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Bachelor's Thesis

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The Macroeconomic Determinants of Venture Capital Investments

A cross-country comparison between driving forces in the European venture capital market.

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Abstract: In this paper, we aim to contribute to the work around different macroeconomic effects that influence the supply and demand of venture capital investments. By introducing a new variable explaining the recent upturn in companies with a more technological business model, we hope to shed some light upon venture capital investments as part of business trends. From panel data consisting of 20 European countries between 2007-2015, we base our empirical model on factors already enumerated in the literature on venture capital. We introduce the new variable online purchasing behaviour as a proxy for the technological development that has influenced both new and established companies in recent years. In our random, between and within effects regressions, we find evidence supporting corporate tax rate, private equity funds raised, GDP growth, IPOs and labor market rigidities as significant determinants for venture capital investments, something that is in line with previous research. Furthermore, by creating a subpanel to control for the time-period between 2012-2015, we find significant results for the technological variable as a positive determinant for venture capital investments.

Keywords: Venture Capital; Fundraising; Cross-country comparison

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1. Introduction

Financial papers frequently discuss the importance of different macroeconomic factors when studying venture capital activity in different economies[4]. But little attention and publications stating empirical evidence on the importance of macroeconomic determinants in the venture capital industry is to be found. Even if most venture capital investment decisions are made upon different microeconomic factors such as product, team and business model, the flow of capital into the industry is highly dependent on macroeconomic factors. These factors both affect investor's willingness to supply capital to venture capital funds and entrepreneurs demand for venture capital backed funding. The goal of this paper is to extend the research on the subject surrounding macroeconomic driven factors and which determinants that explain venture capital activity.

Posterba (1989) was the first to examine the determinants of venture capital investments on a macroeconomic level. Like most of his successors, his paper is foremost built around the US venture capital landscape. We believe more profound work can be done with respect to the European market. However, like Posterba (1989) and most of the later papers regarding this subject, we believe investment activities can be described by either a change in the supply or the demand side of venture capital investments. Gompers and Lerner (1996) build on Posterba's (1989) work and they argue that different tax rules affect both venture capital investments and activity. Black and Gilson (1998) were the first ones to highlight the importance of advanced capital markets as driving forces of venture capital investments. In Jeng and Wells (2000) paper, they show that IPOs are a significant driving factor for venture capital investments. Schertler (working paper, 2003) was the first one to solely examine the effects in European markets, she concludes that capital endowment is central for venture capital activity. When comparing the conclusions from previous papers, a distinct difference can be seen regarding the significance in the results. One explanation for this phenomenon could be that the macroeconomic factors affecting venture capital investments are constantly changing and are highly affected by the economic state in the market. As the venture capital industry is known for being innovative and fast-changing on a microeconomic level, our theory is that the effects of the macroeconomic factors influencing the venture capital industry will fluctuate over time. This perception lays

[4] The Economist, ‘’The rise of “deep-tech” is boosting Paris’s start-up scene,’’ (23/2-2017)

the foundation for why we believe it to be interesting to further study this topic by using a replicated model.

Our contribution to existing literature is trying to explain the technological development in business models by introducing new variables to the model; online purchasing behaviour and internet access. By analysing the EVCA (2016) investment report we find that industries where business models solely rely on purchases made over the internet now represent around 50% of all venture capital investments. Previous literature discussing macroeconomic factors haven't included this type of technology variable. But, looking at the venture capital scenery today, our hypothesis is that these factors highly determine both young and more established firms' potential to raise capital in different markets. To study the macroeconomic determinants in venture capital we use random, between and within effect regression models.

