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Leveraged Buyouts in the Era of Quantitative Easing

An Empirical Analysis of European Private Equity Buyouts
& Unconventional Monetary Policies

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NORWEGIAN SCHOOL OF ECONOMICS

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This thesis concludes my academic pursuits and is the final effort made in the Master of Science in Economics and Business Administration at the Norwegian School of Economics. The main motivation for this thesis has been to apply the knowledge I have gained through master-level courses included in the major in Financial Economics. Furthermore, I have been able to leverage knowledge gained from my bachelor's degree where I majored in Applied Macroeconomics.

This work has allowed me to increase my knowledge of what has become my main interests during five years of studies, namely macroeconomics, monetary policies, financial markets and alternative investments. The challenge of the work has been diminished by the relevance of the topic, which I am grateful for. I believe that we are only at the beginning of what is going to be a substantial research field in the coming years.

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Abstract

Using proprietary European data on private equity (PE) buyouts, this thesis contributes to the growing research on the relationship between financial markets, investment decisions and quantitative easing. Detailed country data with yearly observations from 2007 to 2021 allow for a dynamic panel data approach when examining the impact of quantitative easing on various variables related to LBOs. The estimations find no evidence of the expected relationship between quantitative easing and private equity buyouts, the fundraising efforts of PE funds or the issuance of leveraged loans conducted to finance buyouts. Instead, there is evidence that lower long-term yields drive the expansion of the leveraged loan market. The results of this thesis suggest that buyout funds may have exploited a relative discount in the leveraged loans market. However, there is nothing to suggest that this discount was driven by quantitative easing.

1 Introduction

Quantitative easing is an alternative monetary policy, first implemented by Western central banks in the aftermath of the great financial crisis (Fawley & Neely, 2013). The known implications of the policy have been increased asset prices and lower yields (Albertazzi et al., 2021). There has been published a substantial amount of research on the relationship between quantitative easing and publicly traded financial assets such as stocks, bonds, and commodities[1]. However, research on the relationship between quantitative easing and alternative assets is much less covered. This paper is the first to empirically analyze the impact of quantitative easing on private equity buyouts. The central hypothesis is that increased liquidity and easier financial conditions caused by quantitative easing have led to more frequent and higher volumes of private equity buyouts. To test this hypothesis, a unique panel dataset has been constructed. The underlying data includes yearly observations on buyout investments from 2007-2021 for 23 European countries. In this paper, quantitative easing is specified as a binary variable. To capture the effect of this variable, a modern econometric technique for GMM estimations with time-invariant variables is applied. Conclusively, there is no evidence of a relationship between quantitative easing and leveraged buyouts. A negative relationship between long-term government bond yields and the issuance of leveraged loans is discovered. The results of this thesis may indicate that buyout funds have exploited a relative discount in the market for leveraged loans. However, there is nothing to suggest that this discount was driven by quantitative easing.

In most developed economies, the central banks are responsible for conducting monetary policy. The overall goal is to achieve price stability through low and stable inflation rates. This is achieved mainly by adjusting short-term nominal interest rates to affect the economic condition (IMF, 2023). Short-term nominal interest rates would be set higher in times of necessary economic constriction and lower in times of necessary economic expansion. The theory of the zero lower bound of interest rates (ZLB) suggests that policy rates cannot be set below zero because market participants would hoard cash instead of continue spending (Altavilla et al., 2019). Thus, the desired expansionary effects would

[1]Examples of research in the cross between quantitative easing and financial markets: Bernardo et al. (2013) look into the real economic effects, Lima et al. (2016) look into the stock market effects, and Amatov & Dorfman (2017) look into the relationship between quantitative easing and commodity prices.

not occur. In ZLB situations where central bankers have seen a demand for further economic stimulus, alternative monetary policies such as quantitative easing (QE) have been implemented. QE broadly involves large-scale central bank asset purchases from the private sector, conducted with central bank-created money (Fawley & Neely, 2013). The purchased assets have mainly been government bonds[2]. According to Fawley & Neely (2013), quantitative easing is designed to stimulate the economy indirectly through several transmission channels. *The price channel* is expected to impact the economy because the large-scale asset purchases of the central banks increase the demand for financial assets, leading to a relative price increase of these assets. Sellers can claim a demand premium on assets, which is by definition a wealth transfer from the central bank to the private sector (Fawley & Neely, 2013). *The portfolio rebalancing channel* has historically been considered to be the most important transmission channel (Joyce et al., 2010). The channel is broadly based on the notion of imperfect substitutability between assets (Albertazzi et al., 2021). Because the central banks' asset acquisition programs have been concentrated around bonds, the prices of these securities increase, and their expected return decrease. The sellers of these assets are left with cash. Since neither cash nor re-investments in the market for government bonds can match the characteristics of the previous investments, investors reallocate to other asset classes. Following the reasoning behind the price channel, investors may have realized their previous positions at a relative premium. Considering both increased relative wealth and demand for other assets, the portfolio rebalancing channel is expected to impact the economy through a combination of a relative increase in investor wealth and demand for other asset classes. Since the holders and subsequent sellers of government securities are mainly institutional investors, the wealth transfer does not necessarily reach the real economy. However, because of the portfolio rebalancing, it is expected that institutional investors will increasingly bid up assets in markets with a higher concentration of retail investors and private economy-aligned investors (Christensen & Krogstrup, 2018). *The signalling channel* induces market participants to increase investment activity. Because the central bank mainly purchases long-dated government bonds, it is expected that the right end of the yield curve flattens. Following traditional theories of the yield curve, it is expected that market participants

[2]Quantitative easing was to some extent used to relieve the private sector of toxic assets during the GFC. Thus, the central banks did not only acquire government bonds. According to Fawley & Neely (2013, p. 77), the following assets were purchased: GSE agency debt, MBS, treasuries and government bonds, corporate bonds, ETFs, and REITs.

interpret the development as a relative discounting of future interest rates. Since financing projects is expected to be cheaper in the long run, market participants are induced to invest, which leads to increased economic activity in the end. Christensen & Rudebusch (2012) show that 10-year government bond yields in the US and UK had a negative effect of between 50 and 100 basis points upon the first announcements of quantitative easing. Furthermore, they find that this effect is caused by a combination of reduced term premiums and lower forward guidance, where the weights are based on the central bank's willingness to communicate future expectations.

As shown above, the research on quantitative easing and its transmission to the economy is substantial. The research on quantitative easing and financial markets is mainly conducted by producing VAR frameworks to observe the shock and immediate changes in prices or yields. The question in this thesis is whether the policy also led to an impact on non-publicly traded illiquid asset classes such as private equity.

Private equity buyouts are often referred to as leveraged buyouts (LBOs) and are defined as an investment where a company is acquired by a private equity (PE) firm (Kaplan & Strömberg, 2009). The PE firm uses a small portion of equity and finances the remaining purchase price with debt. Brown et al. (2021) show that the majority of LBOs since 2015 have been financed with a debt-to-value ratio between 40 and 60% for all industries. LBOs tend to have higher leverage when the debt market is liquid, and the credit spreads are low (De Maeseneire & Brinkhuis, 2012). The majority of leveraged buyouts are financed with bank debt, often referred to as leveraged loans. Leveraged loans are loans with non-investment grade ratings, often characterized by a senior position in the capital structure. They are commonly syndicated by multiple banks and subsequently sold in the leveraged loans market (Brown et al., 2021). The prominent investors in the leveraged loans market are institutional investors and CLO funds (ESMA, 2019). According to Axelson et al. (2013), market conditions are essential determinants of leverage in buyouts. Moreover, more investments are being conducted during LBO booms, both of good and bad quality (Axelson, Strömberg & Weisbach, 2009). Since market conditions are fundamentally changing under quantitative easing, it is relevant to explore if these changes can be traced in the market for leveraged buyouts. This thesis attempts to answer that question by exploring a unique dataset with yearly observations on buyout investments and fundraising from 2007 to 2021, covering 23 European countries. In addition to the central hypothesis of a direct impact of quantitative easing on buyouts, two indirect hypotheses have been constructed. The empirical analysis is conducted by employing a select panel data method for dynamic panels. The need for a dynamic panel estimation methodology is due to the expectation that previous realizations of the dependent variable impact the current estimate. Since fixed effects estimations are inconsistent in dynamic finite samples, a GMM estimation technique is applied (Han & Phillips, 2010). Furthermore, quantitative easing has been specified as a binary variable, taking the value of 1 if the policy was active in the given country at the selected time, and 0 if not. Common GMM estimation techniques rely on first-difference transformations to eliminate fixed effects, which means that time-invariant variables will be eliminated. The sequential GMM technique for time-invariant regressors, suggested by Kripfganz & Schwarz (2015), solves this problem and is therefore applied in this thesis. The results from this thesis are relevant as the macroeconomic climate is changing, going from a low-interest rate climate with active quantitative easing measures, to an economic climate where interest rates are rising and quantitative easing in some economies is becoming reversed[3].

The rest of the thesis is organized as follows. Section 2 discusses private equity cyclicality, and presents the identified hypotheses. Section 3 presents the underlying data and descriptive statistics. Section 4 provides more details on the empirical methodology and presents the empirical results. Section 5 concludes. Finally, references are made throughout the thesis to the appendix, where several figures and tables are presented.

[3]A reversion of quantitative easing is referred to as quantitative tightening (QT). This process involves central bank balance sheet decreases through letting their bond holdings mature, and in some instances selling bond holdings to the private sector (UBS, 2019).

2 Empirical Hypotheses

2.1 Private Equity Cycles and Quantitative Easing

Private equity commitments and transactions are cyclical, and according to Kaplan & Strömberg (2009), the cyclicality is driven by the state of the credit market. The percentage of leverage in a buyout capital structure depends on the credit market conditions. The amount of leverage in an LBO has an inverse relationship with interest rates. Furthermore, Axelson et al. (2009) confirm that easier credit conditions will lead to private equity firms paying more for their investments. Ljungqvist et al. (2007) provide conclusive evidence that the pace of private equity investments is increased when interest rates are relatively low. Based on the above sources, it is reasonable to conclude that the private equity landscape is closely linked to the broader economy. As quantitative easing by design only is supposed to be applied in ultra-low interest rate environments (ZLB situations), a major challenge for research on the implications of the policy is isolating its effects. Most likely, the economic effect of monetary stimulus will be caused by a combination of conventional and unconventional methods. Considering the findings of Kaplan & Strömberg (2009), it should be expected that private equity activity already is benefiting from the ZLB situation. The key question becomes whether the application of quantitative easing has provided an additional activity boost, and if this is possible to document empirically.

As discussed in the introduction, quantitative easing is designed to have an indirect economic effect through several transmission channels. To design hypotheses of impact from quantitative easing, it is thus necessary to explore how the different channels could affect private equity.

2.2 Hypothesis 1: Credit Impact

The credit impact hypothesis is based on the conclusions made by Ayroubi et al. (2020). They conclude that the growth in the leveraged loan market is due to quantitative easing and that this is direct evidence of quantitative easing's impact on private equity buyouts. The paper is not based on empirical research but rather on verbal argumentation. However, I argue that the link is worth exploring empirically. Pedraz (2019) conclude that the growth in the leveraged loan market is due to the low-interest rate environment in the last decade. Laber & Yozzo (2017) claim that financial sponsors have been the drivers behind the growth in the leveraged loan market. Based on these observations, it would seem that the growth in the leveraged loan market falls in line with the findings of Kaplan & Strömberg (2009), namely of private equity cyclicality and increased use of debt in LBOs during low-interest periods. If this indeed is the case, the conclusions of Ayroubi et al. (2020) must be considered wrong. However, this argumentation fails to employ the indirect identified effects of quantitative easing. As discussed in the introduction, there are numerous indirect transmission channels of quantitative easing. Several of the identified channels can have impacted the market for leveraged loans. The interpretation of QE signalling that monetary policy will remain loose for the foreseeable future, in combination with the increased wealth of investors and a growing demand for portfolio rebalancing may have caused investors to make long-term commitments to the leveraged loans market. If financial sponsors and intermediaries have made the observations that syndicated loans are easier to sell due to increased investor demand, these effects may have worked together to create market growth.

