Erasmus University Rotterdam

Erasmus School of Economics

Bachelor Thesis in Finance

The Early Hours

"An analysis of the effect of macroeconomic drivers and drivers related to entrepreneurial activity on seed and early stage investments across twelve European countries."

Author: Y. van Weeren
Student number: 388022
Thesis Supervisor: T. Eisert
First Reader: C.S. Pfeil
Finish Date: 14-06-2018

Abstract

The goal of this research is to quantitatively assess the factors influencing seed and early stage investments. This thesis aims to put a finger on its drivers, divided in macroeconomic drivers and drivers that relate to the entrepreneurial environment, and how they affect these investments. Both the number of deals and average deal size function as measures of seed and early stage investments. The number of deals are mostly influenced by the short term interest rate and a country's GDP level. Average deal size is particularly influenced by the long term interest rate. In addition, country and year specific effects play a larger role with respect to the number of deals than in the case of average deal size as a measure of the investments.

Table of contents

Abstract ... 2
Table of contents ... 3
List of tables ... 4
List of figures ... 4
1. Introduction ... 5
2. Theoretical framework ... 8
2.1 Early investments ... 8
2.2 Venture capital fund dynamics ... 9
2.3 Venture capital: public and private ... 10
2.4 Angel investments ... 10
2.5 The driving factors of early investments: previous research ... 11
2.6 The driving factors of early investments considered in this research ... 14
3. Methodology and data ... 17
3.1 Data definition and selection ... 17
3.2 Sample analysis ... 20
3.3 Methodology ... 24
4. Results ... 28
4.1 The effect of drivers on the Number of Deals ... 28
4.1.1 Robustness of the effect of drivers on Number of Deals ... 31
4.2 The effect of drivers on Average Deal Value ... 31
4.2.1 Robustness of the effect of drivers on Average Deal Value ... 33
4.3 The effect of drivers on the Share of Angel Investors ... 33
4.3.1 Robustness of the effect of drivers on the Share of Angel Investors ... 35
5. Conclusion ... 36
5.1 Implications ... 36
5.2 Limitations of the study and recommendations for further research ... 37
References ... 39
Appendices ... 42
Appendix A ... 42
Appendix B ... 43
Appendix C ... 44
Appendix D ... 45
Appendix E ... 46
Appendix F ... 47
Appendix G ... 48
Appendix I ... 50
Appendix J ... 51

List of tables

Table 1: *Variable description in short* 17/18
Table 2: *Descriptive statistics: no mean imputation* 21
Table 3: *Descriptive statistics: mean imputation* 21
Table 4: *Mean value of each variable per country* 46
Table 5: *Mean and standard deviation of each variable per year* 47
Table 6: *Variable correlation matrix* 48
Table 7: *Results of the effect of various drivers on the Number of Deals* 29/30/31
Table 8: *Robustness of the main drivers of the Number of Deals* 49
Table 9: *Results of the effect of various drivers on Average Deal Value* 33/34
Table 10: *Robustness of rLT as a driver of Average Deal Value* 50
Table 11: *The effect of various drivers on the Share of Angel Investors* 35/36
Table 12: *Robustness of the effect of various drivers on the Share of Angel Investors* 51

List of figures

Figure 1: *The stages of entrepreneurial firm development* 8
Figure 2: *Number of deals per country per year* 22
Figure 3: *Average deal value per country per year* 23
Figure 4: *Proportion of angel investors involved per country per year* 23
Figure 5: *Histogram: Number of Deals* 42
Figure 6: *Histogram: natural logarithm of the Number of Deals* 42
Figure 7: *Histogram: Average Deal Value* 43
Figure 8: *Histogram: natural logarithm of Average Deal Value* 43
Figure 9: *Histogram: long term interest rate* 44
Figure 10: *Histogram: natural logarithm of the long term interest rate* 44
Figure 11: *Histogram: number of patents* 45
Figure 12: *Histogram: natural logarithm of the number of patents* 45

1. Introduction

Innovation is a phenomenon that has many different aspects. From disruptive technologies to high impact entrepreneurs trying to save the planet and from impressive success stories to hopelessly failed projects. One thing however, a lot of these aspects have in common: their need for financial resources. Entrepreneurs have numerous possibilities to finance their idea. In the UK many starting businesses are financed internally by personal savings, loans and equity from friends and family. In 2008 only 13,2% used external financial resources, existing mostly of bank loans. Second and third, equity from business angels and equity from venture capitalists (VCs) come in (Fraser, 2009). Over the last few decades[1] venture capital as an external source of finance more than doubled. The share that private individuals (angels) cover of total external finance raised has nearly tripled (Storey & Greene, 2010). In a recent Dealroom report the total amount of angel and seed investments in Europe increased from €0,3 bln in 2012 to €1,2 bln in 2016. For series A and other early VC investments these numbers cumulated to €0,9 bln and €3,8 bln, respectively (Dealroom, 2016, p.10).

The VC industry flourished earlier in the US. A handful of studies have tried to point out the differences between the US and Europe. Mentioned was that Europe's VC industry has to focus on growth and maturation based on an analysis of the European VC industry in the 1990s. Also, European VCs are thought to be more conservative which means that they are less involved in the growing process of start-ups (Bottazzi & Da Rin, 2002). This thesis will try to provide a more quantitative insight into the drivers that are the reason behind the growth and maturation of the European VC industry. It will focus solely on the EU-area. The aim is to provide an understanding of the macroeconomic as well as the entrepreneurial activity related drivers of seed and early stage investments. The next chapter will show a clear definition of seed and early stage investments, which from now on will be referred to as *early investments*.

As mentioned, next to VC young start-ups also turn to angel investors as a source of external equity finance. Not a lot of research has been conducted over the years on angel investors. A reason for that is that angel investors are not used to share all the ins and outs surrounding a deal. Nevertheless, some data about their investing activities is available to the public, as will be explained in the chapter that handles data selection and sample analysis. Since angel investors do presumably contribute to the financing of start-ups nearly as often as VCs do, this study will include their seed and early stage investments as early investments.

Early investments are essential to the growth and unlocking of potential of start-ups. Eventually, they are a crucial factor in determining whether a start-up succeeds or not. Governments are aware of this and pay more and more attention to creating an optimal entrepreneurial

[1] From 1991 to 2004 according to the Centre for Business Research (2007), exhibit 9.16

environment(Mason & Brown, 2013). All start-ups face the characteristics of the entrepreneurial environment they are operating in. These characteristics can vary from the accessibility of financial resources to the extent to which entrepreneurship is implemented in a country's educational system. It is important for start-ups that the market for early-stage investments is matured and that they have sufficient access to innovation-related resources. In other words: the local conditions must be optimal (Da Gbadji et al., 2014).

Various factors possibly play a role as determinants of early investments. Just a few economists have tried to quantitatively evaluate macroeconomic determinants of VC. Pottelsberghe and Romain (2004), Jeng and Wells (2000), Ning et al. (2014), Gompers & Lerner (1999) and Schertler (2003) have researched whether inter alia the liquidity of stock markets, labour market rigidities, IPOs (Initial Public Offerings), accounting standards and private pension funds could be drivers of the VC industry. In the Theoretical Framework this will be discussed thoroughly.

This thesis will contribute to the described field of research in multiple ways. It will test a unique set of potential drivers of VC investments and the focus is more on the earliest stages of investment. All VC investments in previous studies also cover later stages of the finance cycle of start-ups, as will be further explained in the Theoretical Framework. The sample used for this research consists of a subset of that, including early investments only. Complementary, data on angel investments is included to cover most early investments. Also, as of yet no other research has covered the years 2012-2016 for the selected twelve European countries. Hence, a recent overview of the industry will be created, which could be useful for investors or management of start-ups. The research question central to this research is:

"How do various macroeconomic and entrepreneurial activity related drivers influence early investments?"

In line with Pottelsberghe and Romain (2004), the expectation is that the intensity of early investments will be in consonance with the cycle of the economy. This means that the number of early investments or the average amount invested will be positively related to the growth of economic quantities like Gross Fixed Capital Formation and GDP. Hence, the first hypothesis:

H1. Early investments are pro-cyclical with respect to Gross Fixed Capital Formation growth and GDP level.

Economic theory predicts that if interest rates fall, the total amount spent on investments will rise, because it will affect more the supply side of investments. However, Gompers and Lerner (1999) and Pottelsberghe and Romain (2004) find a positive relationship between the short and long term interest rate and the level of VC investment. Their explanation is that it affects more the demand side of VC investments, because the higher interest rate causes venture investments to be more attractive than the more traditional bank loan. The effect of the short and long term

interest rate could thus be ambiguous. Short and long term interest rates tend to move in pairs, hence the following hypothesis:

H2. The long and short term interest rates affect the level of early investments in the same direction.

Entrepreneurial activity is linked to the early investment level. Many factors can be considered as influencing variables of the entrepreneurial environment (Tyson et al., 1993). The Global Entrepreneurship Monitor developed measures of multiple aspects of the environment which enable more quantitative research. Some of these measures will be included in this research.

H3. Factors influencing the level of entrepreneurial activity in a positive sense, will also positively affect the level of early investments.

In some of the number of early investment deals in each year for each country that is included in this study, angel investors are involved. Since angel investors on average tend to invest at an earlier stage in the life cycle of a start-up compared to VCs, various drivers might influence this proportion (Cumming & Johan, 2013). Also, when venture firms are confronted with negative changes in the economy they reallocate their investments to a safer later stage (Ning et al., 2015). Angel investors might do the same. Hence, when the economy is prone to positive shocks (in a boom), the early stage investments are likely to increase.

H4. The share of angel investors involved in early investment deals is pro-cyclical.

The sample used in this paper includes the number of early investment deals and the average deal value of 12 countries from the European Union between January 2012 until December 2016. A total of 3310 deals are included. For all these countries and over most of these years the values of 12 different variables have been retrieved that can be considered macroeconomic or related to the entrepreneurial activity.

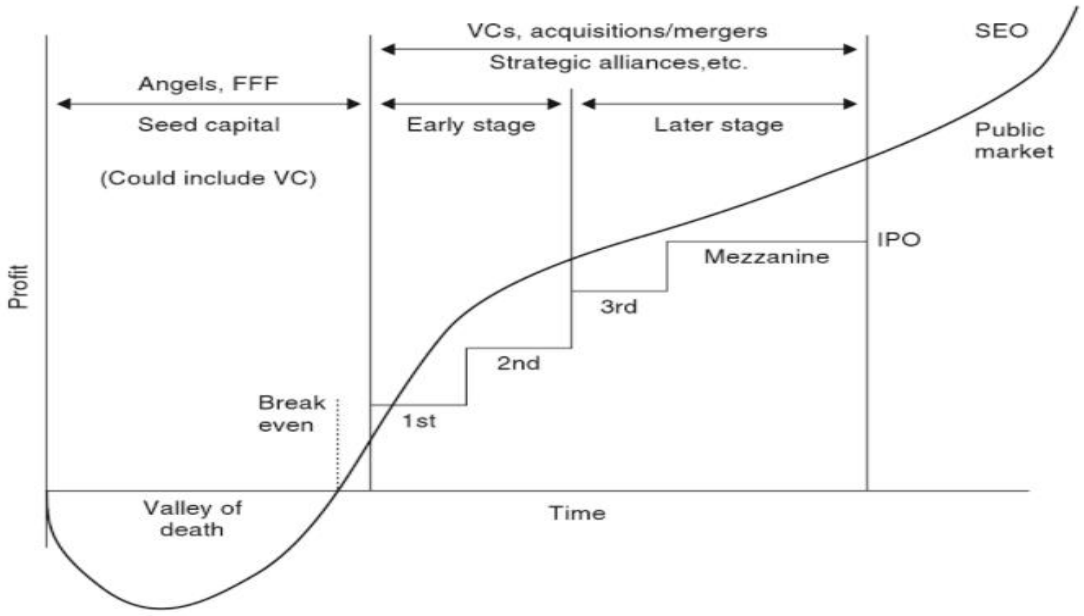
In this thesis the relevant literature, definitions and theories will be discussed first in the chapter Theoretical Framework. After that will be described which methods have been used to assess the relationship between early investments and its drivers. In the same chapter the data definition and selection process will be explained. The near end of the thesis will contain the result section, which is followed by a conclusion of the results and recommendations for further research.

2. Theoretical framework

2.1 Early investments

At first, it is important to keep ahead of definitional confusion and vagueness with respect to early investments. Early investments in this research incorporate seed and early stage VC investments as well as seed and early stage angel investments. In figure 1, the stages of entrepreneurial firm development are depicted, to give a clear idea of the life cycle of start-ups and at which this research is scoped (Cumming & Johan, 2013). This research uses a narrow definition of venture capital. The definition applied in this research is, as the figure shows, narrower than and somewhat different from the broad definition of venture capital.

Figure 1. The stages of entrepreneurial firm development



A common used definition of venture capital is: "the investment by professional investors of long-term, unquoted, risk equity finance in new firms where the primary reward is an eventual capital gain, supplemented by dividend yield." The reward aspect, where the VC plans strategical later stage investments in order to most adequately support its eventual exit strategy, is not the focus here (Robbie & Mike, 1998). Plenty of research has been done in this area. According to Jeng & Wells (2000) not much is known about the early investment area, but they discovered that there is a fundamental difference between early stage and later stage VC (see section 2.5).

VC is usually thought to be fundamental to the rapid growth of high tech companies. Companies like Microsoft, Oracle and Compaq are the proof of this in the US. Quite some research has been done in the field of VC in combination with high technology sectors (Jeng & Wells, 2000). In Europe some of the largest VC-backed exits include Skype, Rocket Internet and Zalando[2]. This

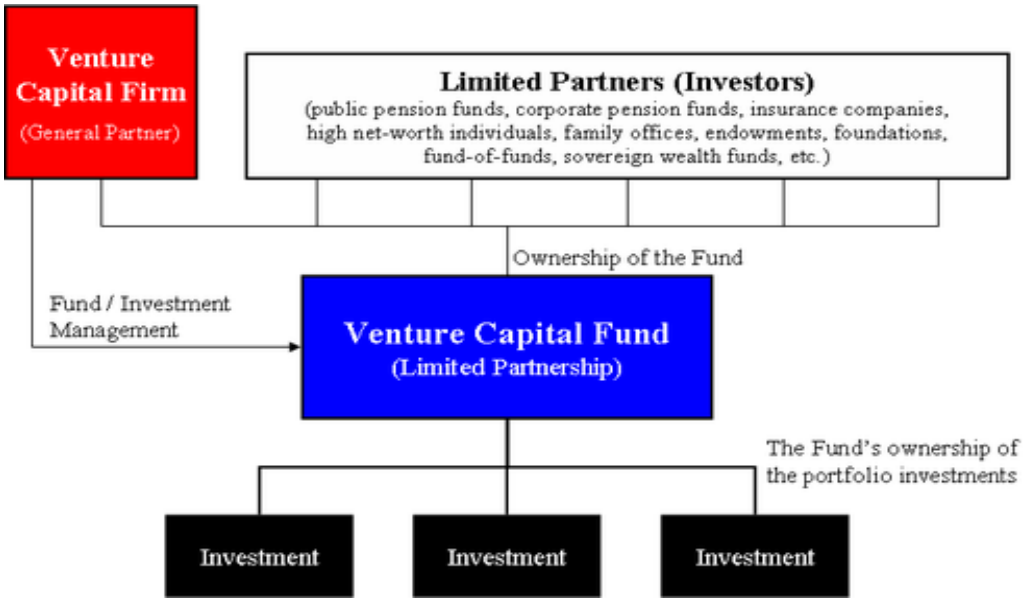
[2] According to a 2015 Dealroom report

shows that naturally not only high tech companies are in VC portfolios. Angel investors are even known to invest more in low-tech industries (Shane, 2008).