The results from these regressions vary, but in all regressions, we find evidence that is in line with previous literature. In all our random effects and between effects regressions, we find significant and positive results for private equity funds raised and corporate tax rate. Furthermore, we find positive and significant coefficients for IPOs in the random effects regression. In these regressions, the coefficient for IPOs in early stage investments is higher than in later stage investments, these results align with findings previously shown by Jeng and Wells (2000). The between effects regressions supports results in previous papers by Gompers and Lerner (1998) and Schertler (2003), regarding GDP growth as a positive influencer in venture capital investments. Apart from the results confirming previous research, the most interesting results can be found in our random effects regressions that uses panel data with a shorter time-period consisting of data from the years 2012 until 2015. These regressions present us with the results that our contribution to previous literature, the variable for technological business model development, is significant and has a positive effect on venture capital investments. Furthermore, these models also show positive and significant coefficients for private equity funds raised and corporate tax rates as well as negative and significant results for labor market rigidities. The negative results around labor market rigidities confirms previous findings from Sahlman (1990) and Jeng and Wells (2000).

Reading through previous literature we have been unable to find papers examining the recent development in technology that is occurring within companies in almost every industry. Despite the increasing number of start-ups being more technologically developed than ever

before, there is no empirical study analysing the impact this has on venture capital investments. Because of the lack of knowledge in this area, we believe that we have found a gap in the studies surrounding venture capital investments. To try and fill this gap, we have, as mentioned above, added a variable representing the technological development that has influenced corporations in recent years. By adding this new variable, we believe this paper contributes with both relevant and missing information in the field of macroeconomic determinants in the venture capital industry.

The rest of this thesis is organised as follows. Section 2 contains previous research on the basics of macroeconomic effects in venture capital. Section 3 discusses necessary background regarding the venture capital industry. The data and potential data issues are discussed in section 4. The methodology and the regression used will be presented in section 5. Section 6 will then present the results. In section 7 there will be an analysis of the results. This thesis will then be summed up in a conclusion presented in section 8.

2. Previous literature

There is already extensive academic literature examining venture capital from a microeconomic perspective. Much research can be found discussing areas such as valuation techniques or venture capitalist decision making process, but when it comes to macroeconomic factors as determinants of venture capital activity it's still a rather unexplored area within finance. Most previous papers have been written by American authors foremost focusing on the domestic country and, therefore, leaving a gap in the research surrounding Europe. By building on existing studies, we hope to find empirical evidence explaining the current venture capital situation in Europe. This section gives a summary of existing literature and explains the application of the supply and demand framework on venture capital investments. In the final subsection, the government's role in venture capital is discussed.

2.1 Empirical findings from the US

Posterba (1989) was the first one to examine the determinants of venture capital investments at a macroeconomic level. He argued that changes in either the supply or demand will affect investment activities. By reducing the capital gains tax rate, investors required expected (pre-tax) rate of return decreased. Because of this, reductions in the capital gains tax had an imminent effect on the demand side of venture capital as more people were induced to becoming entrepreneurs which led to better projects being invented. Gompers and Lerner (1998) continued to build on Posterba's (1989) work, more specifically, on what factors drives venture capital fundraising. By examining an empirical dataset of 2000 venture capital funds between the years 1972 through 1994, they also argue that capital gains tax rates have a significant effect on the demand side of venture capital since it affects both taxable and tax-exempt investors.

Black and Gilson (1998) found that economies where capital markets are more developed are also more active in private equity investments when compared to economies with a more centred bank system. They argued that a well-developed stock market that permits venture capitalist to exit through an initial public offering is crucial to the existence of a vibrant venture capital market.

Jeng and Wells (2000) analysed the determinants of venture capital through a sample of 15 countries over a ten-year period. Using factors already documented in the literature on venture capital, they found IPOs to be a driving force for venture capital investments. Jeng and Wells (2000) empirical study demonstrates the necessity of separating venture capital into early (seed and start-up) and later (expansion) stage investing, by showing how different stages are affected

differently by determinants of venture capital. For example, labor market rigidities negatively affect early stage ventures but have no impact on later stage investments. IPOs have no impact on early stage investments across countries, but are a significant determinant for later stage venture capital investments.