Since traditional credit markets fundamentally change upon the impact of quantitative easing, it is relevant to explore if also the market for leveraged loans was impacted by this change. Furthermore, since it has been concluded that the benefactor of the majority of leveraged loans is financial sponsors and portfolio companies, it is reasonable to conclude that if quantitative easing impacted the market for leveraged loans, the policy has also impacted private equity.

H_{Credit}: *Quantitative easing is a driver of the leveraged loans market. Growth in the leveraged loans market leads to an increase in the number and value of LBOs.*

2.3 Hypothesis 2: Portfolio Rebalancing

The second hypothesis is based on one of the most researched transmission channels of quantitative easing, namely the *portfolio rebalancing channel*. This transmission channel relies on the notion of imperfect substitutability between cash and government bonds (Albertazzi et al., 2021). The central bank acquires government bonds from the private sector, which increases the monetary basis and increases deposits in commercial banks.

This process represents a liquidity transfer from the central bank to the private sector. Because bank deposits cannot match the risk-return profile of investments in government bonds, the sellers of these bonds seek other investment opportunities. Quantitative easing leads to substantial central bank demand in the market for government bonds, which makes the market less attractive when the sellers of government bonds are looking to reinvest their free capital. The less attractive characteristics are for instance increased volatility, higher prices and lower yield. This induces the investors to allocate their portfolios to other assets (Bauer & Rudebusch, 2013). According to Jakl (2019), institutional investors have mainly switched out investments in government bonds for investments in corporate bonds and public equities. Particularly the switch from government bonds to public equities becomes interesting in the light of this thesis[4]. The switch of asset classes may be considered strange given the strict investment mandates which govern asset allocations of institutional fund managers. However, one possible reason for the observation could be related to yield requirements by investors operating under less strict mandates. The signalling effect of quantitative easing is that the central banks will support the persistence of an ultra-low interest rate environment, and this might be a fueling factor of portfolio rebalancing to other higher-yielding asset classes. Nevertheless, since it is evident that public equities saw an increased demand upon quantitative easing, it is also possible to imagine a similar development in private equity. Several points speak to this argument: First, there has been substantial growth in private equity dry powder over the last decade. The term dry powder refers to committed, but unallocated capital in the individual private equity firm (PitchBook, 2022). In 2021, dry powder accounted for 28.3% of assets under management in global private equity (Thomas, 2022). The second apparent development is the QE-led increase in money supply (M2) the last decade[5]. An increase in broad money should be viewed as relevant in the investment landscape. The correlation between increased dry powder and increased broad money with the development of private equity fundraising is highly apparent when assessed graphically[6]. If quantitative easing indeed has led to additional fundraising activity by private equity firms, it would be reasonable to conclude that quantitative easing has impacted private equity extraordinarily, as opposed

[4]See Shah (2018) for another source on portfolio rebalancing to public equities.

[5]See for instance Butt et al. (2012 for an explanation on how quantitative easing creates broad money.

[6]See Appendix A2.3 and A2.4 for graphical representations of private equity fundraising in the Eurozone together with the developments in global private equity dry powder and eurozone money supply (M2)

to traditional cycles of private equity. Furthermore, it should be expected that increased fundraising should lead to increased private equity investments, as the fund must generate returns for its investors.

$H_{Portfolio}$: *Portfolio rebalancing increases the value of fundraising for private equity buyout funds. Increased PE fundraising in turn leads to a higher value and number of LBOs.*

3 Data & Descriptive Statistics

3.1 Data

The purpose of this section is to describe further the content of the uniquely constructed dataset used in this thesis. First, the data sources will be presented. Secondly, table 3.1 formalizes and describes all variables included in the empirical research. Thirdly, figure 3.1, 3.2 and 3.3 presents the graphical relationship between the dependent variables of the three different models together with the main independent variable.

Aggregated data on European private equity has been a crucial part of the thesis. This has been provided by Invest Europe[7]. The research department of Invest Europe produces yearly activity reports on the European private equity landscape. Furthermore, they report country statistics for several European countries. The underlying data material of the activity reports includes a broad range of potential data inputs. For constructing the unique dataset, three main variables have been extracted: The nominal value of buyouts, the number of buyouts, and the nominal value of fundraising for buyouts. These variables are reported yearly from 2007 to 2021 for 23 European countries. The majority of these economies are governed by the European Central Bank, while some countries are under the jurisdiction of smaller independent central banks[8].

The primary independent variable, *QE Dummy*, is designed to capture the impact of quantitative easing. The variable has been specified as a binary variable taking the value of one if the policy was active in the selected country in a given year and zero if not. Whether the policy was active or not has been significantly documented through the relevant central bank web pages[9]. The policy activation has also been highly documented in news and research and can be confirmed through these sources. In addition, the American think tank and research agency Atlantic Council (2022) monitor a useful quantitative easing tracker which offers information on the global presence of QE. The tracker can work as

[7]Invest Europe is one of the most significant associations of private capital providers in the world. They represent investors and funds at all private equity stages (Invest Europe, 2022c). The research department of Invest Europe has been a trusted source of private equity research since 1984 (Invest Europe, 2022b).

[8]An overview of the included countries, their central banks, and their currencies is presented in Appendix A1.1.

[9]See Bank of England (2022) and the European Central Bank (2022).

an information reference for the policy globally[10]. The application of quantitative easing as a single dummy variable can be considered a simplification of reality. As discussed in the introduction of this thesis, quantitative easing is designed to impact the economy through several transmission channels. Many of these channels are difficult to include in this research. Furthermore, it becomes difficult to isolate the country-specific effect of quantitative easing as the policy is expected to have international spillover effects (Fratzscher et al., 2013). However, since the timeline of the application of quantitative easing varies between the underlying countries, it is expected that a single dummy will be able to capture any additional impact from the presence of the policy.

Invest Europe has defined the variables in a particular manner: Buyout investments are gathered throughout the year, and the country of investment is based on where the portfolio company is registered. The number of buyouts is defined in the same manner. Buyout fundraising is defined as the nominal value of funds raised at the end of the year and is based on the location of the fundraising team and, by extension, the location of the private equity fund.

The remaining variables have been retrieved from Refinitiv Eikon and Tradingview[11]. Refinitiv Eikon has been used to collect data on leveraged loan issuance. The value of nominal issuance is specified by taking the sum of the yearly issuance denominated in a given country[12]. Table 3.1 presents and describes the included variables in the thesis.

[10]Please see Appendix A2.1 for a graphical representation of the included countries and a timeline for their quantitative easing activation.

[11]Refinitiv Eikon is a financial interface providing access to industry-leading data based on 150,000 data sources (Refinitiv, 2022). Tradingview is an online charting platform providing data on all ranges of financial and economic figures (Tradingview, 2022))

[12]Refinitiv Eikon includes all subcategories of leveraged loans. The subcategories are Borrower Base, Covenant Lite, Green Loan, Highly Leveraged, Hybrid, Institutional, Investment Grade, LBO, Leveraged, M&A, Non-Investment Grade, PIK, Project Finance, Sponsored, Sustainability Linked Loans, Sustainability Finance Loans, and Unitranche.

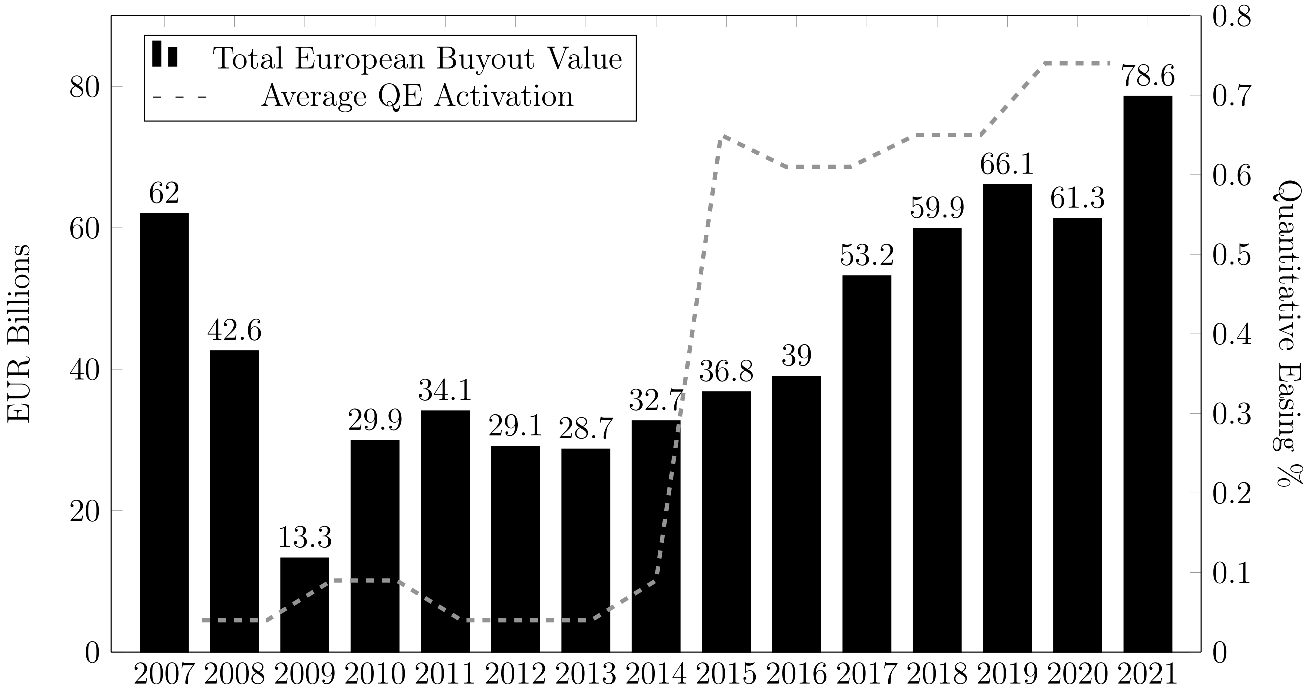
Table 3.1: Included Variables & Descriptions

Variable	Description
Dependent Variables:	
ln Buyout Investments*	Private Equity Buyout Investments measured yearly and nominally. Grouped by the domicile of the company invested in. If a UK-based PE fund invests in a Spanish firm, the investment is counted as a Spanish investment.
ln Buyout Fundraising	Private Equity Buyout Fundraising measured yearly and nominally. Fundraising is summed at the end of the year and reported for the domicile of the private equity fund. If the PE fund is located in the UK, fundraising will be reported as from the UK.
ln Leveraged Loan Issuance	Yearly Sum of Leveraged Loan Issuance's, measured nominally. All subcategories of leveraged loans are included. The leveraged loan issuance is connected to a country by the domicile of the issuer.
Independent Variables:	
QE Dummy*	Quantitative Easing Dummy, 1 if the selected country was impacted by an active QE policy, and 0 if not.
Buyouts (Number)	Number of Private Equity Buyout Investments. Measured by domicile of portfolio company investment, in the same manner as the Buyout Investment variable.
Economic Control Variables:	
Real Rate	Average Yearly Policy Rate Less Average Yearly Inflation. Central bank policy rates and country-specific inflation.
10-Year Government Bond Yield	Average Yearly 10-Year Government Bond Yield
GDP Growth	Average Yearly GDP Growth

This table presents the variables included in the empirical estimations, which will be presented in the empirical analysis. All nominal values are denominated in EUR. *ln* indicates that the variable has been logged-transformed. The log transformations are made to account for the skew in the larger variables as opposed to the dummy and control variables. Only one of the dependent variables is used at one time, however, three models are presented. The remaining dependent variables act as independent when they are not active. *-sign indicate that the variable is the main dependent or independent variable in all estimations.

There is merit in graphically assessing the main variables of the underlying sample. The first variable to present is the development in the aggregated value of buyouts. Since the overall hypothesis is that quantitative easing has impacted the variable, the average QE activation for the entire country sample is also graphed in the figure.

Figure 3.1: Total Buyout Investments & Average Activation of Quantitative Easing. Source: Refinitiv (Refinitiv, 2022), Invest Europe (Invest Europe, 2022a) and own calculations.