2.2 Venture capital fund dynamics

Although tiny differences exist between countries in the legal form of each fund, overall it comes down to the structure in figure 2, which is the limited partnership (Ramsinghani, 2011). Limited partnerships have general partners that run the business (or the funds in this case) and the limited partners, who put in their money and have limited liability. In most countries the maximum loss for limited partners is their initial investment. The limited partners that put money in a VC fund can be public and private pension funds, insurance companies and high net-worth individuals, to name a few. They can put pressure on the VC firm that functions as general partner and manages the fund, because they expect a return on investment (ROI). The VC firm in its turn puts pressure on the entrepreneurial ventures that the fund invests in. The structure is liable to principle-agent problems due to information asymmetry between these principals and agents (Sahlman 1990). A good way of dealing with this is value-sensitive compensation systems. In this way the entrepreneurs will not take advantage of information asymmetry and will be pushed to perform better. The same can be done by limited partners to the VC firm.

Figure 2. Venture capital fund structure



An interesting feature of funds across countries may be how different limited partners influence the fund or the firm's investment decisions. Each type of investor has a different vision on how the fund should be managed. The field of powers influencing the investment decision is quite complex and the more diverse the composition of the group of investors is, the more complex this field of powers will become. In 2016 in Europe the composition of the limited partners in the limited partnership was quite diverse. The 2016 Private Equity Activity Report by Invest Europe

shows that in the UK and Ireland 49% of the invested money came from pension funds, while in France and the Benelux this is only 15%. In the UK and Ireland 2% of the money came from government agencies. In Southern Europe this was 23%. This is to give an indication of how varied the composition of an investors panel can be across countries. In some countries more public organisations are involved than in other countries, both as fund managers and investors. The next subsection will describe how governments influence the dynamics surrounding venture capital investments.

2.3 Venture capital: public and private

An analysis of the public involvement in the VC industry in Europe is provided by Leleux and Surlemont (2003). They give several reasons why public funds distort the market. Publicly managed funds are managed by civil servants, that do not have the experience or motivation that private fund managers have. Hence, they are not as qualified to select or support companies. Another reason is that publicly managed firms can finance start-ups at below-market rates and in this way attract the best ideas, leaving lemons for the privately managed firms. For these statements Leleux and Surlemont do not find empirical evidence. They do find evidence that markets with a larger proportion of publicly backed funds are smaller overall than markets with a larger proportion of privately backed funds. However, they cannot decide whether the lack of funds is forcing more public intervention or that the public intervention is causing impediments to let an efficient VC market emerge.

Engel and Heger (2006) come up with different conclusions. Next to measuring the performance of start-ups funded by VC funds that are managed and backed both privately and publicly, they measure the performance and compare the characteristics of start-ups that are financed by VC funds that are managed by solely publicly owned firms. Start-ups funded by exclusively privately owned VC firms outperform start-ups exclusively publicly owned. Furthermore, they suggest that private firms will be able to provide better support for start-ups, since they have a less non-financial focus than public firms. Public firms tend to focus more on goals like employment and innovation, while private firms' motives are to a high extent of financial nature. Most firms are hybrid in terms of the type of investors in the funds as well as the type of management in the funds. 'Mixed' funds tend to close the gap between the first small rounds and the larger later rounds. A 2016 article from the Dutch paper Financieel Dagblad by Betlem confirms this empirically.

2.4 Angel investments

Less is known about angel investors than about venture capitalists. All research about angel investors is on a micro scale and mostly conducted through interviews and surveys. The influence of macroeconomic drivers and drivers related to the entrepreneurial environment has not been researched. Prowse (1998) describes the angel capital market as the market "where individuals

provide risk capital directly to small, private, often start-up firms." Back then, in 1998, very little was known about the size of the market, the type of firms that angels invest in and the type of individuals that provide it. Usually angel investors invest earlier in the life cycle of a start-up (see figure 1). Even though this is more risky, they exercise less formal control over the investee in the form of contractual provisions to monitor and steer the behaviour of the entrepreneur. Instead they use more informal ways to control their investments. For example, by investing in local start-ups and mitigating the risk by investing in syndication with other angel investors. Moreover, angel investors are most of the time complementary investors (Wong et al., 2009).

The time spent on due diligence, experience of the investor and frequency of interaction between angel and investee positively effects the return on investment (Wiltbank & Boeker, 2007). There also appears to be a difference between what drives an investor to invest in a business that is owned by a family member and a more distant business. Investing in a business that is owned by a family member could less clearly be explained by the same factors as investing in a more distant business. This could mean that investing in a business owned by a family member is based more on altruistic considerations (Maula et al., 2005). Angel investors also seem to play a key role in arranging further finance for start-ups. Here, angels can form a bridge between the very first seed finance and a later (but still early stage) investment by another angel or a venture capitalist (Sørheim, 2005).

2.5 The driving factors of early investments: previous research

Very little research has been conducted about the driving factors behind angel investments. Most of them, however, will be similar to the ones influencing early stage VC investments. Even though the amounts invested by angel investors is smaller than the amounts invested by VC funds, a field of powers influencing demand and supply for these kind of investments will be active. The Methodology and Data section further in this research will introduce the proportion of early investment deals in which an angel investor is involved. Hence, a difference in reaction on this variable will be measurable to some extent.

Various researchers like Poterba (1989) and Gompers and Lerner (1997) have viewed VC from a demand and supply perspective. Different factors influence both sides and an investment equilibrium is reached. It is clear that some kind of bid and ask mechanism is driving VC investments. Entrepreneurs that want to set up an innovative start up cause demand and the supply is caused by the risk capital provided by investors. Hypothetically, it makes sense that some of the VC activity drivers introduced later will affect more the supply side than the demand side or vice versa.

Jeng and Wells (2000) identify six factors affecting VC in the US. Next to these factors they also see capital gains tax rates and the efficiency of bankruptcy procedures as drivers, but were not able to find representative measures for these variables. The factors they include are Initial Public

Offering (IPO), labour market rigidities, financial reporting standards, private pension funds, macroeconomic variables and government programs. They think that a viable exit mechanism is important for VCs with the eye on a future return on their investment. IPO's seem to reap the highest returns. On the other hand, the most common exit strategy is trade sales, which encompass a sale of start-up to a larger company. Between 1991 and 1995 trade sales accounted for 30% of the exit strategies in the UK and for 76% in Portugal[3]. Labour market rigidities are regarded as the reason why the VC industry in Europe was not as prevalent as in the US during the 1990s. When labour market rigidity is high, the demand for VC is expected to fall. It makes hiring employees more difficult for firms. Especially start-ups want to be flexible on that score, because they strongly focus on the short term. With strict accounting standards, VCs have to spend less time picking and monitoring start-ups, because it will overcome some cost of asymmetric information.

Money from private pension funds is regarded by Jeng and Wells as a factor influencing the supply side of VC only. The advantage of receiving money from private pension funds is that it provides a large amount of investing capital at once. There was no mention of why they did not include public pension funds. With macroeconomic variables they refer to variables that represent macroeconomic fluctuations. GDP growth is the variable that they expect to be positively related to VC investing, since start-up activity increases the demand for VC funds. Also, they include market capitalization as an independent variable, since they believe that this variable has a positive influence on the entrepreneurial environment. The final driver introduced by Jeng and Wells is government programs. Based on a study by Gompers and Lerner (1997), government programs have benefits, but O'Shea (1996) points out that too much government interference in the VC industry may be disadvantageous towards the development of a private VC sector.

Jeng and Wells (2000) see a strong difference in the influence that the factors have on early stage investments and on later stage investments. In the end, for early stage investments, the only factor that has a significant positive influence is government programs. Labour market rigidities have a significant negative influence on early stage investments, but not on later stage investments. IPOs have no effect on early stage investments across countries, but strongly affect later stage investments. Private pension funds only have an effect over time, but not across countries. For accounting standards they find a significant negative coefficient, but this could be caused by the proxy variable they chose for it, hence the result is not considered right.

Schertler (2003) focusses more on early stage VC. Like Jeng and Wells she emphasises the importance of the tax system for the demand side, since it determines start-up revenues and profits. The higher the capital gains tax rate, the lower the level of entrepreneurial activity. Nevertheless, it is not included as an independent variable. The factors mentioned that influence

[3] According to EVCA yearbooks

VC activity are the price of venture capital, institutional regulations, labour market rigidity, stock market liquidity and human capital endowment. VC investments are scaled by GDP and by GCF (Gross Capital Formation), so the investments can be viewed relatively to the size of an economy or the capital component of an economy.

A difference with Jeng and Wells is that Schertlers research is based on a selection of 14 European countries. Also, an additional argument in favour of labour market rigidity as a driver of VC is formulated. If labour market rigidity is high, the expected pay-off for an employee to become an entrepreneur is lower. This is because when the employee fails as an entrepreneur, it takes longer for him to get his job back in a rigid labour market than in a labour market that is more flexible. Besides, his income is safer as an employee with a rigid market.

Schertler follows an idea brought up by Black and Gilson (1998). The more liquid a stock market is, scaled by the size of the economy, the higher the demand for VC finance. Stock market liquidity is a measure for the extent to which banks play a role in corporate governance. The more liquid the market, the less influence banks have and the more vital the VC industry is. A liquid stock market goes hand in hand with relatively small banks with respect to companies (see also section 2.6).

According to Schertler, human capital endowment influences the level of VC investments. Human capital refers to the potential to innovate by individuals. The better the human capital endowment, the more successful ideas will be created and the more likely VC finance emerges. Universities and other educational institutions play an important role in creating the level of human capital. In the research, human capital endowment is measured as the number of patents and the number of employees in R&D departments in the business sector.

In the end, Schertler finds the liquidity of stock markets to have a significant positive effect, where Jeng and Wells find no significant relationship. Human capital endowment also has a significant positive impact on early investments. Thus, the higher the share of the population with specific skills to develop high-tech business ideas, the higher the level of VC investments. Labour market rigidity also turns out to have a positive impact, which can be caused by the labour-capital ratio in the high-technology sector. High-technology firms operating in rigid labour markets might demand more capital than firms in flexible markets. Moreover, the growth rate of the stock market capitalisation does not have a significant impact.

Another paper by Pottelsberghe and Romain (2004) tries to identify the determinants of VC in 16 OECD countries from all over the world. The tested determinants are categorized in three groups: macroeconomic conditions, technological opportunity and the entrepreneurial environment. Where Schertler focusses less on the macroeconomic conditions, Pottelsberghe and Romain take in this area a similar approach to Jeng and Wells, because they take GDP growth as a measure for the macroeconomic conditions. Next to this they also include the long term and short term

interest rates, because economic theory predicts that when interest rates fall, investment rises. Technological opportunity is what Schertler calls human capital. In the research it is measured as the number of patents and the total R&D expenditures. The variables that Pottelsberghe and Romain included representing the entrepreneurial environment are the employment protection index (as a measure of labour market rigidity), the Total Entrepreneurial Activity (TEA)-index (see section 3.1) and the corporate income tax rate. Pottelberghe and Romain (2004) are the first to add the TEA-index and the corporate income tax rate to their model, though Jeng and Wells(2000) and Schertler(2003) already mention the influence of this tax rate on the level of VC investments. Also, Félix et al. (2012) claim that they were the first to consider the effect of the entrepreneurial environment on VC investments.

GDP growth has a significant effect on VC intensity, hence confirming that VC is pro-cyclical. Both the short-term and long-term interest rates had the strongest positive significant effect of all variables. This is contradicting economic theory, but Pottelberghe and Romain (2004) interpret it as a sign that the demand side is stronger, meaning that entrepreneurs in times of high interest rates would rather opt for venture capital than for the more traditional bank loan. The effect of the long and short term interest rates could be ambiguous. All measures representing the impact of technological opportunity have a significant positive impact. It shows that VC activity is sensitive to the dynamics of research activities and the level of innovation output. When including TEA as an interacting variable with the total R&D expenditures, it causes a jointly significant effect. The rest of the variables representing the entrepreneurial environment are stable and do not significantly affect VC activity.

Ning et al. (2015) examine the driving forces of VC in the US. They measure VC intensity by the total amount invested, the number of deals and the average amount per deal. The findings are that VC intensity is significantly influenced by macroeconomic factors and public market signals like the 2000 high-tech bubble and the 2008 global financial crisis. An effect was measured that in response to dramatic changes in the economy, investors adjusted their risk preferences and allocated their investments more to later stages.

2.6 The driving factors of early investments considered in this research

Based on previous research and in accordance with the particular field of investments the driving factors that I expect to have an influence on the level of VC are categorized by two groups: macroeconomic drivers and drivers that represent the entrepreneurial environment. The macroeconomic variables that I expect to have an effect on VC activity are GDP, the long and short term interest rates and the Gross Fixed Capital Formation (GFCF) growth. The variables representing the entrepreneurial environment are Patents, Total early-stage Entrepreneurial Activity (TEA), the Accessibility of Finance, Governmental Policy and Education. In this section the expected effect of each of the variables is discussed.

The Gross Domestic Product indicates how well developed and scaled a country's economy is. It measures its total size. GDP will probably have a positive effect on VC activity, because larger economies have more capacity to invest. The reason why GDP growth is not a variable that is included is that it would be too much correlated with GFCF growth, which is assumed to be a better regressor of VC activity. Why? The GFCF growth represents better the growth in the capital component of the economy, which is thought to absorb a great deal of invested money according to Schertler (2003). The argument in favour of using GDP and not IPO as a potential influencing factor of early investments resides in the finding by Gompers & Lerner (1998). They found that GDP is strongly correlated with IPO and that GDP serves as a proxy for exit opportunities. Besides, Jeng and Wells (2000) find that IPOs do not influence early investments. They only influence (strongly positive) later stage investments. A logical explanation for this would be that when VCs make an early stage deal, they do not immediately have an IPO as exit strategy in mind. IPOs occur only to a selected few.

As explained before, the long and short term interest rates can have ambiguous effects (see Introduction and section 2.5). Most of the time they move in pairs, which is what the Pure Expectations Theory predicts (Langetieg, 1980). This is also what is reflected in the data of this research (see section 3.2 and Appendix F). Hence, the expectation is that both rates will influence early investment activity in the same direction.