2.2 Empirical findings from Europe

Considering the European venture capital landscape, there is one report that stands out, Schertler (2003). This report was financed by the European commission and explains the driving forces for venture capital in European countries. From panel data of 14 western European countries between the years 1988 through 2000, Schertler (2003) draws some interesting conclusions. In contrary to Jeng and Wells (2000), she argues that liquidity of stock markets have a significant positive impact on early stage investments. Furthermore, she finds evidence that human capital endowment and labor market rigidities only affect early stage investments and not the expansion stage investments. Another difference between the results presented by Schertler (2003) and previous studies is that she introduces a new variable trying to explain how human capital endowments affect venture capital activity. By approximating either the number of research and development employees or the number of patents in each country, she comes up with significant results that human capital endowments have a significant positive impact on early stage venture capital investments.

Another European paper, Bonini and Alkan (working paper, 2006), discover that in both their random effects and fixed effects models, the total value of stocks traded are one of the most important determinants of venture capital investments. Apart from these two papers there are a few more researchers discussing macroeconomic factors influencing venture capital in Europe. However, because they lack recognition in established financial journals we're excluding them from this summary.

2.3 Studies on corporate tax rate, labor markets and government programs

Apart from the papers studying the factors affecting venture capital there are also a range of papers focusing more on specific variables. For example, Djankov et al. (2010) discusses the effects of corporate tax rate on factors such as investments, foreign direct investments (FDI) and entrepreneurial activity. This is of interest to us because we include a variable that represents corporate tax rate in our study and we want to see how this influence venture capital investments. Also, in similarity to Jeng and Wells (2000) and Schertler (2003), we include a

variable connected to the labor market. We want to examine if illiquidity in the labor market affects the investment from venture capital. This dilemma is something that has previously been brought forward by Sahlman (1990). He discusses the impact of labor rigidities on venture capital growth and he concludes that it works as a barrier to the success of venture capital. In a paper by O'Shea (1996), government programs are mentioned as an influencing factor on venture capital. O'Shea (1996) brings up numerous examples ranging from support programs to tax incentives that have been implemented to increase investments into venture capital.

2.4 Supply and demand framework

Most previous authors have built their research around the notion that the supply and demand framework are a main factor which can describe the quantity of venture capital investments in a country. Gompers and Lerner (1996), Black and Gilson (1998), Jeng and Wells (2000) and Schertler (2003) all state that this well-established national economic concept also is applicable to the venture capital industry. However, there are some issues around the validity of the concept. Instead of having price on the vertical axis, a venture capital schedule has expected rate of return. This is not a problem, but every supply and demand equilibrium implies a certain price (expected rate of return). Since the real returns of a venture capital investment only can be observed many years after the initial investment and when liquidating the portfolio, this becomes a bit problematic. Our assumption is that the expected rate of returns does not vary much over our sample period and so, the concept of demand and supply is therefore applicable.

2.4.1 Demand side

The demand side of venture capital increases with individual incentives for entrepreneurship in a country. One important factor is labor market rigidities, Schertler (2003) argues that employees have lower incentives to start their own technology companies in economies with rigid labor markets than in economies with flexible labor market. If the newly started company would fail, an entrepreneur could put herself in work quarantine and have a hard time finding new employment. Furthermore, Schertler (2003) states that entrepreneurs compare the expected payoff from starting their own business with being an employee and if protection against dismissal is high, as in rigid labor markets, they have safer income from being an employee. Bozkaya and Kerr (working paper, 2003) argues that fluidity in the labor market is of utmost importance to the increase of new firms and therefore affect the level of investments from venture capital. An alternative interpretation of rigid labor market is that the negative effect it has on the demand side of venture capital could be cancelled out by a potential positive