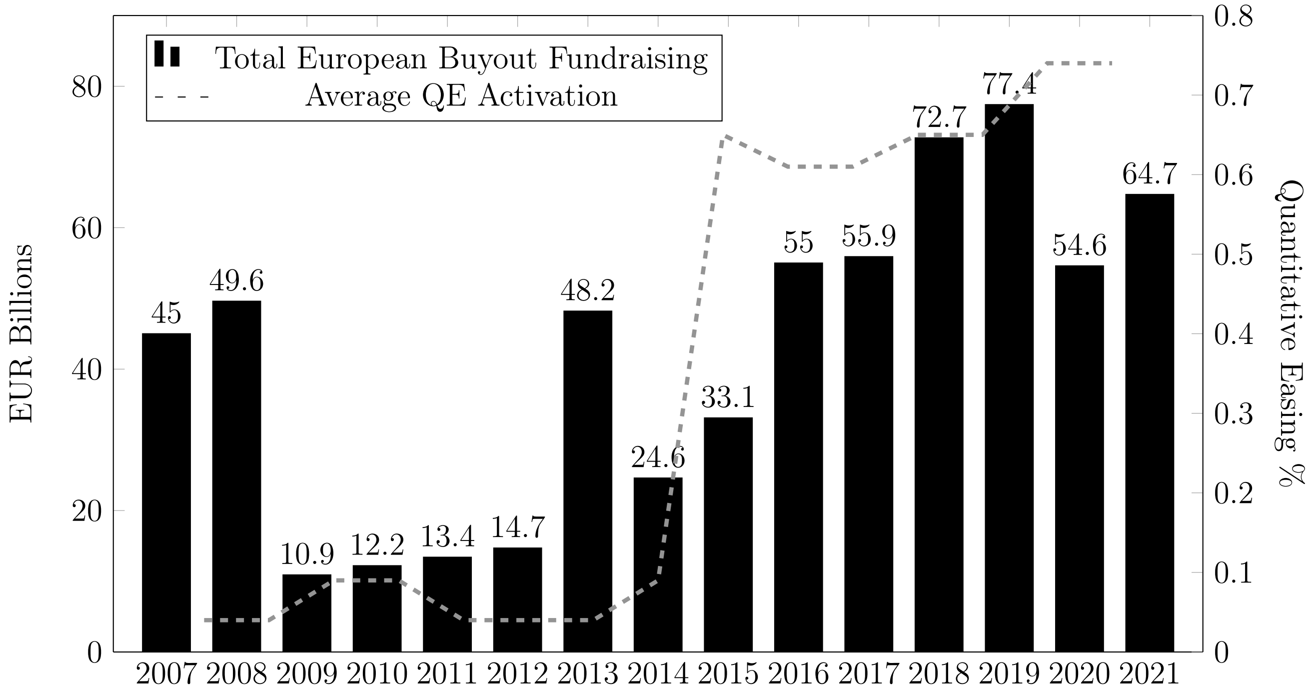


The figure shows two y-axes where the first presents the yearly sum of buyout investments domiciled in one of the countries presented in table A1.1. The value of buyouts is denominated in EUR billions. The second y-axis presents the average yearly level of quantitative easing activation. Since the variable is a dummy variable taking the value of 0 if the policy is inactive and 1 otherwise, the average across the countries creates a figure between 0 and 1. In 2021 over 70% of the 23 countries had quantitative easing.

The figure shows that the aggregated value of buyouts stayed relatively flat after what can seem like higher values before the financial crisis of 2008. The growth started again in 2013, and since then, the change has been evident. The correlation between the aggregated value of buyouts and the increased activation of quantitative easing can be observed graphically.

The second figure to assess is similar to the first, only now the aggregated value of buyouts is swapped for the aggregated value of fundraising. This is relevant to assess, as the fundraising variable is instrumental in depicting the portfolio rebalancing hypothesis.

Figure 3.2: Total Fundraising & Average Activation of Quantitative Easing. Source: Refinitiv (Refinitiv, 2022), Invest Europe (Invest Europe, 2022a) and own calculations.

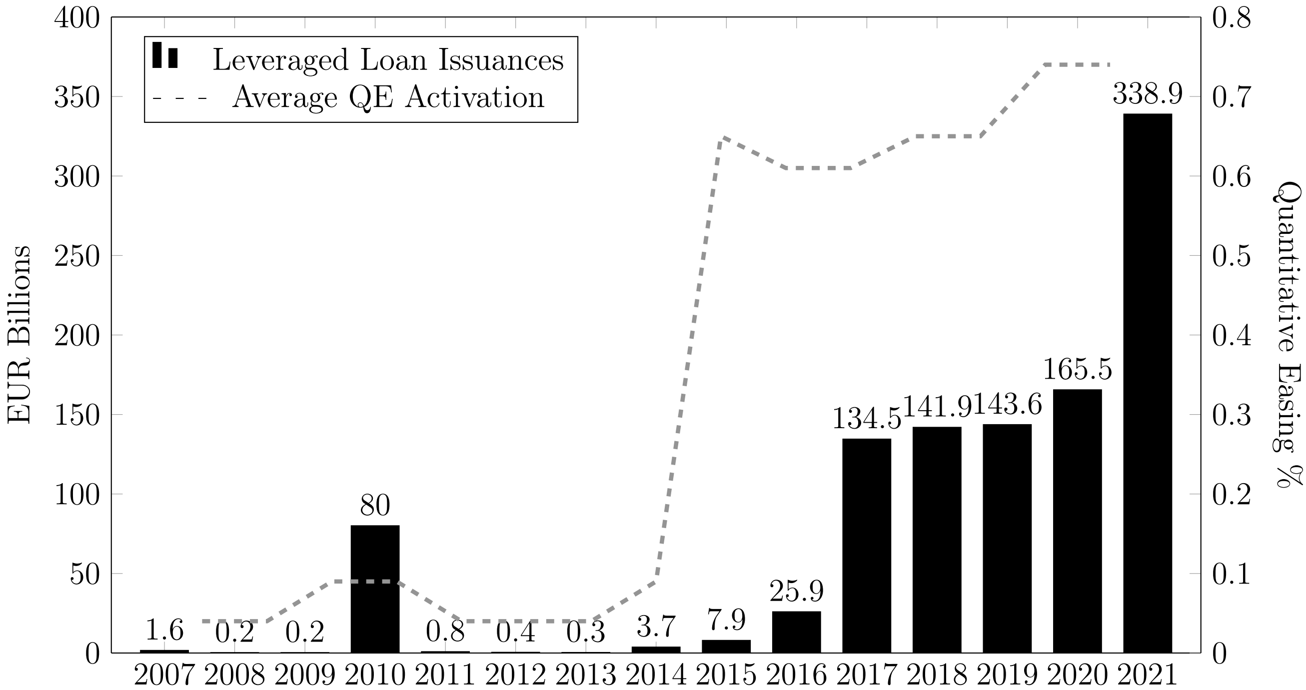


The figure shows two y-axes where the first presents the yearly sum of fundraising domiciled in one of the countries presented in table A1.1. The value of buyouts is denominated in EUR billions. The second y-axis presents the average yearly level of quantitative easing activation. Since the variable is a dummy variable taking the value of 0 if the policy is inactive and 1 otherwise, the average across the countries creates a figure between 0 and 1. In 2021 over 70% of the 23 countries had quantitative easing.

Unlike the aggregated value of investments, fundraising seems to have a more staggered development. However, fundraising levels after the financial crisis remained low until 2012. From 2013 the aggregated value of fundraising grew with the activation percentage of quantitative easing. The correlation between the two variables does not seem as strong as in the previous figure.

The third figure to graphically assess is again a replica of the two previous figures, only that the aggregated yearly sum of leveraged loan issuance is presented. This is also instrumental as it depicts the credit impact hypothesis.

Figure 3.3: Total Leveraged Loans Issuance's & Average Activation of Quantitative Easing. Source: Refinitiv (Refinitiv, 2022) and own calculations.



The figure shows two y-axes where the first presents the yearly sum of leveraged loan issuance domiciled in one of the countries presented in table A1.1. The value of issues is denominated in EUR billions. The second y-axis presents the average yearly level of quantitative easing activation. Since the variable is a dummy variable taking the value of 0 if the policy is inactive and 1 otherwise, the average across the countries creates a figure between 0 and 1. In 2021 over 70% of the 23 countries had quantitative easing.

The figure clearly shows that leveraged loans generally were unusual before 2015-2016. After this, the market grew significantly following the increased activation of quantitative easing. There can be numerous reasons for the rapid growth, but the correlation between the two variables is evident.

Several economic variables have been included to control for general economic activity and its impacts on private equity. The first variable is the real rate, calculated by taking the year's average policy rate less the year's average inflation. This variable accounts for the left side of the yield curve. The second variable is the 10-year government bond yield, which also has been computed as the year average. This variable accounts for the right side of the yield curve. In addition, the variable is relevant in periods of quantitative easing, as one of the policy's main objectives is to push down long-term yields (Gagnon, 2016). The third variable is GDP growth, which as the variables above, have been specified as the average of the year.

A desired ability of the empirical research would be to control inflation in corporate assets.

A proxy for this development could be the development in deal multiples. Preqin (2022) has been a source of average EV/EBITDA entry multiples from 2007-2021. The problem with this data is that it is not country-specific but an average of deal valuations in Europe. Since the generalized method of moments estimation technique omits variables lacking cross-sectional variation, these multiples could not be included in the estimations. Another variable with the same issue is the global private equity dry powder level. However, the developments can be assessed graphically. The tables are presented in Appendix A2.2 and A2.3, respectively.

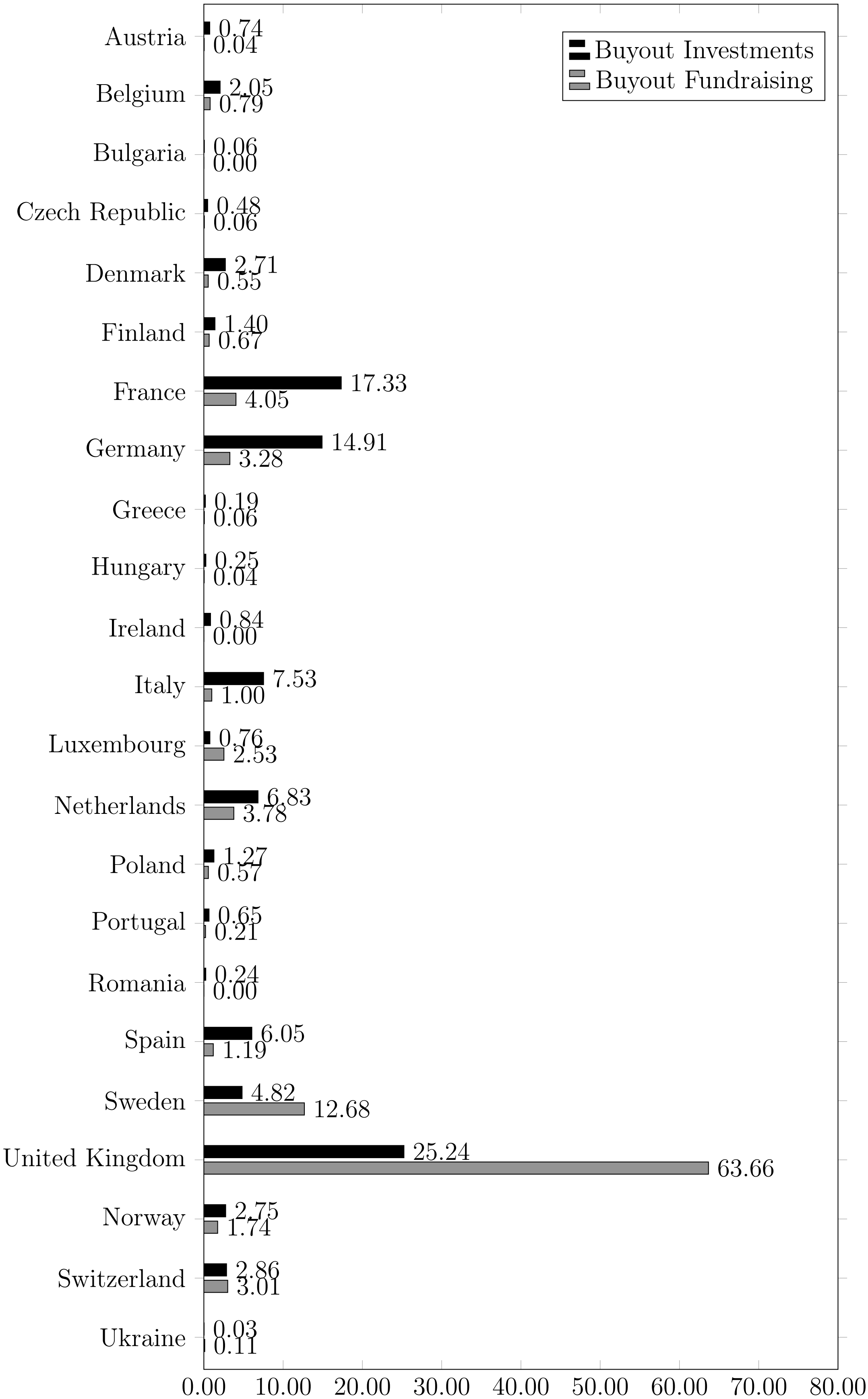
3.2 Descriptive Statistics

The purpose of this section is to present descriptive statistics for the unique dataset which has been constructed. Comments made below refer to insights gathered from Table 3.2, which presents the summary statistics. Furthermore, figure 3.4 includes a graphical representation of the country distribution of buyout investments and fundraising. The correlation matrix is presented in Appendix A1.2.

