVID-19	-0.608	-0.544***			-0.665	-0.553***		
	(2.058)	(0.0452)			(2.070)	(0.0457)		
Secondaries x COVID-19	8.625***	-0.443***			8.700***	-0.437***		
	(2.917)	(0.0657)			(2.908)	(0.0632)		
Real Estate x COVID-19	-0.930	-0.619***			-1.073	-0.614***		
	(2.384)	(0.0352)			(2.228)	(0.0498)		
Venture x COVID-19	-3.339**	-0.565***			-3.258**	-0.559***		
	(1.442)	(0.0503)			(1.446)	(0.0509)		
Fund Types x GFC								
Bracket (benchmark: Buyout)								
Balanced x GFC			-5.077	-0.362*			-4.932	-0.343*
			(5.130)	(0.186)			(5.108)	(0.186)
Co-Investment x GFC			-	-			-	-
Distressed x GFC			6.985	0.363			7.450	0.398
			(10.36)	(0.477)			(10.38)	(0.479)
Expansion x GFC			-10.25***	-0.350*			-10.06***	-0.342*
			(2.495)	(0.190)			(2.504)	(0.192)
Growth x GFC			-4.768***	0.0246			-4.866***	0.0137
			(1.214)	(0.104)			(1.227)	(0.105)
Secondaries x GFC			-3.180**	-0.167			-3.264**	-0.175*
			(1.476)	(0.103)			(1.474)	(0.104)
Real Estate x GFC			7.609	0.361***			7.712	0.368***
			(7.656)	(0.107)			(7.253)	(0.137)
Venture x GFC			-7.415***	-0.123			-7.294***	-0.110
			(1.021)	(0.0831)			(1.029)	(0.0832)
Size Variable								
LN(Fund Size)	-0.749***	-0.0933***	-0.810***	-0.0974***				
	(0.187)	(0.0123)	(0.187)	(0.0124)				
Size Brackets (benchmark <$100mn)								
size100mn - 250mn					-2.098***	-0.211***	-2.194***	-0.224***
					(0.624)	(0.0373)	(0.624)	(0.0376)
size250mn - 500mn					-1.469**	-0.198***	-1.654***	-0.210***
					(0.639)	(0.0383)	(0.640)	(0.0389)
size500mn - 1bn					-1.800***	-0.250***	-2.010***	-0.260***
					(0.657)	(0.0382)	(0.656)	(0.0388)
Region (benchmark: North America)								
Africa	-4.464**	-0.242**	-3.935**	-0.220**	-4.307**	-0.223**	-3.776**	-0.200**
	(1.807)	(0.0998)	(1.765)	(0.0969)	(1.815)	(0.102)	(1.776)	(0.0997)
Asia	2.025***	0.154***	2.093***	0.132***	2.131***	0.165***	2.203***	0.144***
	(0.720)	(0.0460)	(0.723)	(0.0474)	(0.727)	(0.0462)	(0.731)	(0.0476)
Australasia	2.250	-0.0485	1.841	-0.0771	2.285	-0.0477	1.866	-0.0766
	(1.471)	(0.0833)	(1.468)	(0.0839)	(1.477)	(0.0847)	(1.472)	(0.0852)
Diversified & Multiregional	-5.940**	-0.224	-6.085**	-0.254	-5.970**	-0.227	-6.107**	-0.256
	(2.848)	(0.185)	(2.879)	(0.189)	(2.812)	(0.182)	(2.843)	(0.185)
Europe	1.184**	-0.0260	1.184**	-0.0166	1.202**	-0.0278	1.195**	-0.0184
	(0.564)	(0.0313)	(0.563)	(0.0316)	(0.566)	(0.0315)	(0.565)	(0.0318)
Middle East & Israel	4.009*	0.113	4.156**	0.112	4.196**	0.124	4.328**	0.123
	(2.129)	(0.123)	(2.105)	(0.124)	(2.125)	(0.123)	(2.102)	(0.124)
Americas	-3.431**	-0.228***	-3.030**	-0.230***	-3.238**	-0.210**	-2.835*	-0.211**
	(1.577)	(0.0880)	(1.540)	(0.0881)	(1.584)	(0.0881)	(1.546)	(0.0881)
Fund Sequence								
Fund Number (Overall)	-0.0507***	-0.00459***	-0.0331*	-0.00490**	-0.0530***	-0.00470***	-0.0352*	-0.00505***
	(0.0156)	(0.00120)	(0.0192)	(0.00195)	(0.0156)	(0.00119)	(0.0195)	(0.00195)
Constant	19.14***	2.348***	19.65***	2.338***	16.64***	2.030***	16.95***	2.008***
	(1.029)	(0.0696)	(1.033)	(0.0702)	(0.512)	(0.0333)	(0.519)	(0.0340)
Observations	5,398	5,398	5,398	5,398	5,398	5,398	5,398	5,398
R-squared	0.016	0.043	0.019	0.025	0.016	0.040	0.018	0.021