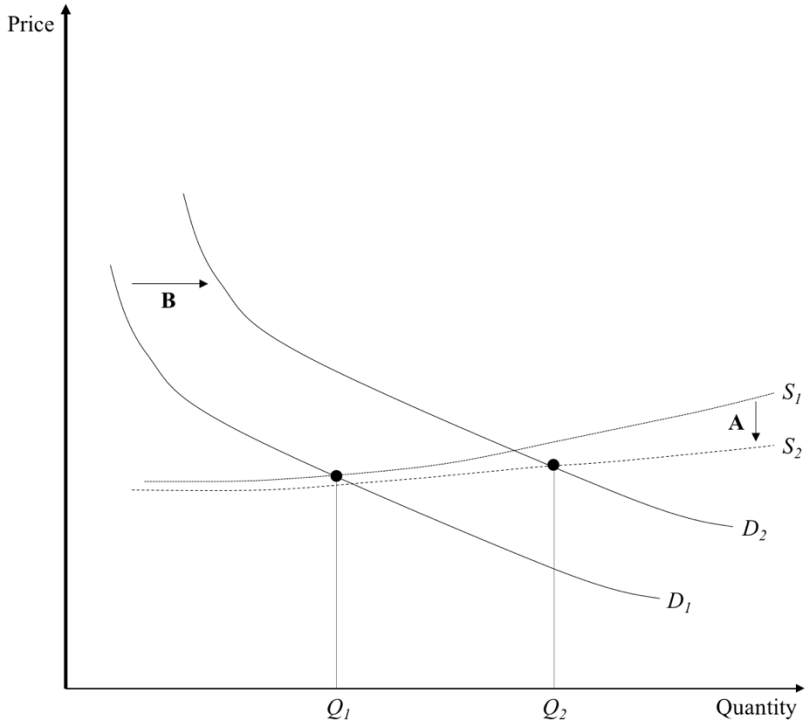
effect on the supply side of venture capital. When these new start-ups begin hiring employees for the first time, a rigid labor market would lead to more expensive personnel costs and therefore an increase in the amount of capital required. Applying this causation of a rigid labor market, the factor would instead be driving higher venture capital monetary volumes but with fewer start-ups meeting venture capitalists' threshold (Jeng and Wells, 2000). Another factor affecting the demand side of venture capital is the liquidity of the stock market. In a liquid stock market, there are more IPOs, which make it possible for entrepreneurs to reacquire control of the company either by repurchasing shares or getting leading management position in the listed company. Another aspect affecting the demand side of venture capital is GDP growth. When the economy is growing at a fast pace, young companies in need of financing will seek to utilize on the positive trend in the economy. This increase in activity from young firms will stimulate the market and increase the demand for venture capital.

2.4.2 Supply side

The supply side of venture capital is determinate by the willingness the investors have in supplying capital to different venture capital funds. Capital providers are dependent on the risk-return relationship of venture capital investments when evaluating alternative investments. If the returns from venture capital investments are attractive compared with other investments, there will be larger investments from the capital providers. The capital providers will study general economic factors such as cost of capital, inflation, interest rates, corporate tax, GDP growth and market capitalization before deciding upon investment. From the venture capitalist perspective, a liquid stock market is essential for two main reasons. First, to make it easier to exit through an IPO and secondly, by signalling experience and credibility to entrepreneurs which in turn will reduce transaction costs (Black and Gilson, 1998). Another component included in the supply side of venture capital is private equity funds raised. As a large part of the economy in almost every country, the private equity industry will have influence over the supply of venture capital. As the private equity investors seek to increase their returns, they will have to take general trends in the market into consideration. When private equity funds are raising capital and increasing their investments, the market could seem more attractive. This could potentially lead to larger investments from other parties as well, resulting in a larger supply of venture capital.

Figure 1

Supply and demand framework in venture capital



A venture capital supply and demand schedule consists of the expected rate of return of the investment on the vertical axis and number the of firms meeting investors requirements on the horizontal axis. As investors expected rate of return decreases (S^1 moves to S^2), more firms are able to meet the investors thresholds (D^1 moves to D^2), this leads to an increase in the amount of venture capital supplied. The new equilibrium quantity of venture capital now moves from Q^1 to Q^2. The upward sloping supply schedule for venture capital is likely to be almost flat since investors have a large variety of financial substitutes. The downward sloping demand curve is steeper because more entrepreneurial firms will likely seek venture capital if the expected rate of returns decreases. Adapted from Gompers and Lerner (1996).