The variable Patents is a proxy of the human capital dimension in the entrepreneurial environment (Schertler, 2003). It depicts how well a country is able to produce new ideas that help a country to innovate and develop. Pottelsberghe and Romain (2004) describe Patents as a proxy of technological opportunity and an indicator of innovative output. Patents provide a clear picture of how opportunity is exploited by entrepreneurs. Patents are expected to positively influence early investment activity. According to Graham et al. (2009) venture backed enterprises hold more patents, regardless of the industry.

Labour market rigidities as an independent variable is represented through TEA, because TEA functions as a proxy for labour market rigidities. The more rigid the labour market, the harder it is to find a job and the higher the expected pay-off as an entrepreneur. But on the other hand, when coming up with an idea and planning ahead for the development of that idea, the flexibility of the labour market is definitely something to consider. It also seems logical to assume that the more flexible the labour market, the easier it gets for an entrepreneur to hire and fire employees and thus to thrive better as an entrepreneur. That is why labour market rigidities can affect early investment activity in opposite ways and hence make the effect ambiguous. TEA is therefore a better parameter. Besides, data from OECD concerning labour market rigidities is available up until 2013.

The accessibility of finance is not often mentioned in previous papers that try to quantitatively measure the effect of macroeconomic (and entrepreneurial environment related) variables on early investment activity. In case of high-tech start-ups, innovator firms tend to obtain an early investment more often than imitator firms (Hellmann & Puri, 2015). Also, start-ups in general face a 'finance gap'. After their very first investment from FFF (fool, friends and family) and a business angel, they usually seek for a VC investment, but from the very first to a second investment is quite a difference (Tyebjee & Bruno, 1984). In that context, the accessibility of financial resources really plays a role. The variable (accessibility of) Finance is expected to positively influence early stage investments.

The relationship between government policy and early investments can be viewed from different angles. Important is how government policy is defined. Here the definition of the Global Entrepreneurship Monitor (see section 3) is used. Quite a few scholars have been writing about the relationship between early investments and government policy. Many of these findings are summarized by Murray (2007). Important features that influence early investments are tax policy, the operation of financial markets and the policy affecting the entrepreneurial climate. Capital gains taxes reduce the amount of entrepreneurs, while wage taxes have the opposite effect. Progressive taxes slow down entrepreneurs and the expansion of innovative industries. Subsidies have a stimulating effect (Keuschnigg & Nielsen, 2003). Multiple academics share the view that government commitment is of great importance, for example Gilbert et al. (2004) and Botazzai and Da Rin (2002). They have found significant evidence of an increase in the amount of venture activity initiated and financed by the government on an international scale. In the end, it all boils down to how well the government makes an effort to let the private investment industry flourish. It is expected that early investment activity will increase the more a government makes an effort.

Another aspect that is expected to positively influence early investment activity is education aimed at creating awareness about the option to become an entrepreneur. It has both a direct positive effect on an entrepreneurs business income and an indirect positive effect, because it decreases capital constraints, which in its turn increases the entrepreneurs income (Parker & Van Praag, 2006). When a country's educational system pays a lot of attention to making students more aware of the possibility of becoming an entrepreneur and even encourages them, this will probably be reflected in the amount of people actually becoming an entrepreneur, which will cause more need for early investments. Entrepreneurial returns form a large part of the income in an economy. Also, the economic value that is created as a consequence of the entrepreneurial ability that is gained by education is identifiable and measurable (Schultz, 1980).

3. Methodology and data

In section 2.6, the theory behind the selected variables influencing early investments is explained. In this chapter the data that represents these variables is discussed. In order to get valid results, the data needs to be properly selected and analysed. This chapter describes that process from selecting the right data to the application of statistical analyses. Firstly I will explain the process of data collection and analyse the sample. Thereafter, in the second subchapter a detailed explanation is provided of the statistical tools that have been used on the data in order to test the hypotheses. In addition, the section explains why time-constant differences between countries are likely to exist and how this is covered in some of the models.

3.1 Data definition and selection

A total of 12 EU countries are included over the period from January 2012 to December 2016: Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. For each country and for almost each year values of 12 different variables[4] have been included into the dataset. Hence, the panel data set is partially balanced. Further on, results will be estimated with balanced panel datasets as well as with a slightly unbalanced panel dataset. More about this distinction in the Sample Analysis section.

Table 1. Variable description in short

Variable	Description	Source
ND	Number of Deals. All start up investments by VCs and angel investors in a specific year for a specific country.	Zephyr
ADV	Average Deal Value. The average deal value of all start up investments by VCs and angel investors in a specific year for a specific country. ADV is expressed in thousands of euros.	Zephyr
Ang	Share of ND where an angel investor is involved. It could mean that one angel investor took care of the entire amount, that multiple angel investors did or that there was a combination of VCs and angel investors.	Zephyr
GFCFgr	Growth rate of the Gross Fixed Capital Formation.	OECD
GDP	Real Gross Domestic Product (in billions of euros).	OECD
rLT	Long term interest rate.	OECD
rST	Short term interest rate	OECD
Patent	Number of patents granted by the European Patent Office	European Patent Office
TEA	Total early-stage Entrepreneurial Activity.	GEM (Global Enterpreneurship Monitor)

Finance	Accessibility of financial resources for start-ups.	GEM
Policy	The extent to which public policies that are supportive to the entrepreneurial activity are represented. I.a. taxes, bureaucracy, regulations and business registration.	GEM
Education	Post school entrepreneurial education and training.	GEM

This thesis focusses on early investments. To define this more precisely: start up investments done by VCs and angel investors. The 3310 deals in total have been retrieved from the Zephyr database, which contains data about investments originating back to 1997. The search function in Zephyr can be modified in such a way that it searches per category and optionally per subcategory. The following (sub)categories were installed and specified: country, time period, company status, deal type, deal financing and sub-deal type.

For the category country, either the Target company or the Acquirer has to be located in the selected country. The Vendor is not relevant. At the time period category the option 'Completed' is selected, in order to select only the deals that have been completed. All rumoured and assumed deals are irrelevant. Just to be sure, only unlisted targets are selected under the company status category.

Under 'deals financing' the labels 'angel investment', 'venture capital', 'seed', '1st round' and '2nd round' have been selected[5]. 'Angel investment' is defined according to the Zephyr Glossary: "Angel Investment would be as a financing method when a 'business angel' invests in a firm that is often a start-up or developing company. A business angel is an individual that invests in companies in much the same way that venture capital companies do. This can occur with business angels acting individually, as a group, or via an angel investment agency." The Glossary provides a definition for 'venture capital', too: "Venture Capital would be added as a financing method when the deal contains an element of Venture Capital activity on the Acquirer's side of the deal via a Development Capital deal." 'Development Capital' is the collective name for all different investment rounds, where 'seed', '1st round' and '2nd round' are part of the options. To define this further, under 'sub-deal type' the option 'start up' is selected, which picks deals that involves start-ups.

After having selected all early investments publicly available through the Zephyr database, the number of deals (ND) and average deal value (ADV) per country per year are determined or calculated. These two measures of early investments are included, because they both represent early investments in a slightly different way. The number of deals are more depending on the final

[5] In line with the definition of early investments from the Theoretical Framework

investment decision of the investor: "Do I invest or not?". In the case of average deal value this this question has already been answered and focusses more on: "How much do I invest?".

Also, by selecting only the 'Angel investment' option, the number of angel investments could be calculated separately. Subsequently, this number was divided by the total number of deals in order to get the share of deals where an angel investor was involved (Ang). In this way a potential difference in effect can be spotted that the independent variables[6] have on either angel investments or VC investments.

The macroeconomic drivers that have been included in the sample as independent variables are GFCFgr, GDP, rLT and rST. Each of these variables is retrieved from OECD databases. The Gross Fixed Capital Formation is defined as "the acquisition and creation of assets by producers for their own use, minus disposals of produced fixed assets." It measures the investment in fixed assets by the business sector, government and households. On average in Europe the business sector covers more than half of the GFCF.

The Organisation for Economic Co-operation and Development (OECD) defines the Gross Domestic Product (GDP) as: "Gross domestic product is an aggregate measure of production equal to the sum of the gross values added of all resident institutional units engaged in production (plus any taxes, and minus any subsidies, on products not included in the value of their outputs). The sum of the final uses of goods and services (all uses except intermediate consumption) measured in purchasers' prices, less the value of imports of goods and services, or the sum of primary incomes distributed by resident producer units."

The long term interest rate (rLT) refers to the trading price of government bonds maturing in ten years. It is an average of all daily interest rates, measured in percentages. Only the trading price on official markets is considered, not the rate at which the loans were issued. Also, the capital repayment of the bonds is guaranteed by the government. The short term interest rate (rST) refers to the yearly averages of daily rates, based on three month money market rates, measured in percentages.

Patents in Europe are granted by the European Patent Office. Yearly, around one third of all filed patents are granted on average in Europe. In this research, only granted patents are considered. The patents represent technological inventions particularly. Between January 2012 and December 2016 23,8% of European patents were granted in the category 'electrical engineering', 16,8% in 'instruments', 24,6% in 'chemistry', 27,3% in 'mechanical engineering' and 7,5% in 'other fields'.[7]

All other drivers considered in this research that are related to entrepreneurial activity have been retrieved from the data section from the Global Entrepreneurship Monitor (GEM). The GEM

[6] The variables below the dashed line in Table 1
[7] Data through the European Patent Office; epo.org/searching-for-patents/data/bulk-data-sets

studies entrepreneurship by providing reports and information. It functions as a resource for international organisations like the World Bank, UN and OECD. The GEM variables portraying entrepreneurial activity are compiled through two large surveys that are conducted in each country: the Adult Population Survey, in which at least a sample of 2000 adults is covered, and the National Expert Survey, which surveys a group of at least 36 business and industry experts. This is a very professional and extensive process, that quantifies variables concerning entrepreneurial activity and aspirations. To make sure that the data is representative across all countries involved the data is cleaned, coded and weighed.

TEA stands for Total early-stage Entrepreneurial Activity and represents the percentage of the 18-64 year old population who are either a nascent entrepreneur or owner-manager of a new business. Nascent entrepreneurs are "actively involved in setting up a business they will own or co-own; this business has not paid salaries, wages or any other payments to the owner for more than three months." An owner-manager of a new business either owns and manages "a running business that has paid salaries, wages, or any other payment to the owners for more than three months, but not more than 42 months."

The variable Finance refers to the availability of financial resources for start-ups. How easy it is for them to get financial support for their ideas. This does not only concern VC and angel investments, but also other resources like bank loans, subsidies or any informal investment.

The variable that measures governmental influences is Policy. It relates to all responses to the surveys that form a support or constraint to entrepreneurship. For example taxes, regulations concerning dismissal of staff[8], bureaucracy, agencies and business registration. In other words: all the different ways in which the government influences the entrepreneurial environment.

The variable Education can be defined as the extent to which post school institutions provide in any way or on any level knowledge about the advantages of becoming an entrepreneur and how to be a successful entrepreneur.

3.2 Sample analysis

The panel data set is unbalanced, since for the variables TEA, Finance, Policy, and Education only 53 observations were available. The 7 lacking observations were due to years in which the GEM report for a certain country or for multiple countries[9] could not be published and thus no data about the variables was publicly available. Stata uses list-wise deletion. This means that if a regression would be performed with both variables that count 53 observations and 60 observations Stata drops every observation for which at least one variable has a missing value. A disadvantage is that it reduces the statistical power quite a lot, especially with observations as few

[8] Incorporates labour market rigidities

[9] 7 missing values for each of the following variables: TEA, Finance, Policy, Education. The missing values have occurred in Austria, Belgium, Denmark and France

as 53. Also, not all data is used. If for one observation a missing value across one of the variables is reported, all values of all variables of that observation are dropped. Mean imputation has been applied in order to create a strongly balanced panel data set. Missing values have been replaced with the sample mean of that variable. The variables for which missing values have been replaced more or less follow a normal distribution, otherwise a median imputation would have been used (Little, 1992).

Table 2. Descriptive statistics: no mean imputation

VARIABLES	N	Mean	Std. Dev.	Min.	Max.
ND	60	55.17	67.19	1	311
ADV	60	3,094	3,504	361.4	19,765
Ang	60	0.385	0.242	0	1
GFCFgr	60	0.909	4.520	-16.62	10.96
GDP	60	1,040	932.2	168.4	3,133
rLT	60	2.019	1.736	0.0900	10.55
rST	60	0.200	0.356	-0.659	1.250
Patent	60	2,703	3,912	22	18,728
TEA	53	6.682	1.952	3.430	11
Finance	53	2.707	0.311	1.790	3.430
Policy	53	2.752	0.429	1.900	3.960
Education	53	2.819	0.338	2.150	3.570

Table 3. Descriptive statistics: mean imputation

VARIABLES	N	Mean	Std. Dev.	Min.	Max.
ND	60	55.17	67.19	1	311
ADV	60	3,094	3,504	361.4	19,765
Ang	60	0.385	0.242	0	1
GFCFgr	60	0.909	4.520	-16.62	10.96
GDP	60	1,040	932.2	168.4	3,133
rLT	60	2.019	1.736	0.0900	10.55
rST	60	0.200	0.356	-0.659	1.250
Patent	60	2,703	3,912	22	18,728
TEA	*60*[10]	6.682	*1.833*	3.430	11
Finance	*60*	2.707	*0.292*	1.790	3.430
Policy	*60*	2.752	*0.402*	1.900	3.960
Education	*60*	2.819	*0.317*	2.150	3.570

[10] All values in *italic* are different with respect to Table 2

As becomes clear from Table 3, the mean of the variables stays the same, but the standard deviation and hence the variation decreases a little bit. This means variation is underestimated slightly.

For regression and panel regression analyses the natural logarithm has been taken of the variables ND, ADV, rLT and Patent in order to compensate for the highly significant skewness. In Appendices A, B, C and D histograms have been included to show the distribution of the variables before and after taking the natural logarithms.

On the following page, the means of the variables representing entrepreneurial activity are shown per country and per year. See Appendix E and F for precise values. That France, the UK and Germany have the highest number of early investment deals should come as no surprise as they also have the largest economies (Ning et al., 2014). Austria, Belgium, Denmark and Portugal show the lowest investment activity. Austria, Germany, France and Spain close the deals with the highest values on average. For Austria the real number could be lower, because the number of deals that were available for calculating the average is low. Italy, the Netherlands and Portugal have the lowest average deal value. Most angel investors are involved in Austria, Finland and France and the least in Denmark, the Netherlands and Portugal. No data is available on the number of investors active in each country, but this gives an idea of in which countries angel investors are more actively involved than in others, or at least relatively to VCs. An explanation for the share of angel investors could be found in the mix of industries from which start-ups emerge in a country. Angel investors typically invest in low-tech industries, at least in the US (Shane, 2008).

Considering the trends in each of the three figures on the next page, it seems that at least the number of deals steadily increases over time for most countries. France almost has a straight increasing line. The steady increase over time is a bit more ambiguous for the average deal value. Due to a lack of available of data some values are likely to be inaccurate. The deal information available for each country is likely a subset of the total number of deals done. Probably, the lower the number, the more inaccurate the values. The same is occurring for the share of deals where an angel investor was involved. Overall, the least deals were available in Zephyr for the year 2012. Even though the trend in the number of deals is in accordance with the 2016 Dealroom report mentioned in the introduction, the deal information in 2012 for some countries is defective.