Notes: Table 8 presents Models 3 and 4 estimated for the vintage year bracket covering the COVID-19 period, and the global financial crisis (GFC) period, respectively. Models 3 and 4 used interaction effects between the fund type and one of these two vintage year brackets. Both models have almost the same control variables, namely the fund types (except Buyout which serves as a benchmark), region (except North America which serves as a benchmark), and fund sequence. The only difference between the Models 3 and 4 is the size variable used. Model 3 used the natural logarithm of a fund size, while Model 4 used the size brackets, where the fund sizes below $100mn are used as a benchmark. The significance levels are: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, and standard deviation of the coefficient is shown in parentheses.

5.4 Limitations and ideas for further research

This study faced several limitations that will be discussed in this section. Firstly, the issue of missing data or lack of observations is a common problem in the private equity industry. Reporting financial data is not mandatory since the private equity industry does not fall under the United States Securities and Exchange Commission or other regulators (Kaplan & Lerner, 2016). Therefore, it is up to fund managers to disclose the performance of their fund. This could lead to several biases that affect the correctness of data. The first bias is a survivorship bias that arises when indexes exclude funds that have not survived, resulting in an upward biased past performance of funds compared to their actual performance (Jorion, 2010). The second bias is the selection bias that arises when private equity firms choose to report the data for the funds that are performing well and omit the ones that are underperforming. This bias results in overrepresentation of funds with better results, leading to upward bias in the data. Moreover, funds with lower returns, or the ones with higher risk choose not to report their results, resulting in underrepresentation of funds with higher risk profiles.

Furthermore, the next issue that arises from voluntary reporting in the industry is the lack of observations of funds with particular characteristics. In the data set used in this study, around 60% of observations consisted of funds that are focused on investing in North America, while regions like Africa, the Americas, Australasia, and the Middle East and Israel had around 2% each. While it might be true that there are fewer funds that focus on emerging markets, the lack of mandatory reporting results in biased data does not reflect the actual state of private equity. Thus, the impact of the focus region on the performance is likely to be biased, and thus over or underestimated. Moreover, the same happens regarding the number of observations of various fund types. Distressed & Turnaround and Real Estate funds had 14, and 41 observations respectively, while Venture had over 2000 observations. Fund types with lower observations could lead to less precise estimates, resulting in under or overestimation of coefficients.

Therefore, for further research, it would be advised to try and combine different private equity databases in the interest of gathering the biggest sample of performance data possible. Moreover, the introduction of mandatory reporting for private equity would enable researchers to thoroughly analyze this industry. Another idea is that the next research on this topic could conflate different types of funds and regions which are underrepresented, so there are no huge differences between the particular numbers of observations. However, in this case the trade-off between the precision of research and the generalizability of results arises, and by combining underrepresented characteristics, the study might lose specific insights about the effect of fund types, regions, or other characteristics affecting performance.