2.5 Understanding government's role

Start-ups are highly affected by the government and the political incentives in the country they are operating in. Government programs are mentioned by Jeng and Wells (2000) as a large influential factor on venture capital. Large discrepancies between the support from different government programs are believed to influence both the private equity flows and venture capital investments (Jeng and Wells, 2000). A vibrant example of this is Portugal in 1986, when the country had an extremely low proportion of venture capital investments as a percentage of GDP. The government then launched a new type of corporation that was granted a variety of tax benefits (Jeng and Wells, 2000). This introduction led to a dramatic increase in investments into venture capital in the coming year. Another role of the government is their ability to influence the capital flow into funds, and therefore the growth of these funds. For example, in US in the 1980s, the government changed the rules for private pension funds, permitting them

to invest into venture capital funds, allowing a much larger part of capital looking to be invested to flow into venture capital (Jeng and Wells, 2000). Similar government incentives can be found in a range of European countries included in our data, two examples of such countries are Italy and Finland (O'shea, 1996).

It's clear that the government's support influences the venture capital investments. Besides monetary support programs, there are also programs and other contributions from the government that can't be measured in direct monetary value. This support works to facilitate the process for companies looking for venture capital and will not be shown as value added in monetary terms. But without the support, monetary value in the industry would be lost.

3. The venture capital industry

To see how different macroeconomic factors affect venture capital it's important to understand the industry on a microeconomic level. The following section explains what venture capital is and how the venture capital process works. To further understand the purpose of this paper this section also discusses the main differences between the US and Europe's venture capital markets as well as looking at the recent trends in the industry.

3.1 What is venture capital

When studying financing through different equity securities it is important to state the dissimilarity between venture capital and private equity investments[5]. While private equity firms use debt financing and leveraged buyouts in already operating companies, venture capital firms instead focus on investments into fast growing companies or early stage innovations (Zider, 1998; SVCA, 2017). A new company often starts with an entrepreneur that has an idea around a product or a service which they believe there is a demand for (Robehmed, 2013). New firms require capital that the founders sometimes can't provide themselves, they then need to seek from outside financing. Entrepreneurs today have two options when it comes to raising money to fund their companies, debt or equity (Clark, 2014). That is, if they can't get help from friends, family or other soft financing. It can be hard for these young companies to obtain debt financing because of four main reasons: uncertainty, asymmetric information, intangibility of firm assets and the current situation in the industry or financial climate (Gompers and Lerner, 2002). The entrepreneur has superior knowledge about the firm which leads to uncertainty for the lenders. Most banks have regulations limiting the interest rates on debt that is appropriate for this type of risky investments, and many young firms lack tangible assets that could work as collateral for bank loans. The other way to obtain financing is through selling equity to either business angels[6] or venture capitalists. In this paper, we exclude investments made from business angels because most of these investments are small in monetary amount and data around private individual investment activity could not be found.

[5] Venture capitalists screen the market for high-risk potentially high returns companies, while private equity funds focus on refining already operational companies.