Figure 2. Number of deals per country per year

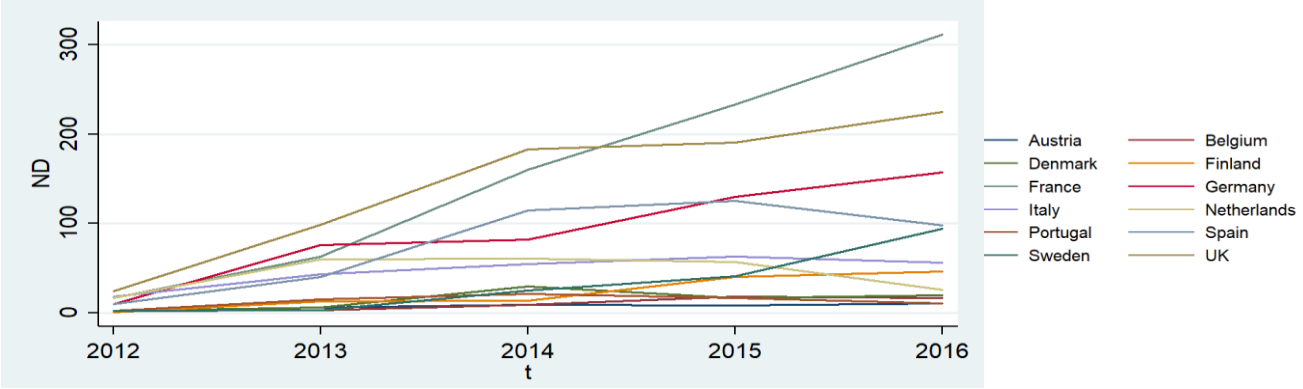


Figure 3. Average deal value per country per year

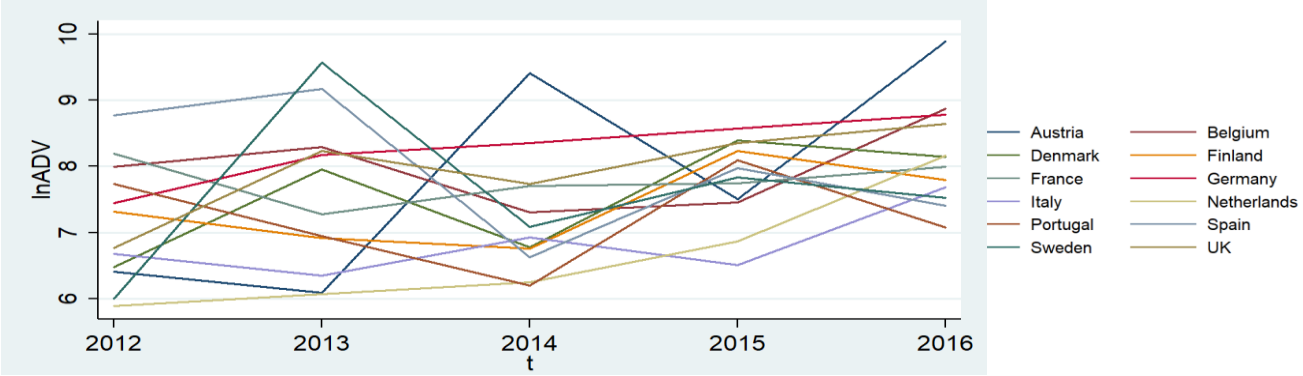


Figure 4. Proportion of angel investors involved per country per year

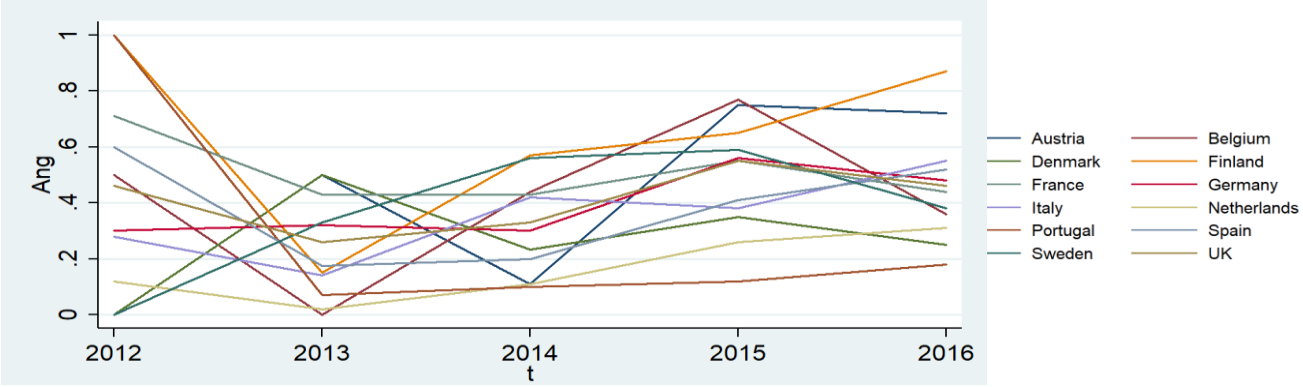


Table 4 in Appendix E shows some summary statistics that seem remarkable. The long term interest rate has been the highest over the observed years in Portugal, Spain and Italy, which are also economically speaking the most unstable countries. On the other hand, more stable economies like Germany, Denmark and the Netherlands have the lowest long term interest rates. The short term interest rate is equal for all countries that have the euro as currency, but varies per year. It is based on key short term interest-rates such as Eonia and Euribor, the rates at which major European banks like Deutsche Bank, ING and BNP-Paribas borrow funds from each other. Also, we see that the short and long term term interest rate move in pairs, like the Pure Expectation Theory would predict.

Patents represent the tech sectors in particular. Germany has roughly three times as much patents as France, the next in line. When observed as a proportion of GDP, Germany still leads convincingly. This points out that Germany has by far the most tech driven industry from all countries in the sample. In line with the earlier mentioned research by Shane in 2008 it would be expected that a tech driven industry goes hand in hand with low angel activity. However, the average proportion of angel investors involved is moderate compared to other countries (0.392).

High correlation could be an indication of multicollinearity. Multicollinearity could heavily disturb outcomes, so it should be reckoned with. The highest calculated correlation is between GDP and Patent with r = 0.78. The VIF[11] (Variance Inflation Factor) for these variables is 2.58 (see table 6, Appendix G). Second highest correlation is between GFCFgr and rLT with r = -0.74. This gives a VIF of 2.22. Following rules of thumb this does not give a strong indication of multicollinearity between variables.

3.3 Methodology

In this subchapter I will describe which statistical methods have been applied in order to test the hypotheses. The effect of various independent variables (the drivers) will be tested on a range of dependent variables representing early investment activity.

For panel data a number of options are available. The first decision to be made is between pooled ordinary least squares (OLS) regression and other panel regressions like the fixed effects model (within estimator) and the random effects model. Pooled OLS is a normal OLS regression run on panel data. A disadvantage of pooled OLS models is that they disregards individual effects. However, it can control for fixed effects, just as the fixed effects model. Not by using demeaned variables, but directly by using dummies.

Intuitively, the data asks for a model that covers fixed effects. The real model describing the real life situation has country specific effects that are fixed over time and also time specific effects that are the same for each country. Countries are prone to have fixed effects. All the factors that differ from one country to the other, that are constant over time and not reflected through explaining variables fall under the country fixed effect. Each country is different with respect to historical endowment, demographics and institutional factors that are (approximately) time-invariant. Countries are shaped by wars, culture, the character of the population and their institutions. The environment that arises hereby influences the investment decision, since these factors are of great economic importance. Especially the design of the institutions and the character of investors are significantly decisive when it comes to investment behaviour.

[11] The following formula is used for the Variance Inflation Factor: $\frac{1}{(1-R^2)}$, where R^2 is the coefficient of determination of a simple regression with the two variables in question used as the only two independent variables.

In addition can be controlled for a time specific effect. Time dummies have to be added to the regression. I assume that the real model is prone to time specific effects. Over the past few years numerous events have taken place that are year specific and may have influenced early investors in each country. All the dynamics surrounding a deal change every year. Their prognosis for the future decides whether they invest or not. The extent to which they trust entrepreneurs and believe they will make profits in the future is a key factor in the investment decision. Expected interest rates are a part of this prognosis. The ECB makes promises to investors about the interest rates, artificially controlled by the quantitative easing programs (Khemraj & Wells, 2016). Of course the interest rates influence early investment activity, but these are already included in the model.

For each of the three dependent variables (and its regressors) the Breusch-Pagan test is performed. This test determines whether the data is poolable. In case of ND as dependent variable, the test is significant,[12] which implies a preference of the random effects model over OLS. The subsequently performed Hausman test is also significant,[13] which points towards the fixed effects model to be the most efficient. For the ADV as well as for Ang as dependent variables the test is insignificant[14], which shows not enough country specific error. This points towards pooled OLS as the appropriate model. However, due to lack of data, the economic arguments provided in the two paragraphs above are decisive in whether fixed effects are involved or not. The fixed effect model automatically controls for a country specific effects by using joint group-specific demeaning. Time dummies can be added. Both will show the same results, but are different ways of implementing a regression that includes fixed effects (Wooldridge, 2001). However, the standard errors and r-squared values are different (see Results).

Equation 1 represents an OLS model, that takes into account that country and time are the panel units of observation (the model responds to model 1 in Tables 7, 9 and 11 in the Results section):

$$y_{it} = \beta_0 + \beta_1 GFCFgr_{it} + \beta_2 GDP_{it} + \beta_3 rLT_{it} + \beta_4 rST_{it} + \beta_5 Patent_{it} + \beta_6 TEA_{it} + \beta_7 Finance_{it} + \beta_8 Policy_{it} + \beta_9 Education_{it} + \upsilon_{it} \quad (1)$$

y_{it} = either of the dependent variables ND, ADV and Ang over years t=2012,…,2016 and across i countries (from Austria until the United Kingdom)

β_0 = intercept

$\beta_1, \dots, \beta_9$ = coefficients for each corresponding

υ_{it} = idiosyncratic error

[12] P-value: 0.0064

[13] P-value: 0.0862

[14] P-value ADV: 0.4957; P-value Ang: 0.1904

A Wald test to whether country dummies should be included turned out to be highly significant (p-value: 0.0000) for the pooled OLS model. The fixed effects model already assumes and takes care of country specific effects by demeaning. and the fixed effects model. The pooled OLS model with country dummies (country fixed effects) is described in equation (2) (see model 2 in Table 7, 9 and 11). Austria is used as a reference point, so for this country no dummy variable is included.

$$y_{it} = \beta_0 + \beta_1 GFCFgr_{it} + \beta_2 GDP_{it} + \beta_3 rLT_{it} + \beta_4 rST_{it} + \beta_5 Patent_{it} + \beta_6 TEA_{it} + \beta_7 Finance_{it} + \beta_8 Policy_{it} + \beta_9 Education_{it} + \mu_1 \pi_{BE} + \cdots + \mu_{11} \pi_{UK} + \upsilon_{it} \quad (2)$$

$\mu_1,\ldots, \mu_{11}$ = coefficients of country dummies

$\pi_{BE},\ldots, \pi_{UK}$ = dummy variables for countries, with in subscript the country-code

A similar Wald test can be done to check for time dummies. The Wald test is again highly significant (p-value: 0.0000), both for the pooled OLS and fixed effects model. Model (3) shows what the pooled OLS model looks like with dummies for country and years (country and time fixed effects). This model is used gain the results from model 3 in Table 7. The year 2012 is used as reference, hence not included, because that would lead to a dummy variable trap.

$$y_{it} = \beta_0 + \beta_1 GFCFgr_{it} + \beta_2 GDP_{it} + \beta_3 rLT_{it} + \beta_4 rST_{it} + \beta_5 Patent_{it} + \beta_6 TEA_{it} + \beta_7 Finance_{it} + \beta_8 Policy_{it} + \beta_9 Education_{it} + \gamma_1 \delta_{2013} + \cdots + \gamma_4 \delta_{2016} + \mu_1 \pi_{BE} + \cdots + \mu_{11} \pi_{UK} + \upsilon_{it} \quad (3)$$

$\gamma_1,\ldots, \gamma_4$ = coefficients of time dummies

$\delta_{2013}, \ldots, \delta_{2016}$ = dummy variables for the years 2013-2016

The fixed effects model eliminates α_i and with that the unobserved heterogeneity by subtracting the time-averaged value of α_i, which is $\bar{\alpha}_i$. Note that α_i is equal to $\bar{\alpha}_i$, since its effect is already time-invariant. It does subtract the time-averaged values of the dependent, independent variables, time-dependent error (year specific effect) and the idiosyncratic error as well, as regression (4) shows. The intercept β_0 is also cancelled out. Subsequently, the regression is simplified into regression (5).

$$y_{it} - \bar{y}_i = (\beta_0 - \bar{\beta}_0) + \beta_1 (GFCFgr_{it} - \overline{GFCFgr_i}) + \beta_2 (GDP_{it} - \overline{GDP_i}) + \beta_3 (rLT_{it} - \overline{rLT_i}) + \beta_4 (rST_{it} - \overline{rST_i}) + \beta_5 (Patent_{it} - \overline{Patent_i}) + \beta_6 (TEA_{it} - \overline{TEA_i}) + \beta_7 (Finance_{it} - \overline{Finance_i}) + \beta_8 (Policy_{it} - \overline{Policy_i}) + \beta_9 (Education_{it} - \overline{Education_i}) + (\alpha_i - \bar{\alpha}_i) + (\upsilon_{it} - \bar{\upsilon}_i) \quad (4)$$

$$\widetilde{y_{it}} = \beta_1 \widetilde{GFCFgr_{it}} + \beta_2 \widetilde{GDP_{it}} + \beta_3 \widetilde{rLT_{it}} + \beta_4 \widetilde{rST_{it}} + \beta_5 \widetilde{Patent_{it}} + \beta_6 \widetilde{TEA_{it}} + \beta_7 \widetilde{Finance_{it}} + \beta_8 \widetilde{Policy_{it}} + \beta_9 \widetilde{Education_{it}} + (\upsilon_{it} - \bar{\upsilon}_i) \quad (5)$$

α_i = country fixed effect

As mentioned before, time dummies should also be included for the fixed effects model to implement time fixed effects. The model with time dummies included is shown in regression (6). Hence, this model includes both country and time fixed effects.

$$\widetilde{y_{it}} = \beta_1 \widetilde{GFCFgr_{it}} + \beta_2 \widetilde{GDP_{it}} + \beta_3 \widetilde{rLT_{it}} + \beta_4 \widetilde{rST_{it}} + \beta_5 \widetilde{Patent_{it}} + \beta_6 \widetilde{TEA_{it}} + \beta_7 \widetilde{Finance_{it}} + \beta_8 \widetilde{Policy_{it}} + \beta_9 \widetilde{Education_{it}} + \gamma_1 \delta_{2013} + \cdots + \gamma_4 \delta_{2016} + (v_{it} - \bar{v}_i) \quad \mathbf{(6)}$$

Equation (5) and (6) will yield almost exactly the same result as equation (2) and (3). Nevertheless, they are included, since the fixed effects model provides more consistent estimates. In the results section is shown that only the standard error differs.