Furthermore, this study distinguished between funds based on their vintage year. Vintage years is the year in which the fund makes their first investment, and they stop collecting capital from potential investors. Moreover, on average, it usually takes 10 to 13 years to realize gains from all investments and

liquidate the fund. Therefore, the analysis of the effect of pandemic, performed in such a short time after it finished, could result in biased results. In this study, the years 2020 and 2021 accounted for the COVID-19 period, so now when this study is written, funds raised during these years operated for only 4 and 5 years, respectively. Thus, indicating that they are almost halfway through the typical life span of funds. Therefore, this study only accounts for the investments that were realized during this 5-year period, and since most of private equity funds realize their gains at the end of the fund's lifetime, the data on the performance used in this research do not represent actual performance of private equity funds.

Consequently, I would advise repeating this study after most of the funds raised in the COVID-19 period are liquidated, so in 6 to 7 years. Further research should focus on the long-term performance of private equity funds that were raised during the pandemic. This further period would ensure that most of the funds realized their investments and would assure researchers that the results are the closest possible to the actual performance. Moreover, further research could also analyze the performance of funds raised after COVID-19 to see if there are any differences in performance between funds raised after 2021 and those raised before 2020.

CHAPTER 6 Conclusion

In this thesis, I focused on analyzing the impact of the COVID-19 pandemic on the performance of private equity funds. Previous research focused mainly on the qualitative approach on this topic, and thus it lacked a quantitative one. It showed that a substantial part of private equity points was impacted by the pandemic, but there were funds that did not feel any difference between before or during the pandemic (Gompers et al., 2022). However, even though those funds managers claimed that they did not suffer from the pandemic, performance measures indicated the opposite. Looking at these discrepancies inspired me to dive deeper into this topic. Therefore, the question that was studied was: "How did COVID-19 impact the performance of various types of private equity funds?".

To answer this research question, I estimated four OLS regression models. The first two models examined the overall performance of private equity funds across the fund types over the vintage years between 1990 and 2021. The second two models were estimated with an interaction term between COVID-19 and fund types to find out how the pandemic affected performance of funds raised during these years. Both models provided me with enough insights to correctly assess the effect of the pandemic across various private equity funds. I found out that although the overall effect of COVID-19 was negative and significant for the most funds, there were two funds that performed better during these times, namely, Co-Investment and Secondary funds. The remaining funds that were raised during these years performed significantly worse than the benchmark. Furthermore, I compared the effect of the COVID-19 pandemic with ones of the global financial crisis and found out that the pandemic was less severe than the GFC for Venture funds. Unfortunately, I was not able to compare other funds since the effect of the GFC on most of the funds was insignificant.

This study is the first quantitative analysis of the impact of the global COVID-19 pandemic on the performance of private equity. It concludes that the coronavirus pandemic had an adverse effect on the performance of private equity funds. Thus, this research not only highlights the vulnerability of the private equity market to global crises but also provides insights into which types of funds performed the worst and which performed best during the pandemic. Moreover, it emphasizes the differences in the degree of impact of the global financial crisis and the pandemic. Furthermore, it once again highlights the number of opportunities that arise with every crisis, showing potential investors that there is always a way to make profit even during hard times. Therefore, this thesis could serve as a valuable guide to investors in making responsible choices during economic downturns.

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APPENDIX A: Supplementary Results

Table 9: Model 1 and 2: Vintage Year Coefficients.