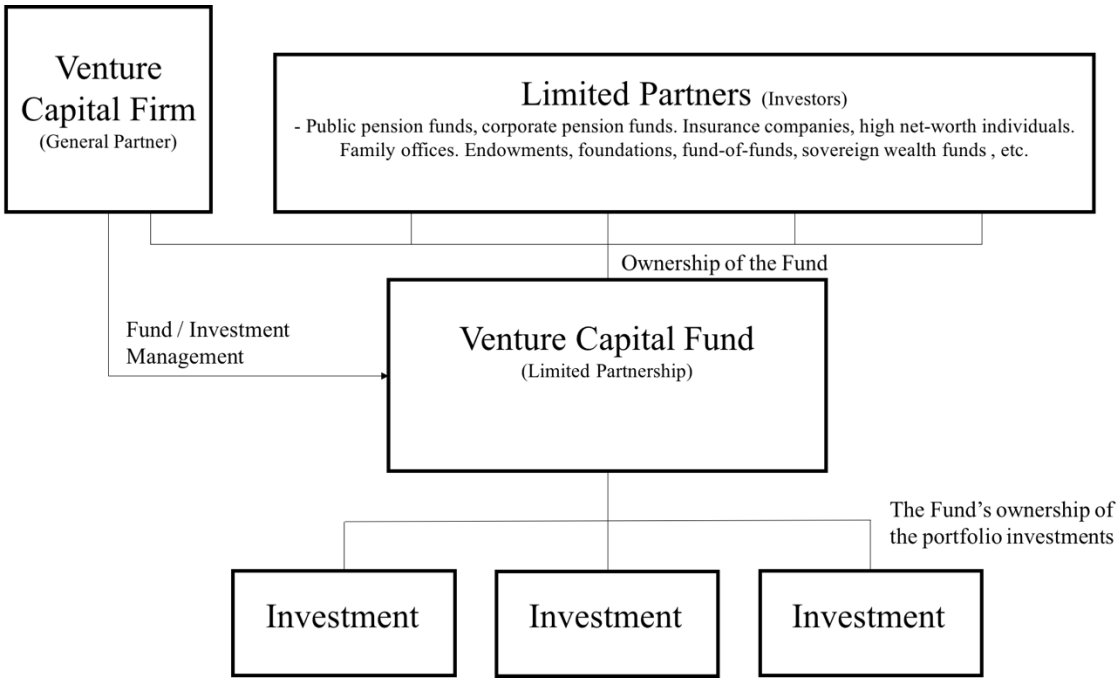
[6] A business angel is an individual investor supplying young companies with resources, in many ways it is the same kind of an arrangement as with venture capital fund.

3.2 The venture capital process

3.2.1 Setting up a venture capital fund

The first step of the venture capital process is to attract investors to the fund, in Europe the most common investors are government agencies, corporate investors and private individuals (EVCA). In contrast to the US, where pension funds are a common investor (Jeng and Wells, 2000), many European countries have regulations prohibiting pension funds to invest in venture capital funds. As shown in Figure 2 below, the funds consist of venture capital firms (general partner) and limited partners (investors). It is solely the venture capitalists that manages the fund. Since money is placed in unlisted companies the investment horizon is usually between 8 to 12 years, from the initial investment to the closing of the fund. During that time-period, investors are unable to sell of their investment and harvest potential profits from the divested companies. Instead, investors must wait until the last portfolio company is divested and the fund liquidates before getting their money back.

Figure 2
How a venture capital fund is structured



3.2.2 Venture capital compensation plan

The compensation plan for the fund managers is divided between management fees and carried interest. The carried interest is a reward system based on how well the managers can make the portfolio companies perform. This is accomplished by achieving profits in the fund and sharing them with the limited partners. From the profits, managers typically receive 20% and the remaining 80% is paid to the fund's investors (Hadzima, 2007). The management fee is based on the fund manager's operations and consists of an annual payment of between 2% and 3% of the committed capital[7]. These fees are charged mostly to cover the funds expenditures connected to finding and managing this early stage companies and as the fund matures, fees usually decline.

3.2.3 Finding and managing companies

Finding companies that fits into the fund profile and that seem as attractive investments can take several years. Therefore, investors only commit capital to the funds instead of transferring the total investment instantly. In that way, investors can avoid having unused capital inside the funds[8].