Taking in consideration that the time series of the panel in this research is quite short, the case of serial correlation is very unlikely. Hence, it is not tested for.

4. Results

In this section the regression results will be shown. In order to determine whether the theoretically identified driving forces significantly impact the level of early investment, dynamic panel data regressions as well as regular regressions are employed. The level of early investment is measured by three different dependent variables[15], all representing early investments in a slightly different way. The results will be presented for each different measure of early investment.

The fixed effects GLS model with fixed effects for country and year (Table 7, 9 and 11) respectively best fits the real life situation in theory. On the other hand, this model asks a lot from the data, so less demanding models are also included.

4.1 The effect of drivers on the Number of Deals

The results of three versions of pooled OLS regressions and two of the fixed effects GLS (Generalized Least Squares) panel regressions are presented in Table 7. The explanatory power of each of the six models is quite high, even when noting that there are quite some variables in each model. R-squared ranges from 0.732 to 0.931. As predicted, the fixed effects models (5 and 6) give the same results with respect to magnitude, sign and significance as model 2 and 3. They do differ however, in standard error and r-squared. Naturally, the r-squared of model 2 and 3 is higher than model 5 and 6, respectively, because of the country dummies. The year fixed effect seems to be stronger than the country fixed effect. Nearly all time dummies are significant, whereas in the models where country specific effects are included (model 2,3 and 5) a maximum of a quarter of the dummies is significant. Nonetheless, this can be misleading, since only 5 observations of each country and 12 observations of each year are at hand.

Model 1 shows a significant[16] positive impact of the variables Gross Fixed Capital Formation growth (GFCFgr) and Gross Domestic Product (GDP). These results support hypothesis 1, implicating early investment activity to be pro-cyclical. The long term interest rate (rLT) has a significant positive effect and the short term interest rate (rST) has a significant negative effect. As laid out in hypothesis 2, the interest rates would influence early investment activity in the same direction. Hence, this hypothesis is not supported by model 1. It might be that the interest rates suffer from multicollinearity to some extent, because they move in pairs. Their separate effects will be tested in the robustness section. With respect to the drivers representing the entrepreneurial environment, model 1 shows no significant results on a 5% significance level. However, the Total early-stage Entrepreneurial Activity (TEA) and governmental policy (Policy) show a positive effect on a 10% significance level. This is in line with hypothesis 3, which states that every variable that positively influences the entrepreneurial environment will also positively influence early investment activity. However, this will not lead to a causal relation. Accessibility

[15] Number of Deals, Average Deal Value and Share of Angel Investors
[16] On a 5% or 1% significance level

to financial resources (Finance) shows a result in model 1 that does not comply with hypothesis 3. The results show a negative effect on a 10% significance level. This negative effect is reflected in each of the models, albeit significant in only two.

In models 2 and 5 country fixed effects are included. These models are asking already a bit more from the data. The effect of the Gross Fixed Capital Formation growth is reduced to non-significant. It indicates that the effect of the Gross Domestic Product is stronger, when accounted for country fixed effects. The long term interest rate also loses its significant effect, but the short term interest rate stays significant and still shows a negative effect which has even become a bit stronger. A remarkable result is that the number of patents (Patent) have a significant negative effect, which is not in accordance with hypothesis 3. The sign becomes negative when country fixed effects are included (as is the case in model 2,3,5 and 6). Hence, when all observations are stacked, not regarding country fixed effects, the amount of patents issued within a year has a positive influence (although not significant, see model 1 and 4) on the number of deals, but when this effect is regarded within countries over the years, the effect appears to be negative.

In model 3 and 6, both country fixed effects and year fixed effects are included. The only variable that shows a significant result is the short term interest rate. The fact that the sign, magnitude and significance are so stable across all models, gives an indication that the short term interest rate might be the strongest influencer of the number of deals.

The model that includes only time fixed effects is model 4. It is interesting that both the short and long term interest rate are significant at a significance level of at least 10%. However, they both influence the number of deals in opposite direction, which does not match hypothesis 2. Also, GFCFgr has a positive sign and GDP has a significantly positive effect, which is in line with hypothesis 1. From the variables that represent the entrepreneurial environment only Finance has a significant (5%) influence on the number of deals. Against the expectation of hypothesis 3 the relation between the two variables is negative.

All in all, GDP and the short term interest rate seem to be the strongest drivers. Both variables are often significant and keep their sign and magnitude.

Table 7. Results of the effect of various drivers on the Number of Deals

Note: The dependent variable in each of the five models of which the results are demonstrated below is *ND*, which is a measure of early investments. For a specific explanation of each of the variables, see section 3.1. Within each model, the natural logarithm is used of the following three variables: *ND, rLT* and *Patent*. Model 1 is a pooled OLS. Model 2 is the same as Model 1, but now country dummies are added. In Model 3, both time dummies are added in addition to Model 2. Model 5 is a fixed effect GLS panel data model with an implemented country fixed effect. Model 6 is the same as model 5, but now also accounts for a year fixed effect. R-squared is the R-squared with respect to the within variation for model 5 and 6. With respect to country dummies, Austria is the reference country. With respect to years, 2012 is the reference.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	OLS	OLS	OLS	OLS	FE	FE

GFCFgr	0.0736***	0.0341	-0.0188	0.0193	0.0341	-0.0188
	(0.0253)	(0.0266)	(0.0236)	(0.0252)	(0.0283)	(0.0192)
GDP	0.00117***	0.00300***	0.000585	0.000995***	0.00300***	0.000585
	(0.000170)	(0.00100)	(0.00107)	(0.000159)	(0.000690)	(0.00115)
rLT	0.394**	0.0684	-0.0145	0.449**	0.0684	-0.0145
	(0.175)	(0.209)	(0.230)	(0.200)	(0.247)	(0.223)
rST	-2.364***	-2.864***	-1.610***	-1.038*	-2.864***	-1.610***
	(0.407)	(0.446)	(0.473)	(0.570)	(0.512)	(0.413)
Patent	0.00708	-1.630***	-1.095	0.108	-1.630***	-1.095
	(0.135)	(0.496)	(0.763)	(0.125)	(0.484)	(0.772)
TEA	0.155*	0.0345	-0.00255	0.120*	0.0345	-0.00255
	(0.0820)	(0.0904)	(0.0888)	(0.0695)	(0.0748)	(0.0814)
Finance	-0.808*	-0.490	-0.251	-0.899***	-0.490	-0.251
	(0.433)	(0.574)	(0.482)	(0.329)	(0.584)	(0.474)
Policy	0.485*	0.407	0.218	0.501*	0.407	0.218
	(0.289)	(0.286)	(0.295)	(0.268)	(0.308)	(0.292)
Education	-0.152	-0.154	0.134	0.0836	-0.154	0.134
	(0.534)	(0.608)	(0.475)	(0.505)	(0.699)	(0.462)
2.Belgium		-0.241	-0.093			
		(0.322)	(0.387)			
3.Denmark		0.348	0.247			
		(0.419)	(0.424)			
4.Finland		0.624	0.388			
		(0.632)	(0.637)			
5.France		0.0954	3.496			
		(2.193)	(2.774)			
6.Germany		-0.844	3.847			
		(3.153)	(4.169)			
7.Italy		-0.174	2.228			
		(1.702)	(1.872)			
8.Netherlands		2.063***	2.382***			
		(0.587)	(0.757)			
9.Portugal		-4.377**	-3.087			
		(1.671)	(2.787)			
10.Spain		-1.236	1.026			
		(1.128)	(1.008)			
11.Sweden		2.021***	1.897***			
		(0.636)	(0.626)			
12.UK		-0.377	3.451			
		(2.115)	(2.373)			
2013			0.833**	1.058**		0.833**
			(0.323)	(0.397)		(0.312)
2014			1.512***	1.746***		1.512***
			(0.348)	(0.374)		(0.313)
2015			1.470**	1.938***		1.470**
			(0.569)	(0.520)		(0.575)
2016			1.506*	1.984***		1.506
			(0.852)	(0.662)		(0.903)
Constant	2.449	12.79***	8.079	0.104	12.62***	9.395
	(1.471)	(3.836)	(5.241)	(1.323)	(3.505)	(5.371)
Observations	60	60	60	60	60	60
R-squared	0.732	0.881	0.9305	0.819	0.749	0.854

FE country?	NO	YES	YES	NO	YES	YES
FE year?	NO	NO	YES	YES	NO	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.1.1 Robustness of the effect of drivers on Number of Deals

In order to test whether the two assumed strongest drivers (GDP and rST) of the number of deals are robust with respect to the addition of other variables the option of using a model that considers both time and country specific effects will exhaust the data. It is true that the real model behind the effect of drivers on the number of deals is in theory a model with both fixed effects for country and time, but when both fixed effects are included in the model, this will distort the occupation of testing robustness. Model 5 in Table 7 does not distort testing robustness, because no country or time dummies are included in the model. Nevertheless, country specific effects are considered, so the fixed effects model that considers the country fixed effects is the model to test for robustness of the variables that are assumed to be the strongest drivers of the number of deals.

Various combinations of variables are added to the model to check whether GDP and the short term interest rate remain stable. The results of this robustness check can be found in Table 8 (Appendix H). From this table can be concluded that both GDP and the short term interest rate (rST) remain very stable when other drivers are introduced. From model 1 becomes clear that GFCF growth, equivalently to GDP, influences the number of deals positively, which corresponds with hypothesis 1. Nonetheless, the effect of GDP is stronger and more stable when the model is expanded (also see Table 7). Due to the fact that GFCF growth is not stable, not much can be concluded about this driver. The negative effect of the long term interest rate in model 2 of Table 8 indicates that the effect of both rates might actually be in the same direction, although the effect of the short term interest rate is stronger. Model 6 from Table 8 confirms that. Hence, hypothesis 2 is possible, but the data has not enough power to show it. Model 3, 4, 7 and 8 show that the drivers representing the entrepreneurial environment are not stable and continuously switch sign and lose statistical explanatory power.

4.2 The effect of drivers on Average Deal Value

In Table 9 the results are presented of the analysis involved with determining the effect of various drivers on the average deal value of early investments. Remarkable is that the values of r-squared are much lower than in Table 7. Also, almost none of the variables is statistically significant. An implication of these observations is that it will be hard to draw any conclusions about the effect of the drivers on average deal value. When country and time dummies are regressed on average deal value, none of the coefficients, only the dummies of 2015 and 2016 are significant on a 5% level. The rest of the dummies does not come close to even a 10% significance level.

Model 1 shows a positive relationship between GDP and average deal value on a 10% significance level. In combination with the low r-squared this is a (very) vague sign that the result is in line with hypothesis 1. About GFCF growth not much can be explained. The long term interest rate has a significant (5%) negative effect on average deal size.

Table 9. Results of the effect of various drivers on Average Deal Value

Note: the dependent variable in each of the five models of which the results are demonstrated below is *ADV*, which is a measure of early investments. For a specific explanation of each of the variables, see section 3.1. Within each model, the natural logarithm is used of the following three variables: *ADV*, *rLT* and *Patent*. Model 1 is a pooled OLS regression. Model 2 is the same as Model 1, but now country dummies are added. Model 3 is the same as Model 2, but time dummies are added. Model 4 is a fixed effect GLS panel data model with a country fixed effect. Model 5 is the same as model 4, but now also accounts for a year fixed effect. R-squared is the R-squared with respect to the within variation for model 4 and 5. With respect to country dummies, Austria is the reference country. With respect to years 2012 is the reference.

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) FE	(5) FE
GFCFgr	-0.0222	-0.0382	-0.0262	-0.0382	-0.0545
	(0.0270)	(0.0403)	(0.0343)	(0.0477)	(0.0651)
GDP	0.000350*	0.00244	0.000269	0.00244	0.000935
	(0.000205)	(0.00176)	(0.000206)	(0.00145)	(0.00189)
rLT	-0.491**	0.0681	-0.357	0.0681	0.0875
	(0.212)	(0.336)	(0.232)	(0.338)	(0.422)
rST	-0.292	-0.498	0.423	-0.498	0.388
	(0.557)	(0.707)	(0.804)	(0.479)	(0.533)
Patent	-0.147	1.205	-0.0991	1.205	0.866
	(0.164)	(0.861)	(0.154)	(0.787)	(2.048)
TEA	0.0921	0.242	0.0668	0.242	0.278*
	(0.0912)	(0.173)	(0.0866)	(0.156)	(0.154)
Finance	-0.328	-0.338	-0.376	-0.338	-0.115
	(0.555)	(0.718)	(0.573)	(0.716)	(0.620)
Policy	0.458	0.364	0.495	0.364	0.158
	(0.377)	(0.539)	(0.412)	(0.683)	(0.799)
Education	-1.057	-0.752	-0.896	-0.752	-0.409
	(0.634)	(0.715)	(0.592)	(0.792)	(0.748)
2.Belgium		0.810			
		(0.769)			
3.Denmark		0.902			
		(0.870)			
4.Finland		0.410			
		(0.847)			
5.France		-6.042			
		(3.897)			
6.Germany		-8.509			
		(5.495)			
7.Italy		-4.768*			
		(2.774)			
8.Netherlands		-2.822**			
		(1.339)			
9.Portugal		3.423			
		(2.925)			

10.Spain		-0.719			
		(1.714)			
11.Sweden		-1.218			
		(1.015)			
12.UK		-5.492			
		(4.157)			
2013			0.605		0.740
			(0.499)		(0.417)
2014			0.375		0.536
			(0.514)		(0.627)
2015			0.780		1.147
			(0.593)		(0.720)
2016			1.159*		1.269
			(0.677)		(1.279)
Constant	10.53***	-0.989	9.246***	-2.991	-1.165
	(1.751)	(6.580)	(1.802)	(5.578)	(14.20)
Observations	60	60	60	60	60
R-squared	0.254	0.463	0.301	0.262	0.310
Number of id				12	12

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.2.1 Robustness of the effect of drivers on Average Deal Value

In order to test for robustness of the effects of drivers on the average deal value, a pooled OLS regression is used, without country or time fixed effects. Results are too much distorted if there will be opted for a model with fixed effects. Only the robustness of the coefficient of the long term interest rate will be tested with respect to the addition of other variables, for none of the other variables in any model has a significant effect on a 5% significance level. The results of this test are shown in Table 10 (Appendix I). With respect to all variables the sign and magnitude are similar to the value shown in Table 9. In all but one of the models in Table 10, the effect of the long term interest rate is significant at a significance level of at least 5%. It indicates that the long term interest rate might be the strongest driver of average deal size. Only when the short term interest rate is added (which itself has an insignificant effect), the significance level is reduced to a 10% level and the magnitude is reduced the most compared to all other models in Table 10.