Vintage Years	Model 1		Model 2	
	Net IRR (%)	Net Multiple	Net IRR (%)	Net Multiple
1990	12.96***	0.855***	13.01***	0.869***
	(2.663)	(0.184)	(2.719)	(0.183)
1991	19.42***	1.210***	19.47***	1.221***
	(3.570)	(0.342)	(3.670)	(0.351)
1992	13.40***	0.641***	13.40***	0.650***
	(2.586)	(0.172)	(2.539)	(0.173)
1993	20.46***	0.968***	20.63***	0.988***
	(2.424)	(0.219)	(3.480)	(0.218)
1994	16.03***	0.822***	16.15***	0.837***
	(2.264)	(0.202)	(2.516)	(0.203)
1995	13.06***	0.346**	13.11***	0.358**
	(2.189)	(0.151)	(2.960)	(0.152)
1996	10.67***	0.304**	10.85***	0.321**
	(2.016)	(0.141)	(2.707)	(0.140)
1997	9.659***	0.0526	9.743***	0.0622
	(1.835)	(0.0955)	(2.100)	(0.0950)
1998	1.531	-0.152*	1.578	-0.147*
	(1.693)	(0.0807)	(1.339)	(0.0808)
1999	-0.601	-0.119	-0.594	-0.119
	(1.656)	(0.0923)	(1.201)	(0.0930)
2000	0.658	-0.123	0.633	-0.124
	(1.497)	(0.0780)	(1.021)	(0.0783)
2001	6.526***	0.174*	6.521***	0.175*
	(1.675)	(0.0992)	(1.506)	(0.0985)
2002	5.274***	0.0416	5.463***	0.0596
	(1.881)	(0.107)	(1.906)	(0.108)
2003	5.602***	0.0288	5.580***	0.0303
	(1.852)	(0.0913)	(1.702)	(0.0921)
2004	2.414	-0.0384	2.331	-0.0394
	(1.746)	(0.102)	(1.703)	(0.102)
2005	3.196**	0.0649	3.303**	0.0724
	(1.564)	(0.0910)	(1.351)	(0.0907)
2007	2.650*	0.188**	2.692**	0.193**
	(1.475)	(0.0867)	(1.052)	(0.0868)
2008	3.228**	0.119	3.308***	0.126
	(1.507)	(0.0864)	(1.086)	(0.0864)
2009	5.631***	0.266**	5.838***	0.281***
	(1.825)	(0.106)	(1.511)	(0.107)
2010	7.085***	0.353***	7.151***	0.358***
	(1.654)	(0.0928)	(1.230)	(0.0927)
2011	7.159***	0.490***	7.278***	0.501***
	(1.575)	(0.105)	(1.314)	(0.106)
2012	8.330***	0.486***	8.445***	0.495***
	(1.559)	(0.0989)	(1.108)	(0.0992)
2013	8.500***	0.511***	8.535***	0.516***
	(1.569)	(0.0975)	(1.174)	(0.0975)
2014	9.615***	0.550***	9.799***	0.564***
	(1.490)	(0.0944)	(1.093)	(0.0944)
2015	9.160***	0.455***	9.199***	0.458***
	(1.463)	(0.0902)	(1.090)	(0.0902)
2016	12.84***	0.599***	12.89***	0.602***
	(1.436)	(0.0889)	(1.100)	(0.0891)
2017	14.83***	0.396***	15.06***	0.412***
	(1.449)	(0.0837)	(1.262)	(0.0837)
2018	16.75***	0.273***	16.94***	0.287***
	(1.436)	(0.0778)	(1.294)	(0.0779)
2019	13.46***	-0.0682	13.62***	-0.0591
	(1.401)	(0.0669)	(1.276)	(0.0669)
2020	10.36***	-0.197***	10.44***	-0.193***
	(1.466)	(0.0699)	(1.435)	(0.0703)
2021	6.712***	-0.336***	6.734***	-0.335***
	(1.460)	(0.0655)	(1.445)	(0.0654)

Notes: This table represents coefficients, standard deviation, and significance of vintage year control variables in Model 1 and 2. The significance levels are: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, and standard deviations are shown in parentheses.

APPENDIX B: Diagnostic Tests for OLS Assumptions

Table 10: Variance Inflation Factor (VIF) for Model 1.

Variable	VIF	1/VIF
2019	2.25	0.444079
2018	2.13	0.469556
2016	2.11	0.473251
2021	2.07	0.482550
2017	2.07	0.482558
2020	2.02	0.494606
2015	2.02	0.494920
2007	1.98	0.504267
2014	1.95	0.512258
2000	1.94	0.516046
2008	1.91	0.524375
2012	1.80	0.554722
2005	1.79	0.559145
2013	1.78	0.561063
2011	1.78	0.562690
2010	1.66	0.602829
1999	1.65	0.605540
2001	1.63	0.614563
Venture	1.61	0.620125
1998	1.61	0.620941
2004	1.55	0.644046
1997	1.49	0.671875
2009	1.49	0.673056
2003	1.46	0.682751
2002	1.44	0.692578
Growth	1.42	0.702348
1996	1.37	0.732062
1995	1.30	0.768991
1994	1.27	0.785506
1993	1.23	0.810438
Ln(Fund Size)	1.22	0.816644
Asia	1.22	0.818566
1992	1.20	0.834558
ar_1990	1.19	0.841646
Fund Number (Overall)	1.17	0.855974
Secondaries	1.15	0.868458
Europe	1.15	0.871499
Expansion & Late Stage	1.10	0.909148
1991	1.10	0.911429
Co-Investment	1.10	0.912055
Balanced	1.08	0.929591
Americas	1.05	0.952636
Australasia	1.04	0.960091
Africa	1.04	0.963118
Middle East & Israel	1.03	0.972298
Distressed & Turnaround	1.02	0.976451
Diversified & Multiregional	1.02	0.982572
Real Estate	1.02	0.985070
Mean VIF	**1.49**	