The whole underlying sample consists of 16850 buyouts from 2007 to 2021 for the 23 countries. Buyouts, fundraising, and leveraged loan issuance are all denominated in EUR billions. The dataset includes 345 observations for all variables except the 10-year government bond yield variable. This is because neither Luxembourg nor Ukraine issues 10-Year Government Bonds.

The median sum of buyout investments yearly across the included countries is approximately EUR 610 million. However, clear outliers can be identified by looking at the maximum value of investments. In this case, buyouts of almost EUR 22 billion were domiciled in one country in a year. The fundraising amount is significantly below the median investment of EUR 90 million. This is most likely because fundraising efforts often are concentrated in some countries. Furthermore, private equity funds are often concentrated in the exact locations, such as the United Kingdom or France. This theory is supported by the maximum fundraising observation in the sample of approximately EUR 59 billion. The country distribution of the aggregated value of buyouts and fundraising is shown in Figure 3.4 below, which highlights the point of country concentration.

Figure 3.4: Country Distribution of Total Buyout Investments & Fundraising %. Source: (Invest Europe, 2022c).



This figure shows the country distribution of buyout fundraising and buyout investments in percentage of the total in the sample. These variables have been defined in Table A1.3. To provide an example of the explanatory power of the figure: Approx. 25% of buyout investments are in companies domiciled in the UK. Approx. 64% of fundraising is taking place for funds domiciled in the UK.

Continuing referring to Table 3.2, the median value of leveraged loan issuance was zero. This is because the market did not start expanding until 2015. Each country's average nominal annual issuance size is approximately EUR 3 billion. The same logic as in the fundraising series applies here; the European capital markets are concentrated. An average issuance value of EUR 93 billion one year is an example. This issuance was domiciled in the United Kingdom, which is why the average value is upward biased. The dummy variable for quantitative easing has a mean value of 0.34, indicating that the quantitative easing policy was active in 34% of the observations. Since the majority of the underlying member countries are subject to the policies of the European Central Bank, they will be affected by quantitative easing[13]. The European Central Bank did not implement quantitative easing before 2015. Since the timeline of this data begins in 2007, there will be several years before the majority of the included countries experience quantitative easing. 34% can therefore be viewed as a reasonable estimate.

The real rate shows a mean and median value of approximately negative 60 basis points. This means that the average country has had inflation higher than the policy rates throughout the panel. The maximum value is around 9%, indicating some outliers in the sample. This is consistent with the 10-year government bond yield, which shows a maximum value of almost 24%. This variable's average and median figures are 2-3%, which seems reasonable. Mean and median GDP growth values are small, approximately 0.4%.

[13]Please see Appendix A2.1 for a graphical representation of country-specific QE implementation

Table 3.2: Summary statistics

	Sum	Mean	St. Dev	Min	Median	Max	N
Country (N)	-	-	-	1	-	23	345
Year (T)	-	2014	-	2007	2014	2021	345
Explanatory Variables:							
Investments (€ Bn)	667	1.93	3.22	0.00	0.61	21.71	345
Fundraising (€ Bn)	632	1.83	6.51	0.00	0.09	59.45	345
Buyouts (Number)	16,850	48.84	78.46	0.00	21.00	419.00	345
QE Dummy	118	0.34	0.48	0.00	0.00	1.00	345
Leveraged Loans Issuance (€ Bn)	1,045	3.03	9.77	0.00	0.00	93.41	345
Control Variables:							
Real Rate (%)	-196	-0.57	2.34	-23.62	-0.63	8.87	345
10Y GB Yield (%)	914	2.90	2.79	-0.59	2.43	23.64	315
GDP Growth (%)	122	0.35	1.56	-15.14	0.42	8.22	345

This table presents summary statistics for the variables included in the empirical regressions. All values are in levels. For the variable *Country*, Sum, Mean, St. Dev, and Median have been removed as these values have no explanatory power. For the variable *Year*, Sum and St.Dev have been removed for the same reasoning as above.

4 Empirical Methodology & Analysis

The purpose of this section is to present the empirical evidence related to the hypotheses defined earlier in the thesis. Three models will be presented. The first model attempts to measure the independent variables' impact on the value of buyout investments. The second model attempts to measure the impact of the independent variables on the value of buyout fundraising and the third model attempts to measure the impact of the independent variables on the value of leveraged loan issuance. The models will be tested by applying a sequential GMM estimation procedure. The methodology will be explained in further detail in Chapter 4.1, and the empirical analysis will be presented in Chapter 4.2.

4.1 Methodology

The empirical methodology is chosen based on the underlying structure of the data and the specified models. Since the previous observation of the dependent variable is hypothesized to be a predictor of the current dependent variable, lagged dependent variables are included in the models as explanatory variables. Standard estimation techniques for panel data, such as pooled ordinary least squares, fixed effects, and random effects, are inconsistent when the model is dynamic[14]. This is because of the correlation between the unobserved effects, the lagged dependent variable, and the disturbance terms (Harris et al., 2008). According to Anderson and Hsiao (1981), estimating dynamic panel data models with the standard methods discussed above would lead to biased estimators. For instance, applying OLS to a dynamic panel would give rise to the dynamic panel bias described by Nickell (1981). Since many research questions require dynamic panels, other econometric methods have been developed.

4.1.1 Generalized Method of Moments

The generalized method of moments (GMM) approach is a common methodology for dynamic panels. GMM is an econometric method for constructing estimators, and according to Kripfganz (2019), GMM is the predominant estimation technique for panel data models with lagged dependent variables. The methodology relies on assumptions

[14]Please see chapter 8.3 in Harris et al. (2008) for a complete derivation of the inconsistency of traditional estimators when the panel is dynamic.

called moment conditions. GMM estimation uses assumptions about specific moments of the random variables instead of assumptions about the entire distribution (Drukker, 2015).

There are different ways to apply GMM practically. Two of the most common GMM techniques are difference GMM and system GMM. Both are designed for dynamic panels with 1) a small time-series dimension and a large cross-sectional dimension, 2) a linear functional relationship, 3) one dependent variable that is dynamic and dependent on its past realizations, 4) independent variables that are not strictly exogenous, 5) fixed individual effects, and 6) heteroskedasticity and autocorrelation within individuals but not across them (Roodman, 2009). Difference GMM was the first version of the two techniques, and the method is commonly credited to Holtz-Eakin et al. (1988) and Arellano & Bond (1991). The system GMM was developed later, and the method is commonly credited to Arellano & Bover (1995) and Blundell & Bond (1998).

The difference GMM relies on a first difference transformation of the econometric model, a standard transformation methodology to remove the embedded fixed effects. System GMM also removes the embedded fixed effects, but the transformation involves simultaneously estimating the model in both differences and levels. System transformation involves subtracting the average of all future available observations of a variable. All variables are valid as instruments with this transformation because they are not treated in the transformation formula (Roodman, 2009). According to Sadoon et al. (2019), the efficiency of system GMM outperforms the difference GMM in small-sample estimations,

It is relevant to briefly discuss the technical aspects of the GMM methodology, which is presented commonly by several researchers. In this thesis, the GMM methodology is explained based on the examples in Zsohar (2012). Imagine a sample which consists of n independent draws from a Poisson distribution with parameter λ, and its population moment condition $E\left[x_i^2\right] - \lambda^2 - \lambda = 0$. The methods of moments estimator λ must satisfy the system of equations based on these sample moments:

$$\begin{bmatrix} \frac{1}{n}\sum_{i=1}^{n} - \hat{\lambda} \\ \frac{1}{n}\sum_{i=1}^{n}\left(x_i^2\right) - \hat{\lambda}^2 - \hat{\lambda} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

As discussed in Zsohar (2012), the moment conditions above do not produce a general solution for $\hat{\lambda}$. Using only p number of moments to estimate the parameters could solve the system of equations. However, the solution would be inefficient, meaning that information would be lost when solving the equations. The benefit of GMM is that it makes it possible to solve the system of equations and have an estimate of θ that brings the sample moments as close to zero as possible (Zsohar, 2012). The GMM technique attempts to estimate an unknown parameter vector which holds the true value of θ_0. $E\left[f(x_i, \theta)\right]$ is a set of q population moments and $f_n(\theta)$ is the corresponding sample moments. The criterion function is $Q_n(\theta) = f_n(\theta)' W_n f_n(\theta)$, where W_n is a weighting matrix that converges to a positive definite matrix W as n grows large. GMM estimator of θ_0 is given by:

$$\hat{\theta} = \underset{\theta \subseteq \Theta}{arg\, min}\, Q_n(\theta)$$

According to Evans (2018), the purpose of the weighting matrix, W_n, is that it allows for controlling how each moment is weighted in the process of bringing the sample moments as close to zero as possible. Initially, the weighting matrix is an identity matrix that gives each moment equal weighting. This identity matrix is based on a uniform weighting matrix. Following this strategy, the criterion function would be a sum of squared percent deviations. However, the most efficient weighting matrix is the one with the smallest possible asymptotic variance. This weighting matrix is found by taking the inverse variance-covariance matrix of the moments at their optimum.

4.1.2 GMM Estimation with Time-Invariant Regressors

A shortcoming of the difference and system GMM is that they are unable to estimate the coefficients of time-invariant regressors, which are commonly included in econometric research. The main independent variable in this thesis is a dummy variable, included to describe if quantitative easing was an active policy in the underlying country at the year of observation. Since the standard GMM estimation techniques rely on first-difference transformations to account for heterogeneity (Roodman, 2009), the explanatory power of time-invariant variables will be distorted. Moreover, binary variables will be eliminated, since the difference between one and one always will be zero. Because this problem is common in econometric research, particularly in areas of finance, economics and politics, an effort has been made to solve it. Kripfganz & Schwarz (2015) has developed a method for estimating linear dynamic panel data models with time-invariant regressors. The following section will describe the sequential GMM estimation technique, which has been applied in this thesis.

Following Kripfganz & Schwarz (2015), consider a general dynamic panel data model with units $i = 1, 2, ..., N$ and periods $t = 1, 2, ..., T$.

$$y_{it} = \lambda y_{i,t-1} + x_{it}^{'}\beta + f_i^{'}\gamma + e_{it}, \qquad e_{it} = a_i + u_{it}$$

In the above equation, x_{it} is a $K_x \times 1$ vector of time-varying variables. f_i is a $K_f \times 1$ vector of observed time-invariant variables. The error term a_i accounts for the unobserved unit-specific effect of the cross-sectional dimension. According to Kripfganz & Schwarz (2015), three assumptions about the model are required.