4.3 The effect of drivers on the Share of Angel Investors

In Table 11 presents the results of the effect on the proportion of early investments in which an angel investor is involved. The r-squared values are comparable to the r-squared values in Table 9. With respect to the models below, time and country specific effects play even a smaller role than they do in the models in Table 9. When time and country dummies are regressed on the share of angel investors, none of the results is significant, not even on a 10% level. In every model in Table 11 the accessibility to financial resources (Finance) has a significantly positive effect. Education has a significantly negative effect in model 1 and 3 (and on a 10% significance level in

model 5). Policy has a significantly positive influence in model 3 (and on a 10% level in model 1). No support for hypothesis 4 whatsoever.

Table 11. The effect of various drivers on the Share of Angel Investors

Note: the dependent variable in each of the five models of which the results are demonstrated below is *Ang*, which is a measure of early investments. For a specific explanation of each of the variables, see section 3.1. Within each model, the natural logarithm is used of the following two variables: *rLT* and *Patent*. Model 1 is pooled OLS. Model 2 is the same as Model 1, but now country dummies are added. Model 3 is the same as Model 1, but time dummies are added. Model 4 is a fixed effect GLS panel data model with a country fixed effect. Model 5 is the same as model 4, but now time dummies are added to implement time fixed effects. R-squared is the R-squared with respect to the within variation for model 4 and 5. With respect to country dummies, Austria is the reference country. With respect to years, 2012 is the reference.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	OLS	OLS	OLS	FE	FE
GFCFgr	-0.0129	-0.0202	-0.0145	-0.0202	-0.0216
	(0.0125)	(0.0159)	(0.0118)	(0.0164)	(0.0171)
GDP	1.28e-05	0.000147	-3.00e-05	0.000147	-0.000197
	(4.63e-05)	(0.000326)	(4.43e-05)	(0.000290)	(0.000507)
rLT	-0.0506	-0.0613	0.0536	-0.0613	0.0604
	(0.0674)	(0.0961)	(0.0701)	(0.0942)	(0.0860)
rST	-0.0949	-0.0242	-0.0713	-0.0242	-0.116
	(0.139)	(0.195)	(0.183)	(0.196)	(0.0800)
Patent	-0.0122	0.0803	0.0302	0.0803	-0.120
	(0.0445)	(0.197)	(0.0389)	(0.119)	(0.249)
TEA	-0.00697	0.0127	-0.00893	0.0127	-0.00149
	(0.0182)	(0.0356)	(0.0168)	(0.0362)	(0.0391)
Finance	0.287**	0.504***	0.292***	0.504***	0.451***
	(0.114)	(0.165)	(0.0913)	(0.131)	(0.127)
Policy	0.194*	0.0683	0.228***	0.0683	0.0644
	(0.104)	(0.143)	(0.0801)	(0.157)	(0.132)
Education	-0.400***	-0.208	-0.414***	-0.208	-0.220*
	(0.117)	(0.177)	(0.0948)	(0.143)	(0.116)
2.Belgium		-0.116			
		(0.159)			
3.Denmark		-0.0532			
		(0.190)			
4.France		0.130			
		(0.250)			
5.Finland		-0.355			
		(0.711)			
6.Germany		-0.744			
		(0.961)			
7.Italy		-0.245			
		(0.513)			
8.Netherlands		-0.467**			
		(0.230)			
9.Portugal		0.112			
		(0.688)			
10.Spain		0.154			
		(0.345)			
11.Sweden		-0.0955			
		(0.241)			
12.UK		-0.381			
		(0.738)			

2013			-0.201*		-0.196
			(0.109)		(0.155)
2014			-0.0319		-0.0373
			(0.109)		(0.146)
2015			0.108		0.154
			(0.139)		(0.217)
2016			0.134		0.179
			(0.177)		(0.295)
Constant	0.374	-1.169	0.0161	-1.341	0.674
	(0.396)	(1.406)	(0.382)	(1.039)	(2.185)
Observations	60	60	60	60	60
R-squared	0.252	0.405	0.387	0.227	0.360
FE country?	NO	YES	NO	YES	YES
FE year?	NO	NO	YES	NO	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.3.1 Robustness of the effect of drivers on the Share of Angel Investors

Table 12 (Appendix J) contains modifications of model 1 from Table 11, which serve the purpose of testing the robustness of the results from Table 11 with respect to the addition of variables. The variables of which robustness is checked are Finance and Education. Model 1,2 and 3 in Table 12 show that the significant results for the variable Finance in Table 11 are more of a coincidence than a regularity. Model 5, 6 and 7 show that this is also the case for the variable Education.

5. Conclusion

5.1 Implications

The objective of this thesis is to assess the drivers of early investments and to see if and how they affect the number of deals, average deal size and the proportion of deals in which an angel investor is involved. In order to try and answer the research question, four hypotheses have been tested. The first three apply to the number of deals and the average deal value. The fourth hypothesis applies to angel investor involvement. The following four hypotheses have been tested:

H1. Early investments are pro-cyclical with respect to Gross Fixed Capital Formation growth and GDP level.

H2. The long and short term interest rates affect the level of early investments in the same direction.

H3. Factors influencing the level of entrepreneurial activity in a positive sense, will also positively affect the level of early investments.

H4. The share of angel investors involved in early investment deals is pro-cyclical with respect to Gross Fixed Capital Formation growth or GDP level.

With respect to the number of deals made, the first hypothesis is not rejected: GFCF growth has a significant positive effect which is flattened if the model is expanded. GDP has a strong significant positive effect. No evidence significantly supports H1 in the case of average deal value. The sign of GFCF growth is negative in every estimated model and GDP positive in every estimated model. H1 is rejected for average deal value as a measure of early investments.

With respect to the number of deals, H2 is not rejected, because in almost every model, the long term interest rate has a positive sign and the short term interest rate has a significant negative sign in every model. However, when the long term interest rate was added separately from the short term interest rate, it did have an effect in the same direction.[17] This could indicate that the effect of the short term interest rate crowds out the effect of the long term interest rate and that they in fact do affect the number of deals in the same direction. The fact that the interest rates would influence early investments in a negative way contradicts research by Gompers & Lerner (1999) and Pottelsberghe & Romain (2004), which both found a positive relationship in case of both the short and long term interest rate. In the case of average deal value, the long term interest rate turned out to have the stronger effect in comparison to the effect of the short term interest rate. The effect observed is negative and in the model that is regarded to be the best fitting (ex-post) as well as in the robustness check, the short term interest rate also had a negative effect

[17] i.e. negative, see Table 8, Appendix H

(although not significantly). The latter also suggests that the effect of one of the interest rates is crowded out by the other.

When regarding H3 with respect to the number of deals, some conflicting evidence has been found. The accessibility to financial resources as well as the number of patents issued, turn out to have a negative (sometimes significant) effect in most models. But in both cases, when tested for robustness with respect to the addition of other variables, they turned out to have a positive effect if the short term interest rate was excluded from the model. Hence, considering these observations, no conclusion can be drawn, except that the variables representing the entrepreneurial environment did not influence the number of deals as much as some macroeconomic variables. The results concerning the number of patents do not confirm the positive influence found by Pottelsberghe & Romain (2004). In case of average deal value, nothing really can be said about the outcomes of the variables representing the entrepreneurial environment. H3 can neither be confirmed, nor totally rejected.

No evidence at all supports H4. It most certainly cannot be confirmed, regarding that no significant influence of either GFCF growth or GDP can be observed. However, some evidence has been found that the accessibility of financial resources would have a positive effect on the share of angel investors involved in the total number of deals in a country in a year. It would make sense, that in a country where it is easier to get a hold of financiers for your start-up, more angel investors are involved. Nevertheless, this result did not appear very robust with respect to other variables. The same goes for the variable Education. Initially, considering the results in Table 11, it had a negative impact. This would also be hard to explain. Education is unlikely to be an influencer of the share of angel investors.

The results turned out quite differently with respect to the number of deals and average deal value. It leads to the conclusion that average deal value is less affected by macroeconomic variables than the number of deals, i.e. the macroeconomic environment influences to a greater extent the question "Will investors invest, yes or no?" than the question "How much will they invest?". Besides, country and time specific effects play a larger role in the context of the number of deals as a measure of early investments than in the context of average deal value.

5.2 Limitations of the study and recommendations for further research

The main flaw of this research is the small sample size. Due to the poor availability of data, estimation models soon tend to ask too much of the data. But with increasing transparency in the European venture capital industry, this problem might be resolved. The US has always been a few steps ahead with regard to the industry. With regard to transparency, they are already making progress. Hopefully, this observation will be transferred to Europe as well (Shubber, 2017). Also, the Zephyr database shows only results dating from 2007 onwards. This shows that in Europe, improvements are made, too. However, it is necessary that this trend continues, in order to obtain

improved insights in early investments. In 10 years for example, a lot of data will be available about early investments. Longer time periods and more countries can be included. Especially more time periods is a condition for fixed effects models to work properly (Santos & Barrios, 2011). In 10 years, it will be a suitable moment to redo this research, with potential improvements and extensions included. It would also be a good idea to compare the situation with the US.

Another flaw that is inherent to the research is that some figures are subjective instead of objective. Referring to the figures produced by the Global Entrepreneurship Monitor. The variables produced by this organisation that are included in this research are based on expert analyses, but remain a subjective estimations of the situations for the variables Policy, Finance and Education. For sequential research it might be an idea to find more objective measures to assess these variables.

In addition, the Methodology and Results sections are a little extensive. For future research it is better to either include pooled OLS with dummies to implement fixed effects or a fixed effects model, since they yield results that have the same coefficients.

References

Bottazzi, L., & Da Rin, M. (2002). Venture capital in Europe and the financing of innovative companies. *Economic policy*, 17(34), 229-270.

Bernanke, B. S., & Reinhart, V. R. (2004). Conducting monetary policy at very low short-term interest rates. *The American Economic Review*, 94(2), 85-90.

Betlem R. (2016, March 31). Overheid steekt opnieuw € 100 mln in risicovolle investeringen. *Financieel Dagblad*. Retrieved from https://fd.nl/ondernemen

Black, B. S., & Gilson, R. J. (1998). Venture capital and the structure of capital markets: banks versus stock markets. *Journal of financial economics*, *47*(3), 243-277.

Breusch, T. S., & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *The Review of Economic Studies*, 47(1), 239-253.

Cumming, D. J., & Johan, S. A. (2013). *Venture capital and private equity contracting: An international perspective*. Academic Press.

Dealroom. (2016). *2016 European Venture Capital Report*. Retrieved from: https://blog.dealroom.co/wp-content/uploads/2017/01/2016-European-Venture-Capital- Report.pdf

Da Gbadji, L. A. G., Gailly, B., & Schwienbacher, A. (2015). International analysis of venture capital programs of large corporations and financial institutions. *Entrepreneurship Theory and Practice*, 39(5), 1213-1245.

Eklund, J. E. (2013). Theories of investment: a theoretical review with empirical applications. In *Swedish Entrepreneurship forum* (pp. 1-15).

Engel, D., & Heger, D. (2006). Differences in public and private venture capital companies' activities: microeconometric evidence for Germany. *Unpublished working paper. RWI: Essen*.

Félix, E. G. S., Pires, C. P., & Gulamhussen, M. A. (2013). The determinants of venture capital in Europe—Evidence across countries. *Journal of Financial Services Research*, 44(3), 259-279.

Fraser, S. (2009) *How Have SME Finances Been Affected by the Credit Crisis?* London: BERR/ESRC seminar.

Gilbert, B. A., Audretsch, D. B., & McDougall, P. P. (2004). The emergence of entrepreneurship policy. *Small Business Economics*, *22*(3), 313-323.

Gompers, P. A., & Lerner, J. (1997). Venture capital and the creation of public companies: do venture capitalists really bring more than money?. *The Journal of Private Equity*, *1*(1), 15-32.

Gompers, P. A., & Lerner, J. (1999). *What drives venture capital fundraising?* (No. w6906). National bureau of economic research.

Graham, S. J., Merges, R. P., Samuelson, P., & Sichelman, T. (2009). High technology entrepreneurs and the patent system: Results of the 2008 Berkeley patent survey. *Berkeley Technology Law Journal*, 1255-1327.

Hellmann, T., & Puri, M. (2000). The interaction between product market and financing strategy: The role of venture capital. *The Review of Financial Studies*, *13*(4), 959-984.

Jeng, L. A., & Wells, P. C. (2000). The determinants of venture capital funding: evidence across countries. *Journal of corporate Finance*, 6(3), 241-289.

Keuschnigg, C., & Nielsen, S. B. (2003). Tax policy, venture capital, and entrepreneurship. *Journal of Public Economics*, *87*(1), 175-203.

Khemraj, T., & Yu, S. (2016). The effectiveness of quantitative easing: new evidence on private investment. *Applied Economics*, 48(28), 2625-2635.

Langetieg, T. C. (1980). A multivariate model of the term structure. *The Journal of Finance*, *35*(1), 71-97.

Little, R. J. (1992). Regression with missing X's: a review. *Journal of the American Statistical Association*, 87(420), 1227-1237.

Mason, C., & Brown, R. (2013). Creating good public policy to support high-growth firms. *Small Business Economics*, 40(2), 211-225.

Maula, M., Autio, E., & Arenius, P. (2005). What drives micro-angel investments?. *Small Business Economics*, *25*(5), 459-475.

Murray, G. C. (2007). Venture capital and government policy. *Handbook of Research on Venture Capital, Cheltenham: Edward Elgar*, 113-151.

Ning, Y., Wang, W., & Yu, B. (2015). The driving forces of venture capital investments. *Small Business Economics*, 44(2), 315-344.

O'Shea, M. (1996). Government programs for venture capital. *OECD Working Group on Innovation and Technology Policy*, *1*, 18-126.

Parker, S. C., & Van Praag, C. M. (2006). Schooling, capital constraints, and entrepreneurial performance: The endogenous triangle. *Journal of Business & Economic Statistics*, *24*(4), 416-431.

Poterba, J. M. (1989). Venture capital and capital gains taxation. *Tax policy and the economy*, *3*, 47-67.

Ramsinghani, M. (2011). *The business of venture capital: insights from leading practitioners on the art of raising a fund, deal structuring, value creation, and exit strategies* (Vol. 612). John Wiley & Sons.

Robbie, W., & Mike, K. (1998). Venture capital and private equity: A review and synthesis. *Journal of Business Finance & Accounting*, *25*(5-6), 521-570.

Romain, A., & Van Pottelsberghe, B. (2004). The determinants of venture capital: Additional evidence.

Sahlman, W. A. (1990). The structure and governance of venture-capital organizations. *Journal of financial economics*, *27*(2), 473-521.

Santos, L. A., & Barrios, E. B. (2011). Small sample estimation in dynamic panel data models: A simulation study. *Open Journal of Statistics*, *1*(02), 58.

Schertler, A. (2003). *Driving forces of venture capital investments in Europe: A dynamic panel data analysis* (No. 1172). Kiel working paper.

Schultz, T. W. (1980). Investment in entrepreneurial ability. *The Scandinavian Journal of Economics*, 437-448.

Shubber, K. (2017, November 27). Transparency in European venture capital. *The Financial Times*. Retrieved from http://ftalphaville.ft.com

Shane, S. (2008). *Fool's Gold?: The truth behind angel investing in America*. Oxford University Press.