Notes: VIF test indicates if there is a multicollinearity between independent variables. The values above 10 indicate that the multicollinearity is present. Therefore, this test confirms that there is no multicollinearity between control variables used in Model 1.

Table 11: Variance Inflation Factor (VIF) for Model 2.

Variable	VIF	1/VIF
2019	2.25	0.443568
2018	2.13	0.469563
2016	2.11	0.473215
2017	2.07	0.482426
2021	2.07	0.482476
2020	2.02	0.493999
2015	2.02	0.494765
2007	1.98	0.504073
2014	1.95	0.512094
2000	1.94	0.515853
2008	1.91	0.524109
2012	1.80	0.554516
2005	1.79	0.558904
2013	1.78	0.560932
2011	1.78	0.562638
2010	1.66	0.602070
1999	1.65	0.605353
2001	1.63	0.614094
1998	1.61	0.620549
Venture	1.60	0.625772
2004	1.55	0.643276
1997	1.49	0.670551
size250mn - 500mn	1.49	0.672227
2009	1.49	0.672747
2003	1.47	0.682459
size500mn - 1bn	1.46	0.682919
2002	1.44	0.692473
Growth	1.43	0.700277
size100mn - 250mn	1.42	0.706421
1996	1.37	0.730475
1995	1.30	0.768222
1994	1.28	0.783716
1993	1.23	0.810393
Asia	1.22	0.817328
1992	1.20	0.832492
1990	1.19	0.840448
Fund Number (Overall)	1.17	0.852858
Europe	1.16	0.862287
Secondaries	1.15	0.868626
Expansion / Late Stage	1.11	0.904576
1991	1.10	0.910591
Co-Investment	1.10	0.911209
Balanced	1.08	0.929143
Americas	1.05	0.952923
Australasia	1.04	0.957201
Africa	1.04	0.964058
Middle East & Israel	1.03	0.968870
Distressed & Turnaround	1.02	0.976327
Diversified & Multiregional	1.02	0.982521
Real Estate	1.02	0.984893
Mean VIF	**1.50**	

Notes: VIF test indicates if there is a multicollinearity between independent variables. The values above 10 indicate that the multicollinearity is present. Therefore, this test confirms that there is no multicollinearity between control variables used in Model 2.

Table 12: Results of the White Test for Model 1 Estimated by Net IRR.

	Model 1 (Net IRR)		
Source	White Test Statistics	Degrees of Freedom	P-Value
Heteroskedasticity	826.68	543	0.0000
Skewness	233.82	48	0.0000
Kurtosis	66.90	1	0.0000
Total	1127.40	592	0.0000

Notes: Table 12 displays the results of the White Test for the Model 1 estimated with the net IRR. The White Test was performed to check whether the data exhibits heteroskedasticity, and its results showed that it does.

Table 13: Results of the White Test for Model 1 Estimated by Net Multiple.

	Model 1 (Net Multiple)		
Source	White Test Statistics	Degrees of Freedom	P-Value
Heteroskedasticity	808.35	543	0.0000
Skewness	263.82	48	0.0000
Kurtosis	68.57	1	0.0000
Total	1140.74	592	0.0000

Notes: Table 13 displays the results of the White Test for the Model 1 estimated with the net multiple. The White Test was performed to check whether the data exhibits heteroskedasticity, and its results showed that it does.