The first assumption relates to the error term: The disturbance term u_{it} and the unobserved unit-specific effects a_i must be independently distributed across i and satisfy $E[u_{it}] = E[a_i] = 0, E[u_{is}u_{it}] = 0 \; \forall \; s \neq t$ and $E[a_i u_{it}] = 0$.

The second assumption relates to the composition of the explanatory variable term: It is assumed that $x_{it} = (x_{1it}^{'}, x_{2it}^{'})^{'}$ and $f_i = (f_{1i}^{'}, f_{2i}^{'})^{'}$ such that $E[a_i|x_{1it}, f_{1i}] = 0, E[a_i|x_{2it}] \neq 0$ and $E[a_i|f_{2i}] \neq 0$.

The final assumption relates to the properties of the included regressors: The time-invariant regressors f_i must be exogenous in relation to u_{it}, while the time-varying regressors x_{it} can be strictly exogenous or pre-determined. Strictly exogenous: $E[u_{it}|x_{i0}, x_{i1}, ..., x_{iT}, f_i; a_i] = 0$. Predetermined: $E[u_{it}|x_{i0}, x_{i1}, ..., x_{iT}, f_i; a_i] = 0$ and $E[u_{it}|x_{is}] \neq 0 \; \forall s > t$.

As presented in Kripfganz & Schwarz (2015), the general dynamic panel data model is rewritten:

$$y_i = \lambda y_{i,(-1)} + X_i\beta + F_i\gamma + e_i, \qquad e_i = a_i\iota_T + u_i$$

In this equation $y_i = (y_{i1}, y_{i2}, ..., y_{iT})^{'}$ represents a vector of stacked observations of the dependent variable for unit i. ι_T is a $T \times 1$ vector of ones. $W = (y_{(-1)}, X)$ is a matrix of time-varying regressors with coefficient vector $\theta = (\lambda, \beta^{'})^{'}$, The full regressor matrix is $\tilde{W} = (y_{(-1)}, X, F)$.

There are several estimators for the first-step regression of the time-variant regressors. To avoid restricting the sequential analysis to the first-step estimator, Kripfganz & Schwarz (2015) assume that $\hat{\theta}$ is a consistent linear first-stage estimator with influence function ψ_i such that:

$$\sqrt{N}(\hat{\theta} - \theta) = \frac{1}{\sqrt{N}} \sum_{i=1}^{N} \psi_i + o_p(1), \qquad E[\psi_i] = 0, \text{ and } E[\psi_i \psi_i^{'}] = \sum_{\theta}$$

The second stage of the estimation sequence estimates the coefficients of the time-invariant variables based on the level relationship:

$$y_{it} - \hat{\lambda} y_{i,t-1} - x_{it}^{'} \hat{\beta} = f_i^{'} \gamma + v_{it}, \qquad v_{it} = a_i + u_{it} - (\hat{\lambda} - \lambda) y_{i,t-1} - x_{it}^{'} (\hat{\beta} - \beta)$$

The second-stage GMM estimator is based on the asymptotic moment conditions:

$$\lim_{N \to \infty} E \left[\frac{1}{N} \sum_{i=1}^{N} Z_{\gamma i}^{'} v_i \right] = 0$$

The corresponding instrument matrix is given as $Z_{\gamma i} = (Z_{xi}, F_{1i})$ with

$$Z_{xi} = \begin{bmatrix} x_{1i0}^{'} & x_{1i1}^{'} & 0 & \cdots & 0 \\ 0 & 0 & x_{1i2}^{'} & & \vdots \\ \vdots & \vdots & & \ddots & 0 \\ 0 & 0 & \cdots & 0 & x_{1iT}^{'} \end{bmatrix}$$

$$\hat{\hat{\gamma}} = \arg\min_{\gamma} v^{'} Z_{\gamma} V_{\gamma N} Z_{\gamma}^{'} v$$

The second-stage GMM estimator solves the above equation for a positive weighting matrix $V_{\gamma N}$. If γ is identified, the second-stage GMM estimator is given by:

$$\hat{\hat{\gamma}} = (F^{'} Z_{\gamma} V_{\gamma N} Z_{\gamma}^{'} F)^{-1} F^{'} Z_{\gamma} V_{\gamma N} Z_{\gamma}^{'} (y - W\hat{\theta})$$

4.1.3 Specification Testing

The variables employed in the empirical analysis have been tested for correlation[15]. Since the correlation between the independent variables is assessed to be low, it can be assumed

[15] See Table A1.2 in Appendix for the correlation matrix.

that the estimated models are not subject to multicollinearity issues (Joshi, 2012).

It is common to apply two selected post-estimation specification tests to GMM estimations. These tests are the Sargan/Hansen test for joint validity of the instruments and the Arellano-Bond test for autocorrelation in the idiosyncratic error term (Roodman, 2009). The sequential GMM estimation defined in Kripfganz & Schwarz (2015) includes an embedded Hansen (1982) post-estimation test statistic for the validity of the second-stage overidentifying restrictions.

A model must be either just-identified or over-identified to estimate its parameters (Selig, 2022). However, if the model is exactly identified, the Sargan/Hansen test cannot test whether the instruments are valid. If the model, on the other hand, is over-identified, the joint validity of the moment conditions can be tested. The null hypothesis of the Sargan/Hansen test is that the moment conditions are jointly valid. One would then expect that the vector of empirical moments, $(1/N)Z'\hat{E}$, are randomly distributed around 0 (Roodman, 2009). To check this hypothesis, the method involves employing a Wald test:

$$\left(\frac{1}{N}Z'\hat{E}\right)Var(z\epsilon)^{-1}\frac{1}{N}Z'\hat{E} = \frac{1}{N}\left(Z'\hat{E}\right)' A_{EGMM}Z'\hat{E}$$

According to Roodman (2009), the Hansen (1982) J test statistic is the above expression with a consistent estimate of A_{EGMM}.

It is commonly discussed that researchers should be wary of trusting Sargan/Hansen tests. According to Roodman (2007), the test is commonly invalid in estimations with *many* instruments.

Arellano & Bond (1991) derived a test for detecting autocorrelation in the first-differenced residuals of the GMM estimator. As discussed by Roodman (2009), the first-differenced error term is mathematically related to the first-differenced lagged error term. It is therefore expected that the researcher will detect autocorrelation in the first order, and it is uncommon to give any weight to this estimate. However, the second-order correlation is relevant and of interest. To derive the Arellano-Bond test for autocorrelation in a generalized GMM estimate, this thesis follows the derivation by Roodman (2009): Imagine a dataset consisting of **X, Y, Z**. **X** and **Z** account for the transformed (or augmented) underlying dataset. The estimator of this dataset yields residuals denoted $\hat{\mathbf{E}}$. The null hypothesis of the test suggest that $(1/N)\sum_i \hat{\mathbf{E}}_i^{-l}{}' \hat{\mathbf{E}}_i$ equals zero when there is zero order-l serial correlation. To the above equation, Arellano & Bond (1991) apply a central limit theorem to ensure that the test statistic is asymptotically normally distributed. To do this, one must estimate the asymptotic variance of the statistic under the null hypothesis[16]. The substituted expression adjusted for terms dropped as N increases towards infinity:

$$(1/\sqrt{N})\left(\mathbf{E}^{-l'}\mathbf{E} - \mathbf{E}^{-l'}\mathbf{X}(\mathbf{X'ZAZ'X})^{-1}\mathbf{X'ZAZ'E}\right)$$

Dividing the variance of the above equation[17] by the asymptotically normally distributed estimator derived earlier yields the Arellano-Bond z-test for serial correlation of order l.

4.1.4 Practical Application & Interpretation of Sequential GMM

In the previous part of the methodology section, the technical aspects of GMM and sequential GMM have been explained. Acknowledging the complexity of the method and the abstractness of its application, this section is dedicated to confirming the fit of the methodology, in addition to supplying information on its practical application. Finally, this section will focus on how the reader should interpret the output of the models presented in the empirical analysis.

The sequential GMM methodology is a two-step procedure, where the first step employs a traditional GMM estimation methodology on the time-variant regressors and stores the time-invariant regressors in the error term to avoid distortion caused by GMM transformations. The second step is retrieving the coefficients of the time-invariant regressors from the error term. The STATA framework of the sequential GMM technique allows for individual selection of traditional GMM methodology. As discussed earlier, two common GMM techniques are known as the difference and the system GMM. In the case of this thesis, it has been argued that the system GMM is the most efficient in finite samples, and thus this method will be applied. When applying the system GMM, it must be decided if the weighting matrix should be uniformly or optimally weighted. According to Kripfganz (2019), the optimal weighting matrix requires initial consistent estimates. Since the underlying sample size in this thesis is small, it is unlikely that the

[16]Please see equation 28 in Roodman (2009, p. 120).
[17]Please see Roodman (2009, p. 120) for the variance derivation.

initial estimates will be consistent to the degree the optimal weighting matrix requires. It is therefore decided that the one-step estimator will be applied, thereby sacrificing some efficiency to avoid small-sample biased estimators.

Having decided which GMM technique to apply, it becomes relevant to discuss if the requirements for the application of the GMM technique are satisfied. Chapter 4.1.1 presented the general requirements of GMM based on the framework of Roodman (2009). These requirements will be the basis of the discussion of methodology fit in this thesis. The first requirement is that the panel should have a small time dimension and a large country dimension. The relativity of this statement has been a subject of frequent discussion in econometric forums. The underlying data in this thesis is made up of a time dimension of 15 observations and a country dimension of 23 observations, which can be considered in line with the requirement of Roodman (2009). The size of the time and country dimensions is also in line with several practical applications of the methodology, conducted by other researchers[18]. The second requirement is that the models should follow a linear functional relationship, which is considered to be the case. The third requirement is that the dependent variable should be dynamic and dependent on its past realizations, which is true for all the included models. The fourth requirement is that the independent variables should not be strictly exogenous, which in this case would mean that the independent variables will be completely unaffected by the dependent variable. The fourth requirement can be considered to be true since the independent variables are expected not to be strictly exogenous. An example could be that GDP growth will be expected to be impacted by private equity buyouts. The fifth requirement is that the models have fixed individual effects. An example in the case of this thesis could for instance be individual country fixed effects, which confirms this requirement as well. The final requirement is that the models are characterized by heteroskedasticity and autocorrelation within individuals, which most likely is the case. An example of autocorrelation could be within the country dimension, where it is likely to expect that a high number of LBOs in the UK in one year will lead to the same the next year. In conclusion, the validity of the application of system GMM on the underlying data is verified, at least in light of the requirements of Roodman (2009).

Having confirmed the fit of the methodology, the next part of this section will be dedicated to the practical application of the methodology. One of the main attributes of the GMM

[18] See for instance Mileva (2007), where T=10 and N=22.

estimation technique is the ability to include instruments, to increase the precision of the estimations. System GMM opens up for both *gmm-style* instruments and *iv-style* instruments. The *gmm-style* instruments can only be endogenous variables, while the *iv-style* instruments must be strictly exogenous (Baum et al., 2003). By default, the GMM estimation technique generates instrument sets that grow quadratically with the time dimension. Increased efficiency and precision caused by relevant instruments is the optimal outcome, but the researcher must employ caution in the model specification. Including too many instruments can overfit the endogenous variables and lead to biased coefficient estimates (Roodman, 2007). According to Mileva (2007), the rule of thumb is to keep the instrument count lower than the group count. In the case of this thesis, only *gmm-style* endogenous instruments have been applied. The reasoning behind this is based upon the desire to keep the instrument count low, and the difficulty of finding proper strict exogenous variables. The models presented in the empirical analysis include a statistic of instrument count, which shows that the rule of thumb presented by Mileva (2007) has been followed.