Sørheim, R. (2005). Business angels as facilitators for further finance: an exploratory study. *Journal of Small Business and Enterprise Development*, *12*(2), 178-191.

Storey, D. J., & Greene, F. J. (2010). *Small business and entrepreneurship*. Financial Times/Prentice Hall.

Tyebjee, T. T., & Bruno, A. V. (1984). A model of venture capitalist investment activity. *Management science*, *30*(9), 1051-1066.

Tyson, L. D. A., Petrin, T., & Rogers, H. (1994). Promoting entrepreneurship in eastern Europe. *Small Business Economics*, 6(3), 165-184.

Wiltbank, R., & Boeker, W. (2007). Returns to angel investors in groups.

Wong, A., Bhatia, M., & Freeman, Z. (2009). Angel finance: the other venture capital. *Strategic change*, *18*(7-8), 221-230.

Wooldridge, J. M. (2001). Applications of generalized method of moments estimation. *The Journal of Economic Perspectives*, *15*(4), 87-100.

Appendices

Appendix A

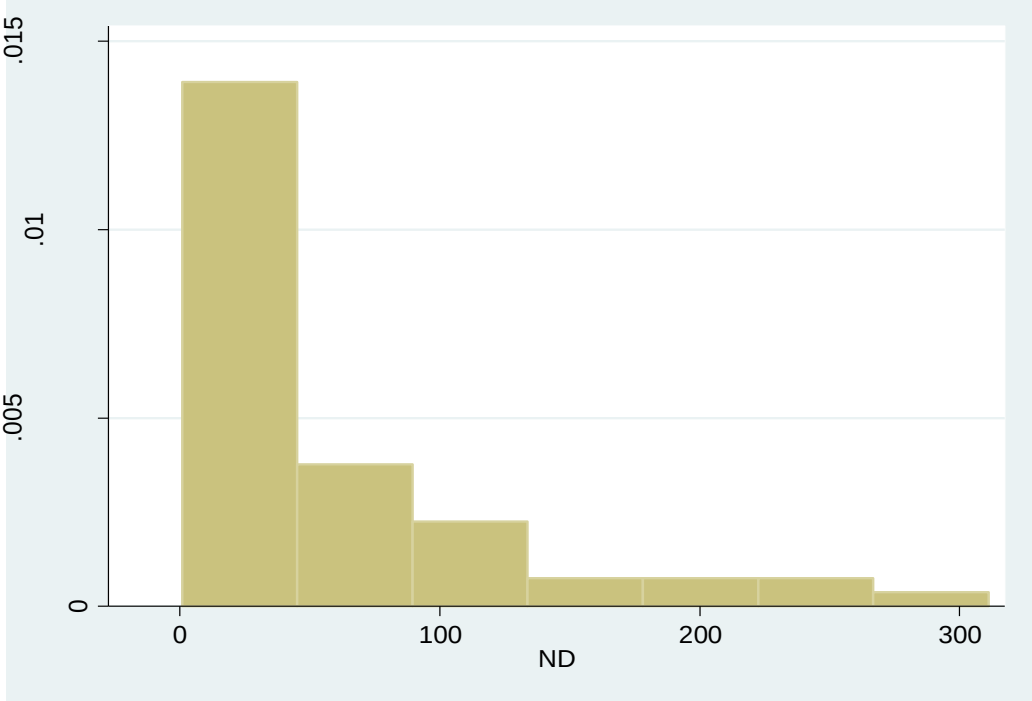


Figure 5. Histogram: Number of Deals

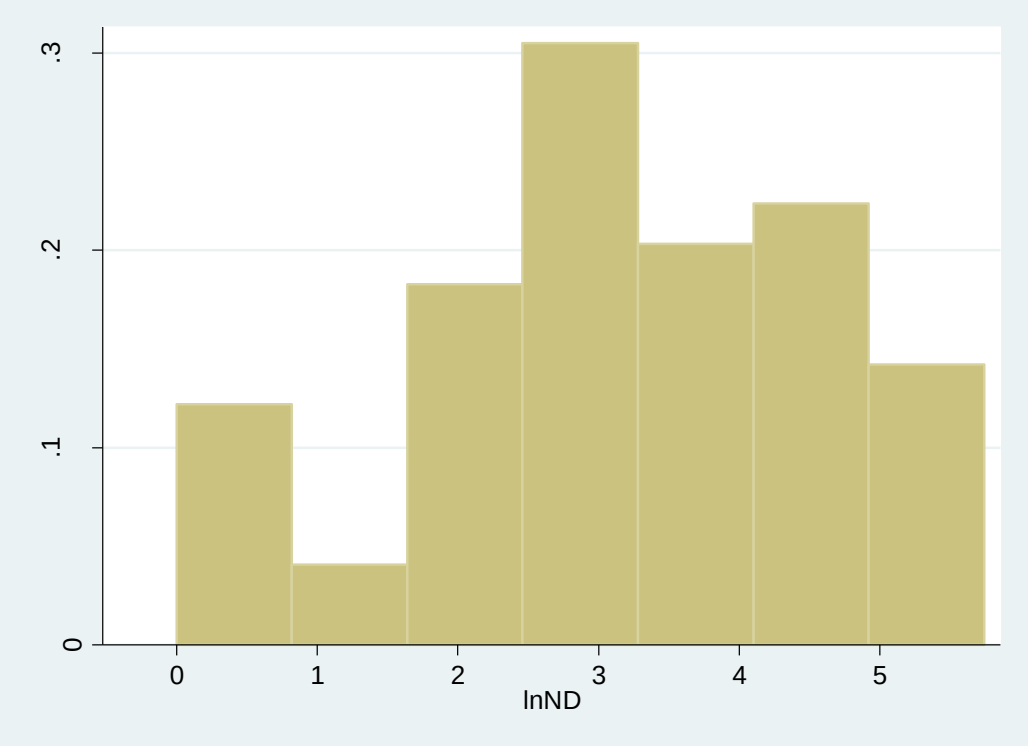


Figure 6. Histogram: natural logarithm of Number of Deals

Appendix B

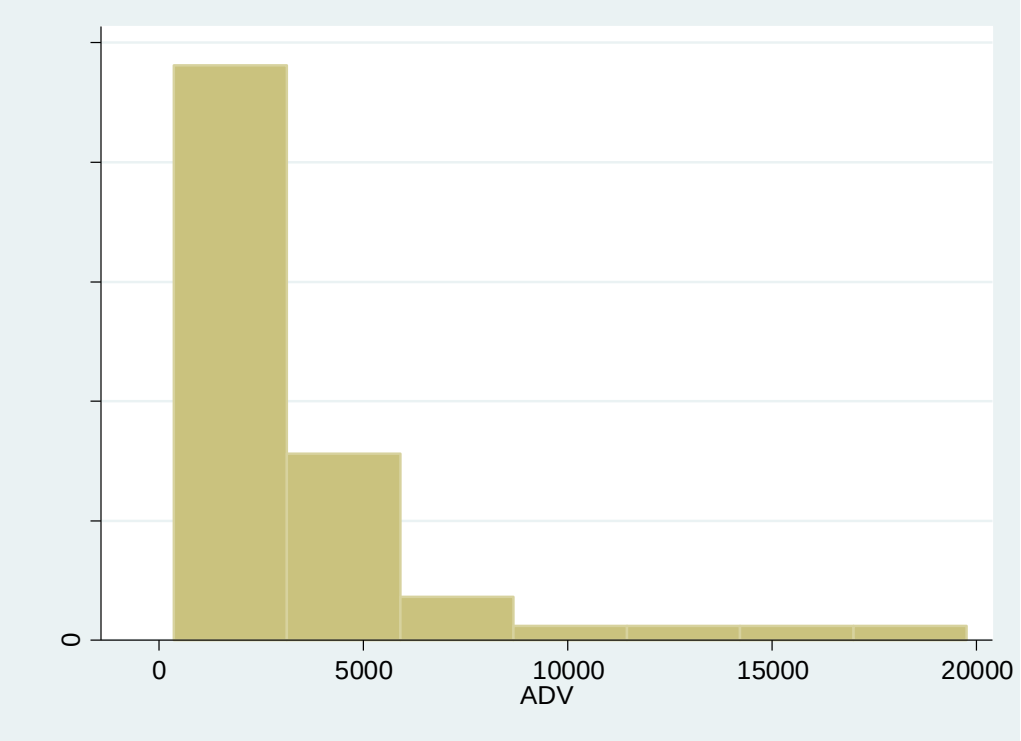


Figure 7. Histogram: Average Deal Value

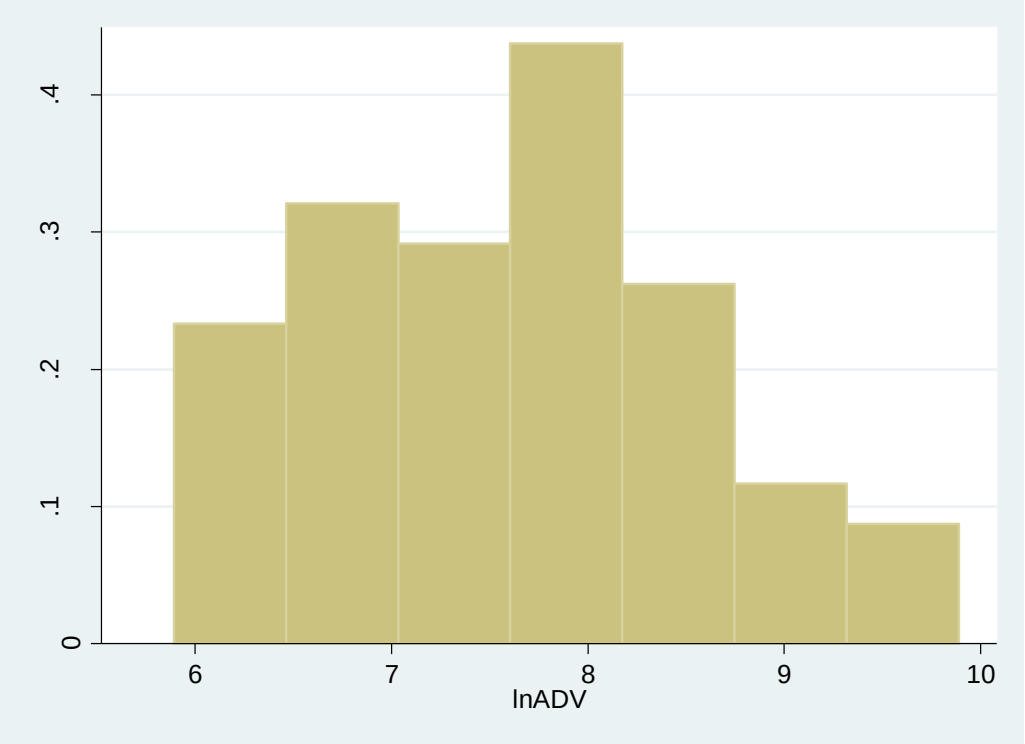


Figure 8: Histogram: natural logarithm of Average Deal Value

Appendix C

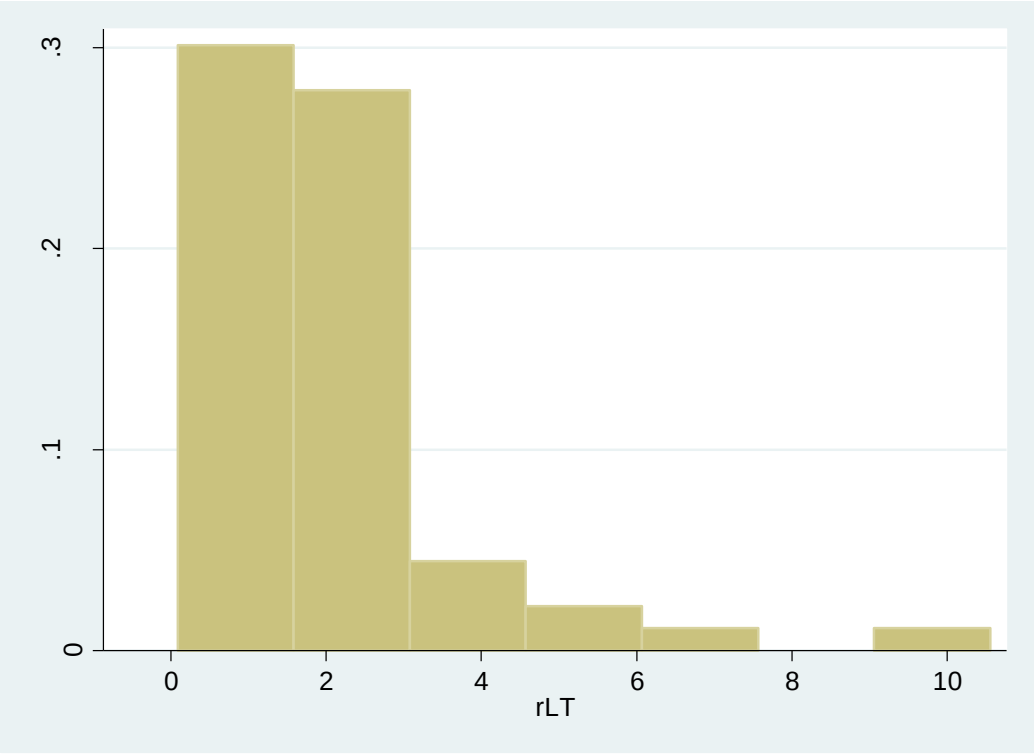


Figure 9. Histogram: long term interest rate

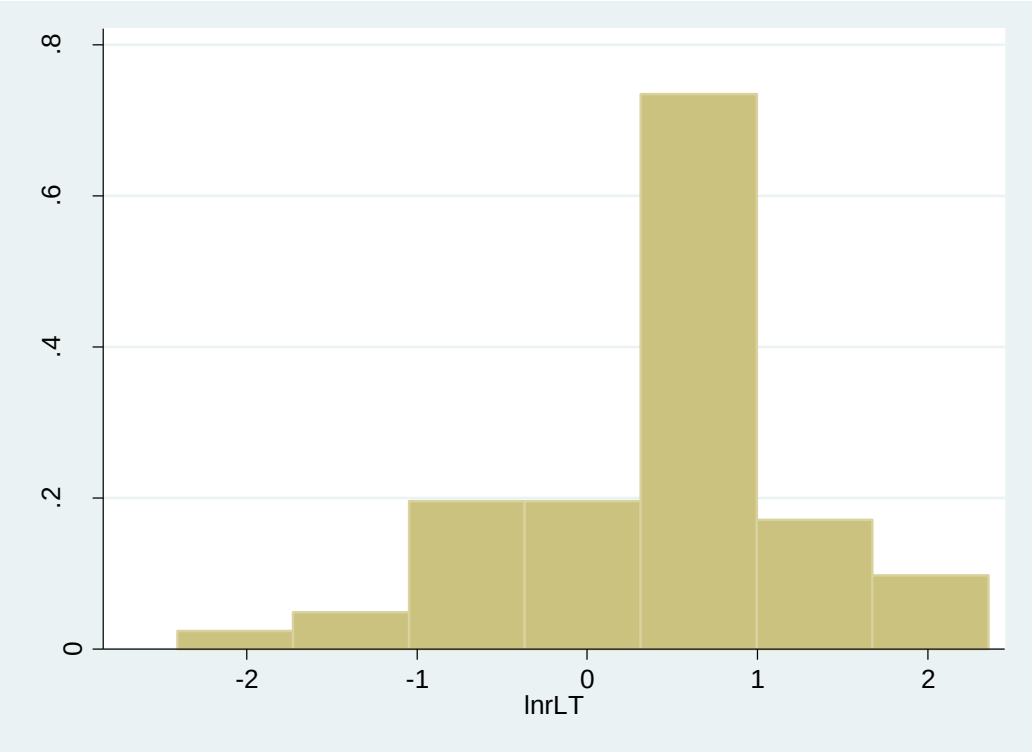


Figure 10. Histogram: natural logarithm of the long term interest rate

Appendix D

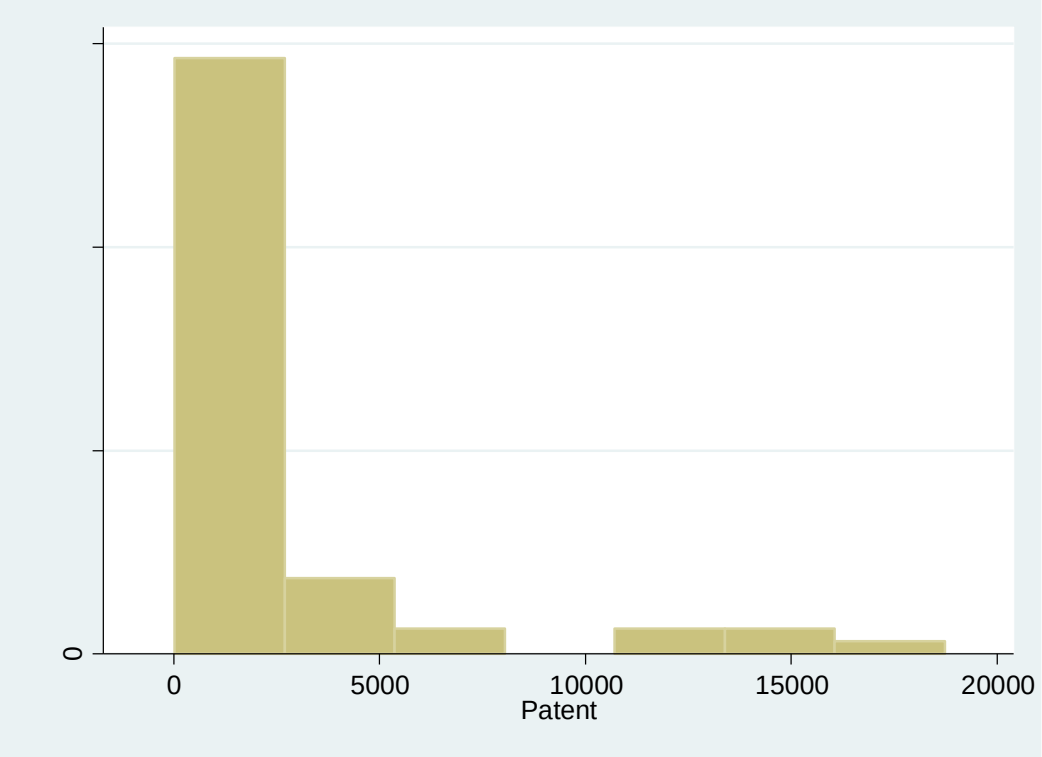


Figure 11. Histogram: number of patents

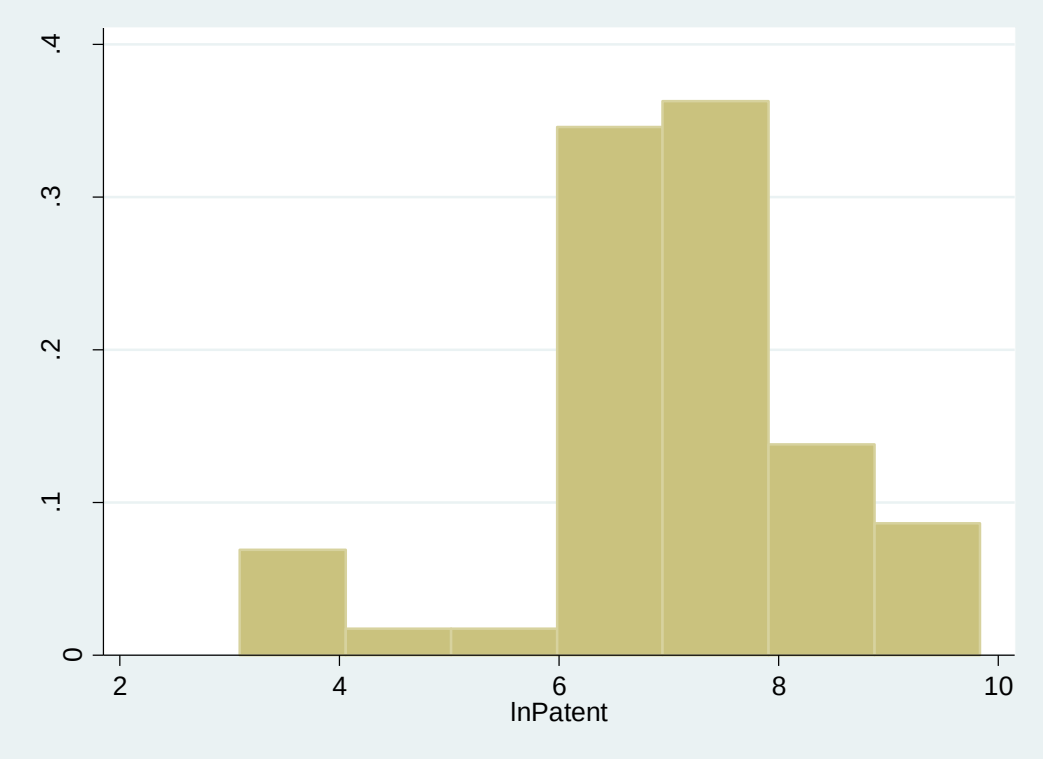


Figure 12. Histogram: natural logarithm of the number of patents

Appendix E

Table 4. Mean value of each variable per country

	ND	ADV	Ang	GFCFgr	GDP	rLT	rST	Patent	TEA[18]	Finance	Policy	Education
Austria	7.2	6,971.22	.416	1.354	331.88	1.400	.144	986.8	9.307	2.643	2.600	2.990
Belgium	9.8	3,454.22	.414	1.610	402.48	1.688	.144	837.8	5.440	3.053	2.990	3.025
Denmark	15.0	2,446.24	.266	3.002	220.83	1.098	.188	700.6	5.415	2.525	2.920	3.040
Finland	22.8	1,914.91	.648	-.318	206.44	1.256	.144	758.4	6.040	2.808	3.214	2.812
France	156.8	2,511.11	.512	.658	2149.72	1.544	.144	5380.0	5.100	2788	3.340	3.023
Germany	91.0	4,271.73	.392	1.286	2934.78	.964	.144	14533.6	4.970	2.820	2.662	2.672
Italy	47.0	1048.11	.354	-2.728	1631.50	3.180	.144	2509.4	4.292	2.464	2.206	2.568
Netherlands	44.2	1,157.95	.164	1.592	666.92	1.264	.144	2014.4	9.450	2.996	2.976	3.384
Portugal	13.2	1.657.18	.294	-2.962	175.24	5.236	.144	36.6	8.706	2.760	2.608	2.894
Spain	77.6	4,271.36	.381	.494	1058.38	3.252	.144	506.0	5.462	2.152	2.374	2.386
Sweden	33.0	4,050.53	.372	3.682	440.24	1.334	.330	1932.6	7.228	2.598	2.570	2.494
UK	144.4	3370.57	.412	3.234	2264.36	2.018	.582	2236.2	8.502	2.824	2.764	2.826

[18] The values for TEA, Finance, Policy and Education are based on the sample without mean imputation. Spread over the countries Austria, Belgium, Denmark and France, 7 observations are missing.

Appendix F

Table 5. Mean and standard deviation of each variable per year

	2012		2013		2014		2015		2016	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
ND	8.9	8.2	35.6	32.9	63.7	59.9	78.3	74.5	89.3	96.1
ADV	1,851.11	1,788.40	3,581.04	4,238.61	2,349.34	3,287.36	2,830.14	1,429.38	4,857.14	5,081.21
Ang	.414	.363	.241	.177	.317	.169	.495	.196	.460	.193
GFCFgr	-2.977	5.991	-1.604	3.312	2.327	3.096	3.575	3.146	3.223	2.029
GDP	991.68	907.83	999.48	918.45	1,032.67	961.00	1,085.72	1,018.52	1,091.60	1011.45
rLT	3.335	2.713	2.787	1.463	1.993	.797	1.127	.632	.857	.869
rST	.653	.203	.306	.211	.264	.109	-.003	.192	-.222	.255
Patent	2,405.583	3,662.169	2,474.250	3,688.182	2,408.583	3,587.203	2,662.417	3,872.516	3,562.667	5,112.423
TEA	6.671	1.976	6.131	1.942	6.876	2.187	6.543	1.443	7.140	2.267
Finance	2.605	.277	2.603	.339	2.723	.285	2.819	.379	2.811	.273
Policy	2.798	.348	2.732	.394	2.767	.296	2.828	.589	2.629	.562