Table 14: Results of the White Test for Model 2 Estimated by Net IRR.

	Model 2 (Net IRR)		
Source	White Test Statistics	Degrees of Freedom	P-Value
Heteroskedasticity	861.37	634	0.0000
Skewness	232.18	50	0.0000
Kurtosis	65.99	1	0.0000
Total	1159.55	685	0.0000

Notes: Table 14 displays the results of the White Test for the Model 2 estimated with the net IRR. The White Test was performed to check whether the data exhibits heteroskedasticity, and its results showed that it does.

Table 15: Results of the White Test for Model 2 Estimated by Net Multiple.

	Model 2 (Net Multiple)		
Source	White Test Statistics	Degrees of Freedom	P-Value
Heteroskedasticity	837.57	634	0.0000
Skewness	253.25	50	0.0000
Kurtosis	66.48	1	0.0000
Total	1157.29	685	0.0000

Notes: Table 15 displays the results of the White Test for the Model 2 estimated with the net multiple. The White Test was run to check whether the data exhibits heteroskedasticity, and its results showed that it does.

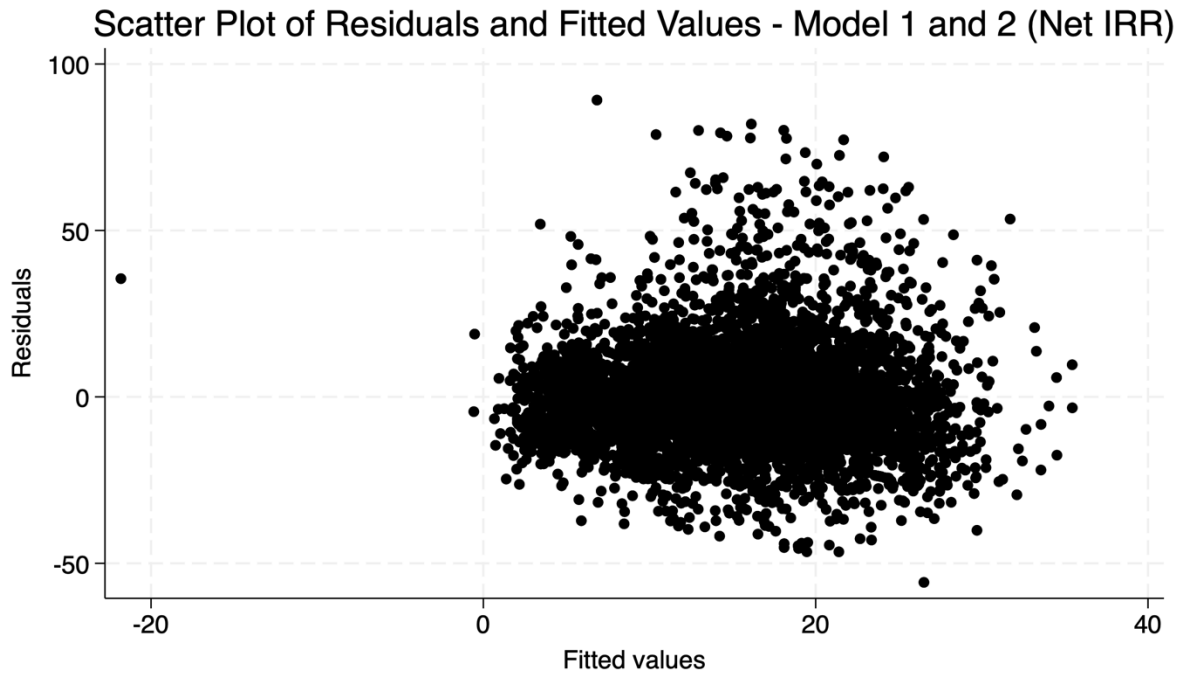

Figure 1: Scatter Plot of Residuals and Fitted Values – Model 1 and 2 Net IRR.