In the following section, the model outputs will be reported, which is a result of sequential-GMM application on panel data with a time-invariant regressor. Tables 4.1, 4.2, and 4.3 are based on the same methodology and can be interpreted in the same manner. The first stage section refers to the estimation of the coefficients that have time-varying attributes. As explained in Chapter 4.1.2, the method estimates all variables but stores the second-stage variables within the error term. Thus, the fixed effects can be eliminated. In the presented model, the second stage retrieves the estimated coefficient of the time-invariant dummy variable from the error term. In the end, it is possible to interpret the first and second stages together as one regression output. When interpreting the regression outputs, the table subscript might help understand the outcome of the model specification testing.

4.2 Empirical Analysis

Three models have been estimated using the above methodology. The models are based on the same underlying data and include the same variables, although the dependent variable is rotated. Table 4.1 presents the first model which applies *Buyout Investments* as the dependent variable. This model is based on the hypothesis of a direct impact on private equity buyouts from quantitative easing. Table 4.2 presents the second model which uses *Buyout Fundraising* as the dependent variable. This model is based on the portfolio rebalancing hypothesis, which expects that the impact is transferred indirectly through the hypothesized transmission channels of quantitative easing. Table 4.3 presents the third model which applies *Leveraged Loan Issuance* as the dependent variable. This model is based on the credit impact hypothesis and is the second model where the impact on private equity is expected to be indirect. The main objective of the models is to empirically deduct if it is possible to observe an additional impact of quantitative easing. Since the underlying data is panel data with 23 countries and observations from 2007 to 2021, it is the overall expectation that it will be possible to observe whether the implementation of quantitative easing had an additional impact in the countries where the policy was implemented.

4.2.1 Direct Impact: Buyout Investments

The first model includes the nominal value of buyouts as the dependent variable. It is hypothesized that the current value of investments depends on past realizations of the variable, thus making the model specification dynamic. Furthermore, it is expected that fundraising and leveraged loan issuance in the previous year will positively impact the current value of investments. Deploying the raised capital likely happens in a lagged manner. This is because it is expected that deal sourcing and subsequent negotiations and closings take time to finalize. Thus, these variables are specified in a first-lagged form. The expectation is that the control variables also have a lagging effect on buyouts in general. As for the remaining variables, it is an expectation that the number of buyouts and the value of buyouts is positively related. Commenting briefly on the expectation of the economic control variables, one would expect that the real rate and the 10-year government bond yield have a negative relationship with the value of buyouts. If the interest level and the debt cost decrease, the debt capacity of firms increase, and it then becomes easier to finance investments. As for the GDP growth, Gudiškis & Urbšienė (2015) find a positive relationship between the variable and the value of buyout investments. The expectation of the relationship between GDP growth and buyouts is based on the same sentiment in this thesis.

Table 4.1: Model 1: Sequential One-Step System GMM - Investments

	ln Buyout Investments
First Stage:	
ln l1 Buyout Investments	**-0.288*****
	(-3.51)
ln l1 Buyout Fundraising	-0.0254
	(-0.57)
ln l1 Leveraged Loan Issuance	-0.0410
	(-0.82)
Buyouts (Number)	**0.0290*****
	(3.66)
l1 Real Rate	-0.0675
	(-0.38)
l1 10-Year Government Bond Yield	-0.116
	(-0.41)
l1 GDP Growth	0.0688
	(0.47)
Constant	**15.67*****
	(18.61)
Second Stage:	
QE Dummy	0.737
	(0.65)
Constant	-0.271
	(-0.65)
Year Dummies	No
Observations	294
Groups/Instruments	23/22
AR (2)	0.554
Hansen Statistic	0.102

This table presents results from the sequential one-step system GMM with robust standard errors in parentheses. The dependent variable is the nominal value of private equity buyout investments. The independent variables are explained in section 5.2. Statistical significance for 1%, 5%, and 10% level are denoted ***, **, *, respectively. p-values are reported for AR(2) and the Hansen statistic. The null hypothesis of the Arellano Bond test of serial correlation is that the disturbance term is absent of serial correlation. The null hypothesis of the Sargan-Hansen test of overidentifying restrictions is that the overidentifying restrictions are valid.

As discussed in Chapter 4.1.4, the report of the model estimation can be interpreted as a traditional regression output. The estimation output of model 1 shows that the first lag of Buyout Investments has a significant impact on the dependent variable at the 1%

level. Also, the number of buyouts impacts the dependent variable at the 1% significance level. The rest of the variables are not significant. The variables of significant impact are transformed logarithmically and must be interpreted as such. The interpretation of the lagged value of buyout investments is the following; If the lagged value of buyout investments is increased by 1%, it could be expected that the current value of buyout investments would decrease by approximately 0.29%, ceteris paribus. It is reasonable to expect that buyout investments would follow a mean reversion to the trend, as investment opportunities often require large amounts of time and capital. Following this logic, it would be expected that significant investments next year would lead to lower investments in two years. The relationship is naturally more complicated than this, as it would depend on the current investment landscape and the macroeconomic environment in general.

The second significant variable is the number of buyout transactions, and unlike the value of buyout investments, this variable is not transformed. The point estimate must be interpreted following a log-to-level distribution; A marginal increase in the number of buyouts would lead to a rise in the value of buyout investments with 2.9%. Initially, this estimate seems to be reasonable. It would mean that the marginal buyout accounts for 2.9% of the total value of buyout investments. By that account, the average marginal buyout would be worth the number of investments times the marginal percentage change in value, $16850 * 2.9\% = 489\ million$. Table 2.1 shows that the median value of buyouts is approximately EUR 610 million. Assuming that buyout investments' value diminishes with scale, this figure can be deemed reasonable.

The remaining variables are insignificant in this estimation; thus, there is nothing to suggest a relationship between the point estimates and the dependent variable. If the analysis is correctly specified, one could conclude that the value of buyout investments is unaffected by the lagged fundraising level and the lagged issues of leveraged loans, in addition to the lag of the economic control variables. Most importantly, it would mean that the value of buyout investments is unaffected by quantitative easing. The simpleness of the estimation methodology, in addition to the data access, must be taken into account before concluding in a deciding manner. Model 1 shows clear evidence of expected relationships, such as the number of buyouts and the value of buyouts, but cannot capture other expected relationships, such as quantitative easing and the value of buyout investments. This single estimation cannot be considered substantial enough to reject a causal relationship between the variables.

4.2.2 Portfolio Rebalancing Impact: Buyout Fundraising

The second model includes the value of buyout fundraising as the dependent variable. As in Model 1, it is also expected that the dependent variable is dynamically dependent. For example, suppose a private equity fund ran significant fundraising rounds the previous year. In that case, one could expect that the fundraising effort in the current year will be lower simply because of limited demand for private equity or because the investment landscape is different than the year before. Fundraising differs within the industry because some funds are larger than others. Large private equity firms will manage multiple funds which follow different timelines. These firms are more frequent fundraisers than smaller firms which only manage a single fund and can limit fundraising efforts to every 5-10 years (Wheater, 2014). Another perspective on the expectation of private equity fundraising is that a substantial fundraising effort in the previous year would lead to even more raises in the current year by following the logic that the private equity industry is a sought-after investment opportunity and that the industry is in an upwards-pointing cycle. Increased demand for private equity, indicated by an increased level of fundraising, leads to the expectation that more fundraising, all else equal, will lead to more buyout investments. This is because the committed capital must be invested for the PE firm to produce the return required by LPs. One reason why increased fundraising could have the opposite effect might be the observed growth in dry powder in the last decade[19]. Increased fundraising might not lead to more investments if the committed capital is not deployed.

With the same explanation as for buyouts and fundraising, leveraged loan issuance is also included in a first-lagged manner. The previous year's value of issuance is expected to impact the current year's value of fundraising. There are two ways to consider which impact this variable will have. The first one is that increased leveraged loan issuance will lower the demand for equity fundraising because the deal structure will increasingly consist of leverage. According to research on LBOs, this is the most unlikely outcome. Brown et al. (2021) show that the majority of leveraged buyouts have been financed with a debt-to-value ratio between 40-60% for all industries, which would mean that the

[19] Please see Appendix A2.3 for the development of global dry powder since 2007.

equity portion of LBOs stays fairly consistent as well. The other expectation is that the relationship between leveraged loan issuance and fundraising is positive. Increased issuance of leveraged loans will facilitate easier access to capital for the financial sponsors, thus demanding more equity fundraising to acquire more firms. It must be stated that this does not necessarily mean more deals in the short run, only higher target valuations and increased competition from other financial sponsors for the same targets. A positive relationship between fundraising and leveraged loan issuance might explain the observed linear increase in average EV/EBITDA deal multiples in the last decade[20].

As in the first model, the economic control variables are specified in a first-lagged manner. The expectation of the relationship between the control variables and the dependent variables follows the same logic as explained previously. The real rate and the dependent variable should have a negative relationship. A lower interest rate climate would improve the investment landscape and ease credit conditions so institutions could leverage their investments in private equity. This is also expected for the government bond yield variable. The GDP growth should be positively related to the dependent variable, based on the same rationale as in the first model. Fundraising efforts are expected to increase if the economy is growing as a whole.

Finally, an active quantitative easing policy is expected to lead to increased private equity fundraising. However, the economy is usually under momentary distress when quantitative easing is implemented. Examples of this are the financial crisis and the covid-19 pandemic, where GDP growth became negative (Alcidi et al., 2010). If the economy is staggering and financial conditions are tight, investments and fundraising efforts usually decrease significantly. However, if quantitative easing works as expected, liquidity and investment activities increase, and thus, the variables should be positively related.

[20]Average European EV/EBITDA multiples from 2007-2021 is shown in Appendix A2.2.

Table 4.2: Model 2: Sequential One-Step System GMM - Fundraising

	ln Buyout Fundraising
First Stage:	
ln l1 Buyout Fundraising	-0.0823
	(-0.65)
ln l1 Buyout Investments	-0.0801
	(-0.45)
ln l1 Leveraged Loan Issuance	0.0794
	(1.64)
Buyouts (Number)	-0.000123
	(-0.00)
l1 Real Rate	-0.0823
	(-0.31)
l1 10-Year Government Bond Yield	0.0370
	(0.22)
l1 GDP Growth	-0.0284
	(-0.11)
Constant	**8.385*****
	(3.22)
Second Stage:	
QE Dummy	2.414
	(1.19)
Constant	-0.887
	(-1.14)
Year Dummies	No
Observations	294
Groups/Instruments	23/22
AR (2)	0.106
Hansen Statistic	0.102

This table presents results from the sequential one-step system GMM with robust standard errors in parentheses. The dependent variable is the nominal value of private equity buyout fundraising. The independent variables are explained in section 5.2. Statistical significance for 1%, 5%, and 10% level are denoted ***, **, *, respectively. p-values are reported for AR(2) and the Hansen statistic. The null hypothesis of the Arellano Bond test of serial correlation is that the disturbance term is absent of serial correlation. The null hypothesis of the Sargan-Hansen test of overidentifying restrictions is that the overidentifying restrictions are valid.

The model shows no significant relationship between the dependent and independent variables at the common econometric significance levels. Since the model was not the original specified model, this might be a likely result. However, the expectations discussed above are well anchored in economic theory, and thus the results from the estimation are surprising. In any case, the model is not able to provide any explanation as to what drives private equity fundraising.

4.2.3 Credit Impact: Leveraged Loan Issuance

The third model includes the yearly summed average of leveraged loan issuance as the dependent variable. As in the previous models, the dependent variable is expected to be dynamically dependent on past realizations.

For the explanatory variables, the value of buyout investments and fundraising is included in a first-lagged manner. A positive relationship between buyout investments and the issuance of leveraged loans is expected. If the leveraged loan market expands, credit will be more available to financial sponsors on a relative basis. Laber & Yozzo (2017) conclude that financial sponsors are behind the growth in the leveraged loan market, which also indicates a positive relationship between the variables. The relationship between the number of buyouts and the value of leveraged loan issuance is also expected to be positive. This is due to the relationship between the number of buyouts and the value of buyouts discussed previously, namely that the marginal impact of another buyout on the value of buyouts is positive. Finally, the relationship between fundraising and the value of leveraged loan issuance is expected to be positive. If there is more debt issuance by financial sponsors, one would expect equity fundraising to follow this trend, as one can expect financial sponsors to keep LBO capital structures consistent.