Education	2.828	.337	2.738	.338	2.879	.286	2.783	.371	2.85	.413

Appendix G

Table 6. Variable correlation matrix

	ND	ADV	Ang	GFCFgr	GDP	rLT	rST	Patent	TEA	Finance	Policy	Education
ND	1.0000											
ADV	-0.0022	1.0000										
Ang	0.0912	0.1433	1.0000									
GFCFgr	0.2575	0.0263	-0.0102	1.0000								
GDP	0.6586	0.0297	0.0793	0.0343	1.0000							
rLT	-0.2455	-0.1170	-0.0106	-0.7418	-0.1131	1.0000						
rST	-0.2179	-0.0915	-0.1685	-0.3835	-0.0728	0.4099	1.0000					
Patent	0.4005	0.0978	0.0646	0.0700	0.7825	-0.1049	-0.0827	1.0000				
TEA	-0.0779	0.1562	-0.1902	0.1477	-0.3243	-0.0542	-0.0185	-0.3239	1.0000			
Finance	0.0296	-0.1745	0.1662	0.3920	0.0175	-0.2163	-0.2532	0.1602	0.2227	1.0000		
Policy	-0.0268	-0.1236	0.1438	0.1693	-0.0821	-0.0735	0.0496	-0.0077	0.1089	0.4897	1.0000	
Education	-0.0410	-0.1812	-0.1545	0.1778	-0.1612	-0.0562	-0.0867	-0.0884	0.4190	0.6115	0.5998	1.0000

Appendix H

Table 8. Robustness of the main drivers of the Number of Deals

VARIABLES	(1) FE	(2) FE	(3) FE	(4) FE	(5) FE	(6) FE	(7) FE	(8) FE
GFCFgr	0.113***							
	(0.0286)							
GDP	0.00443***	0.00207**	0.00419**	0.00453*	0.00190***			
	(0.00118)	(0.000768)	(0.00140)	(0.00222)	(0.000427)			
rLT		-0.817***				0.0800		
		(0.234)				(0 .197)		
Patent			1.513*				-1.571***	
			(0.778)				(0.504)	
TEA			0.0797				0.0340	
			(0.159)				(0.0620)	
Finance				1.261*				-0.119
				(0.698)				(0.495)
Policy				-0.157				0.128
				(0.698)				(0.375)
Education				-0.0284				0.175
				(0.803)				(0.705)
rST					-2.213***	-2.488***	-3.043***	-2.402***
					(0.249)	(0. .406)	(0.508)	(0.287)
Constant	-1.485	1.389	-12.42**	-4.387	1.687***	3.689***	14.77***	3.181
	(1.225)	(0.859)	(4.467)	(3.742)	(0.467)	(0 .0608)	(3.591)	(2.158)
Observations	60	60	60	60	60	60	60	60
R-squared	0.387	0.405	0.275	0.223	0.671	0.655	0.704	0.657
FE country?	YES	YES	YES	YES	YES	YES	YES	YES
FE year?	NO	NO	NO	NO	NO	NO	NO	NO

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Appendix I

Table 10. Robustness of rLT as a driver of Average Deal Value

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS
GFCFgr	-0.0242							
	(0.0301)							
rLT	-0.429***	-0.333**	-0.312*	-0.337**	-0.355***	-0.446***	-0.376***	-0.402***
	(0.137)	(0.132)	(0.172)	(0.147)	(0.126)	(0.115)	(0.125)	(0.115)
GDP		0.000171*						
		(9.30e-05)						
rST			-0.166					
			(0.504)					
Patent				0.0191				
				(0.0731)				
TEA					-0.0143			
					(0.0706)			
Finance						-0.683		
						(0.481)		
Policy							-0.241	
							(0.240)	
Education								-0.816**
								(0.387)
Constant	7.781***	7.543***	7.746***	7.587***	7.825***	9.614***	8.400***	10.05***
	(0.136)	(0.187)	(0.110)	(0.561)	(0.435)	(1.358)	(0.706)	(1.112)
Observations	60	60	60	60	60	60	60	60
R-squared	0.109	0.128	0.102	0.101	0.101	0.138	0.110	0.173

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix J

Table 12. Robustness of the effect of various drivers on the Share of Angel Investors

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS
GFCFgr	-0.0126				-0.00939			
	(0.0119)				(0.0113)			
GDP	1.82e-05	2.28e-05			9.06e-06	1.76e-05		
	(3.04e-05)	(2.98e-05)			(3.38e-05)	(3.10e-05)		
rLT	-0.0587				-0.0784			
	(0.0502)				(0.0510)			
rST	-0.0752	-0.0995			-0.0594	-0.124		
	(0.113)	(0.0853)			(0.126)	(0.0905)		
Finance	0.127	0.110	0.194*	0.296***				
	(0.0999)	(0.0908)	(0.102)	(0.0907)				
Patent			-3.55e-06					
			(6.10e-06)					
TEA			-0.0345*				-0.0167	-0.0121
			(0.0173)				(0.0186)	(0.0176)
Policy				0.181*				0.210*
				(0.107)				(0.106)
Education				-0.423***	-0.127	-0.117	-0.0761	-0.248**
				(0.103)	(0.0918)	(0.0854)	(0.0996)	(0.120)
Patent							0.0114	
							(0.0269)	
Constant	0.0712	0.0830	0.102	0.276	0.784***	0.723***	0.630*	0.589**
	(0.260)	(0.245)	(0.262)	(0.261)	(0.272)	(0.251)	(0.355)	(0.247)
Observations	60	60	60	60	60	60	60	60
R-squared	0.093	0.054	0.085	0.188	0.099	0.060	0.047	0.118

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1