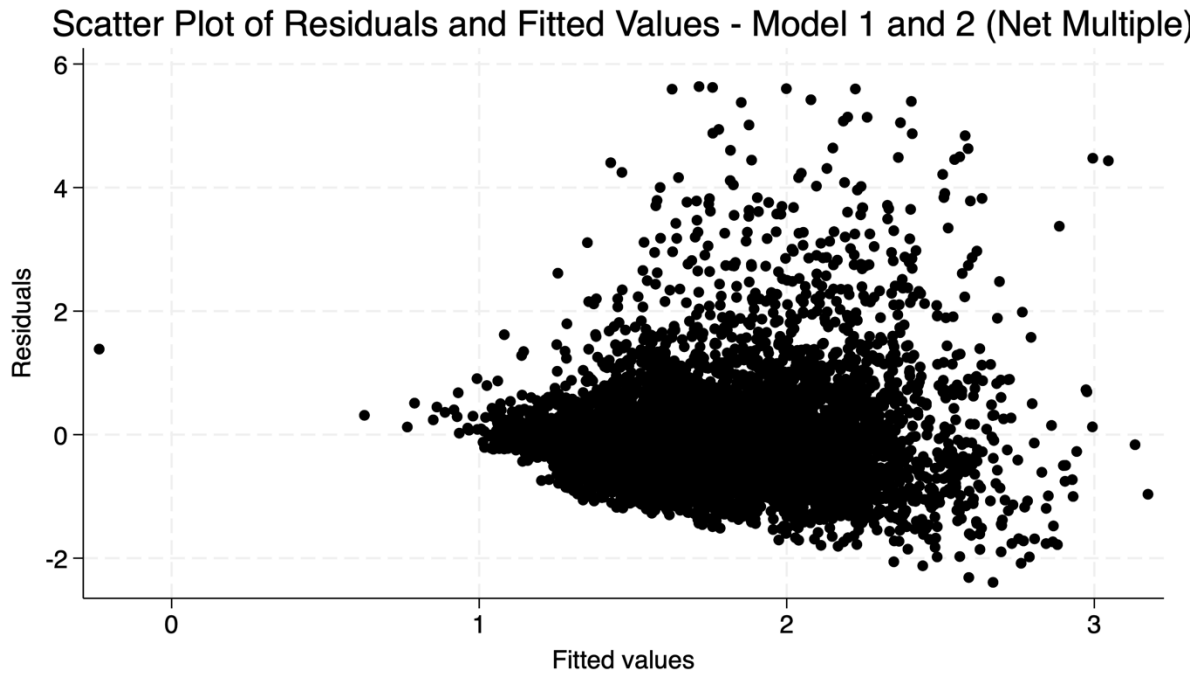

Figure 2: Scatter Plot of Residuals and Fitted Values – Model 1 and 2 Net Multiple.