Following the rationale described in the previous models, the control variables are all presented in their first-lagged form. As in the earlier models, one can expect a negative relationship between the real rate and the leveraged loan issuance. The same can be expected for the government bond yield. These expectations are based on monetary policy theory regarding the stimulating effect on economic activity when the central bank decreases short-term interest rates. A positive relationship between leveraged loan issuance and GDP growth is expected based on the notion that leverage leads to increased investment activity and that increased investment activity leads to increased economic activity in general. According to Barajas & Natalucci (2021), leverage is a facilitator of business growth.

The expectation of the impact of an active quantitative easing policy on the issuance of leveraged loans is one of the core questions of the thesis. Ayroubi et al. (2020) concluded in their seminal paper that private equity was impacted by quantitative easing, and they used the expansion of the leveraged loan market as evidence. It is, therefore, natural that their conclusion becomes the expectation for the empirical model in this thesis.

Table 4.3: Model 3: Sequential One-Step System GMM - Leveraged Loans

	ln Leveraged Loan Issuance
First Stage:	
ln l1 Leveraged Loan Issuance	**0.398*****
	(3.80)
ln l1 Buyout Investments	-0.250
	(-0.78)
ln l1 Buyout Fundraising	**-0.195***
	(-1.93)
Buyouts (Number)	0.107
	(1.38)
l1 Real Rate	-0.330
	(-0.91)
l1 10-Year Government Bond Yield	**-1.474*****
	(-5.97)
l1 GDP Growth	**-1.067***
	(-1.65)
Constant	**9.906*****
	(2.58)
Second Stage:	
QE Dummy	-0.672
	(-0.20)
Constant	0.247
	(0.20)
Observations	294
Groups/Instruments	23/22
AR (2)	0.417
Hansen Statistic	0.102

This table presents results from the sequential one-step system GMM with robust standard errors in parentheses. The dependent variable is the logged yearly average of nominal leveraged loan issuance. The independent variables are explained in section 5.2. Statistical significance for 1%, 5%, and 10% level are denoted ***, **, *, respectively. p-values are reported for AR(2) and the Hansen statistic. The null hypothesis of the Arellano Bond test of serial correlation is that the disturbance term is absent of serial correlation. The null hypothesis of the Sargan-Hansen test of overidentifying restrictions is that the overidentifying restrictions are valid.

The first lag of the dependent variable is significant at the 1% level. The interpretation of this variable is that if the issuance of leveraged loans is increased by 1% in the year before, one can expect the current value of leveraged loan issuance to be raised by approximately

0.4%. The outcome is as expected and must be interpreted in the context of positive development for leveraged loan markets in the underlying sample. After 2015, the market has only grown[21].

The next significant variable in the estimation is the value of private equity fundraising, presented as the first lag. The variable impact the issuance of leveraged loans negatively, which is unexpected. The interpretation of the variable is that a marginal increase in fundraising will lead to a decrease in the next year's issuance of leveraged loans by approximately 0.2%. The possible explanation for this relationship can be that the capital structure of leveraged buyouts temporarily is increasingly consisting of debt as opposed to equity. Shivdasani & Wang (2011) characterizes the period from 2004 to 2009 as an LBO boom, which indicates rapid growth in the market for buyouts. According to De Maeseneire & Brinkhuis (2012), the average debt-to-value in LBOs from 2004-2007 was approximately 71%. They explain that LBOs tend to have higher leverage when the debt market is liquid, and the credit spreads are low. As discussed extensively, the expansion of the leveraged loans market has increased the liquidity of the debt markets for financial sponsors. Although not directly provable by this thesis, an explanation for the relationship between equity fundraising and leverage loan issuance can be that financial sponsors increasingly have replaced equity with debt in LBOs, caused by easier accessible leverage.

The third significant variable in this model is the 10-year government bond yield, also specified as the first lag. The variable has a negative impact on the value of leveraged loan issuance, which was the expected impact. The interpretation of the point estimate is that if the 10-year government bond yield were increased by 1% in the last year, it would result in a 47.4% decrease in the value of leveraged loan issuance in the current year. Although it was expected that the relationship would be negative, this is a rather large impact caused by a relatively small change in yield. The institutional demand for high-yielding fixed-income securities has been one of the facilitators of the leveraged loan market expansion (Pedraz, 2019). According to the estimation, institutional investors would prefer to invest in government bond securities if the yield was only marginally improved. Furthermore, this might present a link to quantitative easing. As discussed previously, one of the main purposes of QE is to push down long-term yields in fixed-income markets. One could indirectly argue that QE has forced institutional investors to choose leveraged loans as an

[21]The expansion of the leveraged loan market is presented graphically in Figure 3.3.

investment class, thereby enabling private equity to conduct more buyouts and issue more leveraged loans. However, the estimate might also confirm the conclusions of Kaplan & Strömberg (2009), namely that private equity is cyclical based on the developments in the credit markets. Since the 10-year government bond yield commonly reflects the interest rate level in the economy, an increased yield might indicate tighter conditions for financial sponsors. Less issuance of leveraged loans might solely reflect a general lower activity level in the market for private equity buyouts. Although not provable by the model itself, it would seem that this estimate should be viewed in the light of traditional private equity cycles, and not quantitative easing itself.

The last significant variable in this model is the GDP growth variable, which is specified as the first lag, similar to the above variables. The variable has a negative impact on the value of leveraged loan issuance, which is unexpected and not in line with the discussion above. The interpretation of the point estimate is that if last year's GDP growth were increased by 1%, this year's issuance of leveraged loans would decline by 6.7%. Since the outcome is unexpected, there are no sudden verifiable explanations. However, one possible reason for the negative sign could be linked to business and credit cycle theory. According to Goel (2018), leveraged loan volumes are particularly pro-cyclical. When the business cycle matures, the default risk of leveraged loans increases. The central banks adjust short-term nominal interest rates to balance inflation risk and economic output (Mathai, 2022). When the cycle matures, increases in the floating rate component of outstanding loans can trigger defaults through violation of covenants. Empirically looking into this relationship is a thesis in itself, but it may explain why the issuance of leveraged loans decreases in times of economic growth.

Similar to the previous models, neither this model is capable of providing a clear relationship between quantitative easing and the dependent variable, which in this case is leveraged loan issuance. If the estimates in this model are valid, there is nothing to suggest that the conclusions made by Ayroubi et al. (2020) are valid. It would rather seem that the developments in the leveraged loan markets are a consequence of traditional monetary policies, and by extension that private equity buyouts still solely respond to traditional cycles in credit markets.

5 Conclusions

This paper is the first to empirically analyze the relationship between private equity buyouts and quantitative easing. In particular, the thesis looks into European countries' private equity buyout segment. Western central banks first implemented quantitative easing in 2008-2009 to respond to the great financial crisis. Since then, the policy has been an active measure for the Federal Reserve, Bank of England, and the European Central Bank, in addition to several independent European central banks.

This thesis explores the possibility that quantitative easing has impacted private equity buyouts. In particular, three potential hypotheses of impact are being researched. The first hypothesis is referred to as the direct impact hypothesis, while the second and third hypothesis is based on indirect channels of impact. The main research question is whether quantitative easing has increased the aggregated value of buyout investments. The relevance of researching the fundraising efforts of private equity firms comes from the identified transmission channels of quantitative easing, particularly the portfolio rebalancing channel of institutional investors. Finally, the issuance of leveraged loans is relevant because this captures a large portion of the capital structure of leveraged buyouts. Furthermore, previous research concludes that quantitative easing impacts private equity due to an expansion in the leveraged loan market.

The empirical research does not suggest a direct relationship between quantitative easing and private equity buyouts. The models designed to capture the indirect impact are also unsuccessful in establishing a relationship between private equity and quantitative easing. Given the estimations in this thesis, it is not possible to prove a causal relationship between private equity buyouts and quantitative easing. However, the estimations are successful in establishing both direct and indirect relationships between private equity and the independent variables. It is confirmed that both buyouts and leveraged loan issuance are dynamically dependent on their past realizations. Furthermore, it is established that an increased value of fundraising in the previous year will lead to a lower value of issued leveraged loans in the current year. Finally, a negative relationship between quantitative easing and long-term government bond yields is established, indicating that lower interest rates will increase the amount of leveraged loans issued and that the credit markets are indeed a driver of private equity financing activity. This finding is in line with the research conducted by Kaplan & Strömberg (2009).

In conclusion, the research conducted in this thesis is unsuccessful in providing any evidence of quantitative easing impact on private equity. According to the findings, it would rather seem that the market for leveraged loans has flourished due to low interest rates. Building on the theory that leveraged loans mostly benefit financial sponsors, it would seem that this research verifies the findings of Kaplan & Strömberg (2009) on private equity cyclicality driven by the credit markets. However, there is nothing to suggest that increased issuance of leveraged loans will lead to an increased number of LBOs or an increased aggregated value of LBOs. Due to data limitations, several interesting research questions have been disregarded. In light of the findings of this thesis, it would indeed be interesting to research whether there is a relationship between dry powder and the issuance of leveraged loans. A closing hypothesis may be that an increase in the issuance of leveraged loans does not lead to more LBOs, but rather more dry powder at the hands of the private equity firms.

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Appendix

A1 Tables

Table A1.1: Countrylist with central banks and currencies

Country Name	Country Number	Central Bank	Currency
Austria	1	European Central Bank	EUR
Belgium	2	European Central Bank	EUR
Bulgaria	*3*	*Bulgarian National Bank*	*BGN*
Czech Republic	*4*	*Czech National Bank*	*CZK*
Denmark	*5*	*Danmarks Nationalbank*	*DKK*
Finland	6	European Central Bank	EUR
France	7	European Central Bank	EUR
Germany	8	European Central Bank	EUR
Greece	9	European Central Bank	EUR
Hungary	*10*	*Nemzeti Bank*	*HUF*
Ireland	11	European Central Bank	EUR
Italy	12	European Central Bank	EUR
Luxembourg	13	European Central Bank	EUR
Netherlands	14	European Central Bank	EUR
Poland	*15*	*National Bank of Poland*	*PLN*
Portugal	16	European Central Bank	EUR
Romania	*17*	*National Bank of Romania*	*RON*
Spain	18	European Central Bank	EUR
Sweden	*19*	*Sveriges Riksbank*	*SEK*
United Kingdom	*20*	*Bank of England*	*GBP*
Norway	*21*	*Norges Bank*	*NOK*
Switzerland	*22*	*Swiss National Bank*	*CHF*
Ukraine	*23*	*National Bank of Ukraine*	*UAH*

This table presents the cross-sectional units in the thesis panel. 10/23 countries have independent central banks. These countries are italicized. Sources: European Central Bank (2022) and BIS (2022).

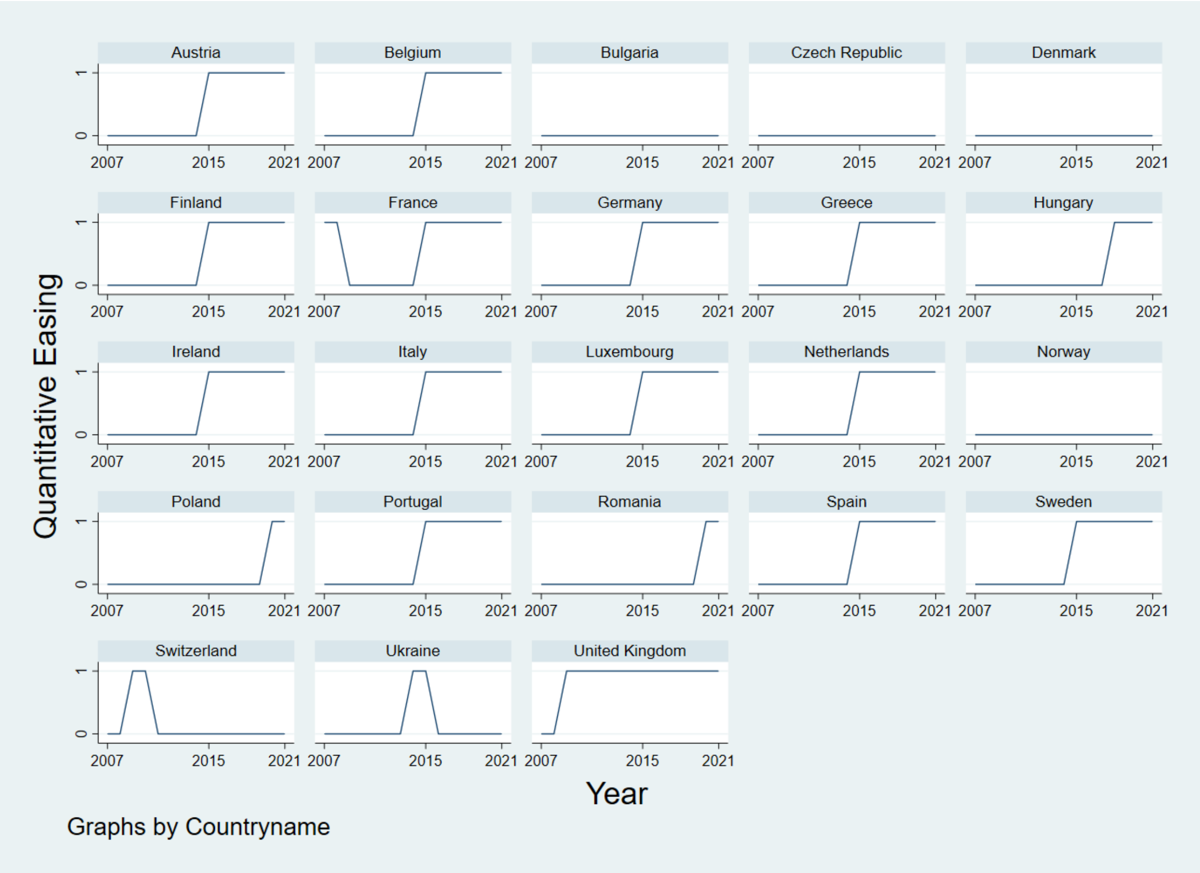
Table A1.2: Correlation matrix

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Buyout Investments (1)	1.000						
Buyout Fundraising (2)	0.543	1.000					
Buyouts (Number) (3)	0.467	0.483	1.000				
Real Rate (4)	0.035	-0.091	-0.030	1.000			
Leveraged Loan Issuance (5)	0.311	0.290	0.338	-0.249	1.000		
10-Year Government Bond Yield (6)	-0.350	-0.323	-0.209	0.298	-0.443	1.000	
GDP Growth (7)	0.092	0.003	-0.030	-0.107	0.078	-0.310	1.000

This table presents the correlation matrix for the variables included in the empirical estimations. All variables are included in levels for the correlation estimations. The number in parenthesis is to indicate which of the vertical variables is correlated with which of the horizontal variables.

A2 Figures

Figure A2.1: Quantitative Easing



This figure show the QE Dummy graphically for all countries included in the sample, during the time period from 2007 to 2021. If the y-axis show a value of 1 it means that the policy was active.

Figure A2.2: Average European Buyout EV/EBITDA Multiples. Source: (Preqin, 2022)

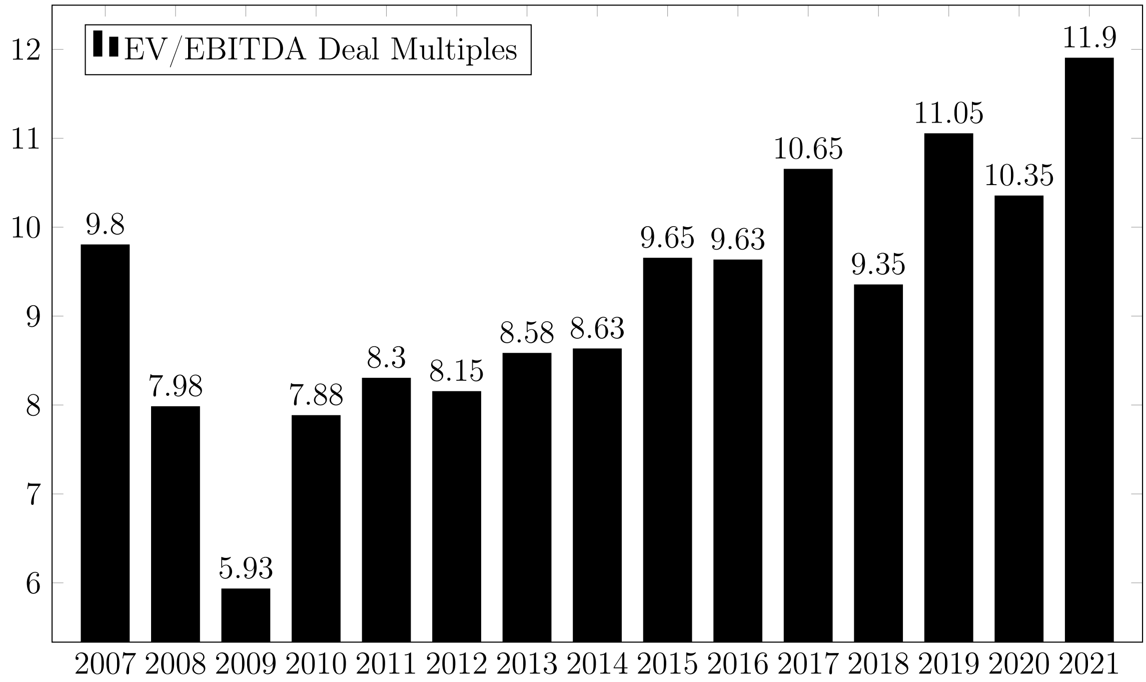


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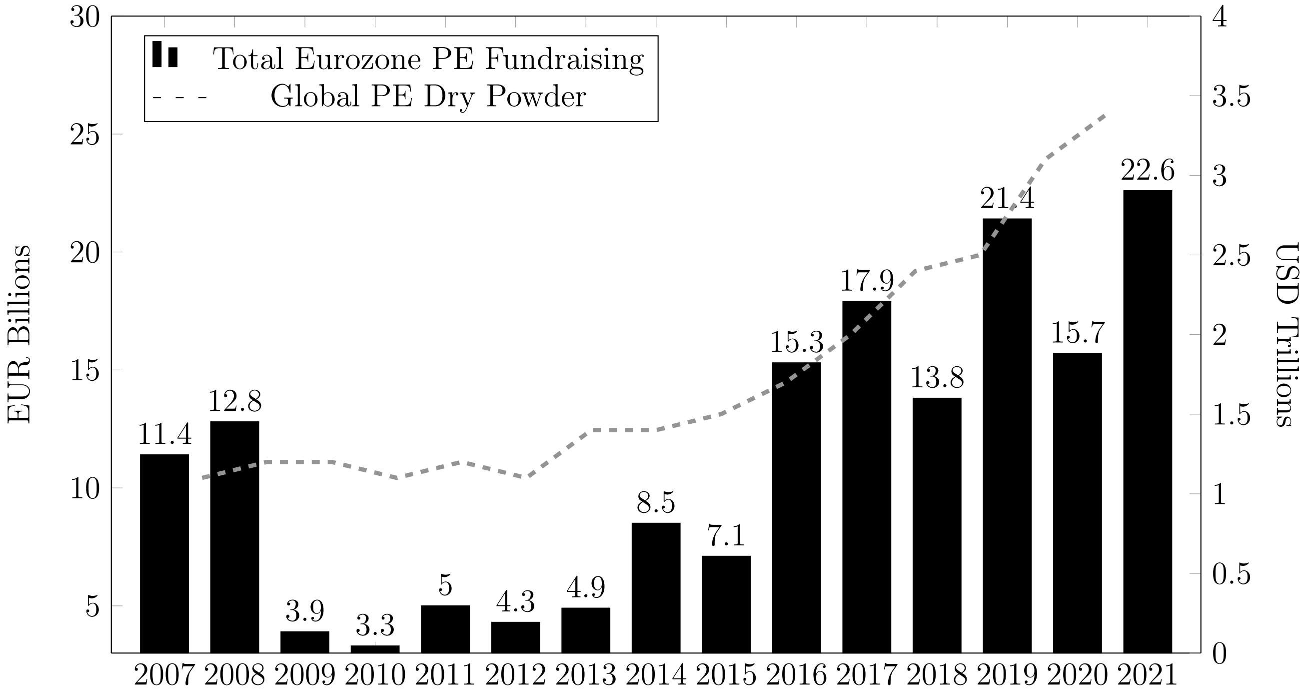
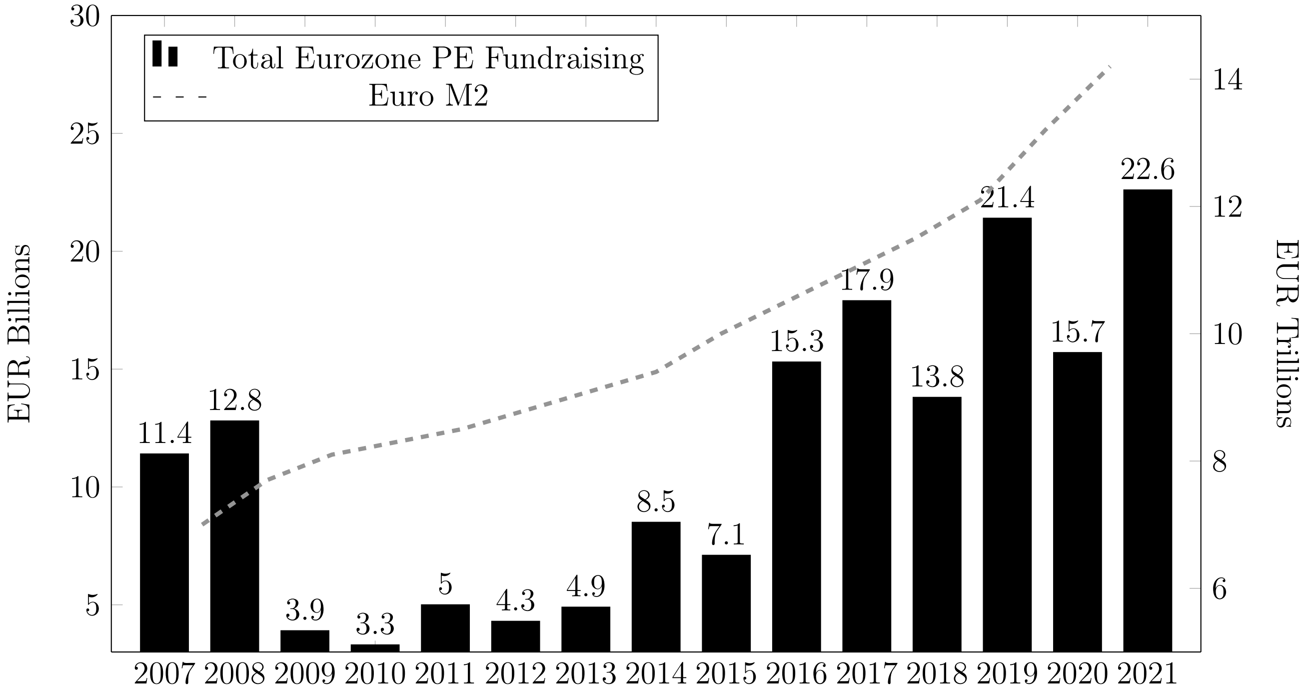
Figure A2.3: Eurozone PE Fundraising & Global Private Equity Dry Powder. Source: (Statista, 2022) and own calculations.



The figure shows two y-axes where the first presents the yearly sum of buyout fundraising domiciled in the Eurozone. The value of fundraising is denominated in EUR billions. The second y-axis presents global private equity dry powder and is denominated in USD trillions.

Figure A2.4: Eurozone PE Fundraising & Eurozone Money Supply (M2). Source: (European Central Bank, 2023) and own calculations.



The figure shows two y-axes where the first presents the yearly sum of buyout fundraising domiciled in the Eurozone. The value of fundraising is denominated in EUR billions. The second y-axis presents the money supply (M2) of the EUR currency and is denominated in EUR trillions.