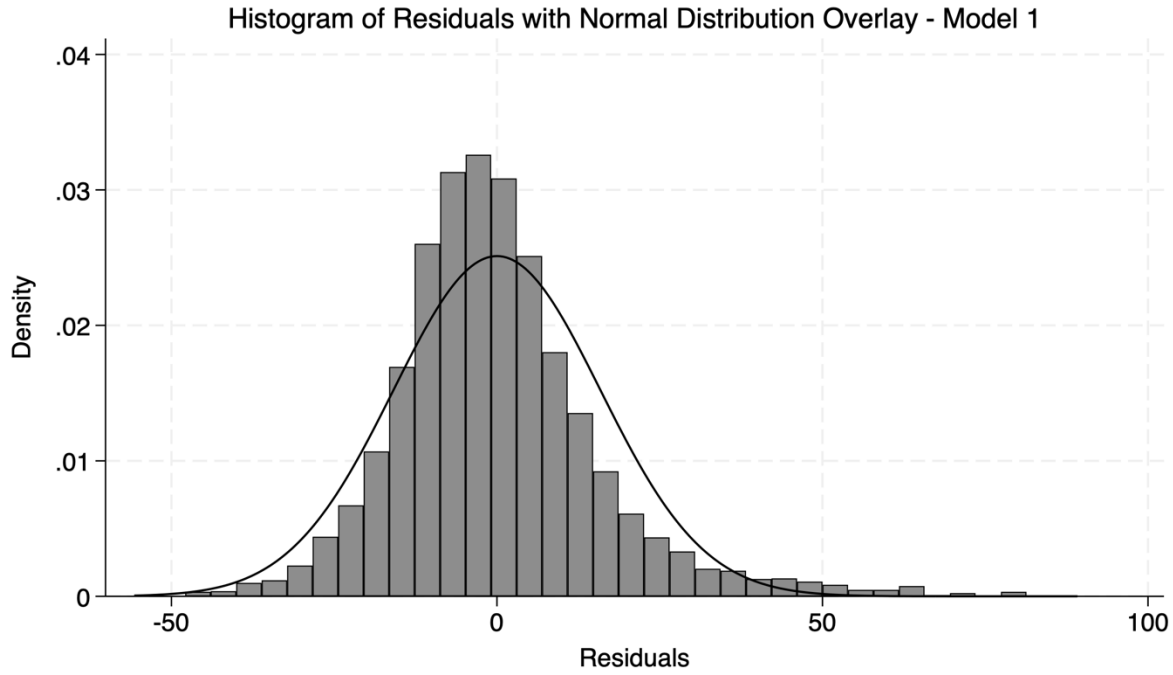

Figure 3: Histogram of Residuals with Normal Distribution Overlay – Model 1.

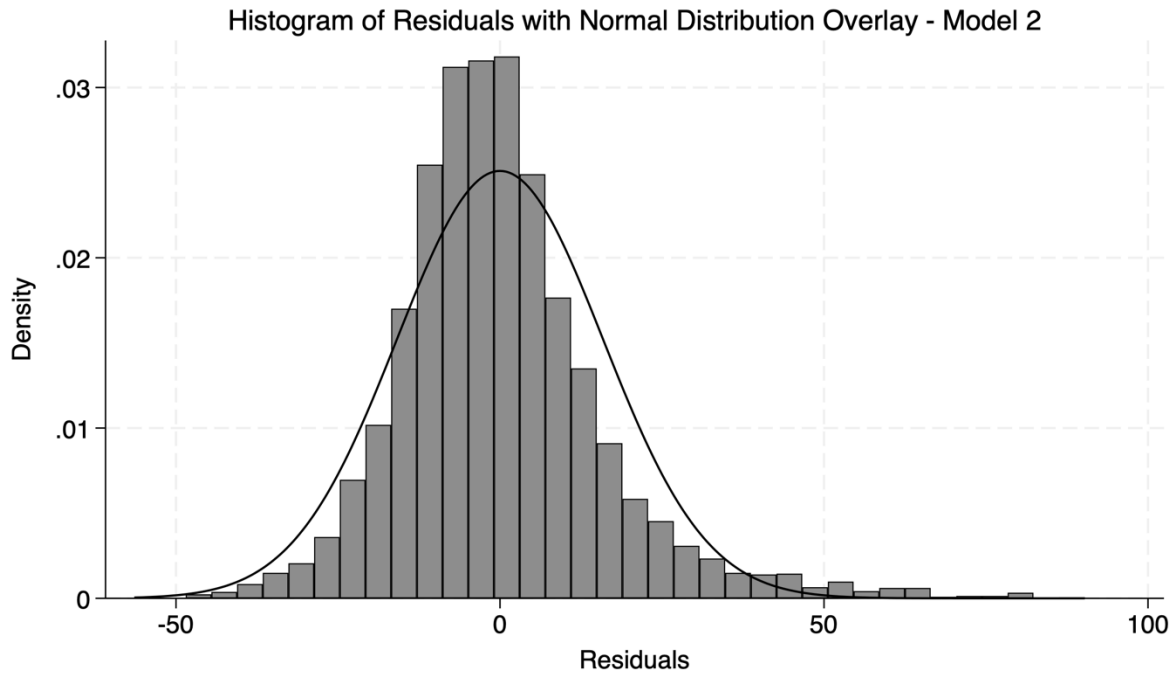

Figure 4: Histogram of Residuals with Normal Distribution Overlay – Model 2.