Venture capital firms tend to develop industry-specific expertise within certain technological fields, markets and sometimes even geographical areas (Chen et al., 2009). Because of this level of specialization, most venture capitalists have a comparative advantage compared with other financial intermediaries in the selection of prominent start-ups in different technological industries (Amit et al., 1998). In opposition to traditional investors, venture capital managers often take an active role in the invested company (Hellmann and Puri, 2002). The expertise from venture capital firms can help entrepreneurs in different ways. From the market perspective, they can assist in derivation of business models, identifying key markets as well as marketing activities (Sjögren and Zackrisson, 2005). By working together with a venture capital firm, start-ups can benefit from the often-well-structured networks of the venture capital firms or collaborations with other portfolio companies, as well as utilizing unique market information, smart recruitment and specialized service providers (Fried and Hisrich, 1995). Venture capital firms also works as a promoter to start-ups in upcoming investment rounds. They contribute with both signalling legitimacy as well as helping with investor meetings.

[7] Committed capital means active investments, and it can take up to 3 years after the initial investment into the fund for the whole investment to be considered committed capital.

[8] Imagine a venture capital fund of $100 million, by investing 10 % in the fund you're committing $10 million. If the fund managers than want to invest $10 million in a target company you as an investor would have to transfer $1 million to cover your position in that portfolio company.

Since most venture capitalists know each other from either previous cases or operating in the same industry, they are used to working together (Gomez-Mejia et al., 1990).

3.2.4 Exit strategies

When considering the whole portfolio of companies, not all investments will be successful and when companies fail to fulfil their targeted goals, problems may arise. To avoid this uncertainty, venture capitalists prefer to stage finance portfolio companies and in that way, consider each single investment as a real option[9]. By having the opportunity to divide larger investments into smaller ones, venture capitalists can recognize which portfolio companies are failing and freeze further investments into these companies. The evaluation of portfolio companies is complex and it usually takes several years before investments can produce sufficient returns to its investors.

Since all investments are illiquid[10] the realizing of investment shares is different from selling shares in a mutual fund's portfolio. In contrast to selling their shares on the open market, all investments in a venture capital fund must be divested separately. There are four different ways to divest portfolio companies; through an IPO, a third-party trade sale, a sale back to entrepreneurs/operating managers or through a liquidation. Several publications discuss the importance of IPOs as part of different exit strategies. For the capital investors, the IPO's are important to achieve sufficient rate of returns as well as to certify their quality as managers of the venture capital fund (Felix et al., (working paper), 2007). Even if IPOs are the most favourable divestment, most deals and the largest sums in Europe are generated from trade sales (EVCA, 2016). Trade sales are a more universal exit channel; a type of exit available to a broader spectrum of firms and not only to the most successful start-ups (Giot and Schwienbacher, 2003). Trade sales can be done in multiple ways, but the most common is an exit through selling shares to either an acquiring company or another venture capital/private equity fund. If portfolio companies fail to deliver upon the venture capitalists predetermined activities, further financing can be cut off and the company can be sold back to its initial founders or operating managers. Liquidation only means that that the company stops operations and is put out of business.

[9] The structure of VC funding could be analysed in terms of real option; as subsequent injections of funds are depending on the portfolio company reaching performance targets

[10] Not sold on the open market, for example a stock exchange. (Black and Gilson, 1998)

3.3 Differences between US and Europe

The early venture capital industry in Europe was greatly inspired by the American counterpart and many of the firms were either affiliates of US firms or consisting of US trained managers (Wright et al., 2004). Today however, the venture capital industry is a global phenomenon but there are still demographical differences. To begin with, venture capital is described differently in the US and Europe. While Europe often uses the broader definition of venture capital activity, which includes investments into either publicly traded or privately held companies. The US on the other hand, denotes venture capital with a narrower definition, where buyouts are excluded and investments consist of three stages, seed-, early- and later stage investments (Bonini and Alkan, 2006). In this paper, we recognize venture capital investments as seed/early and later stage of investment.

When comparing venture capital firms in Europe with the ones in the US, there are some differences in foremost exit possibilities, capital supply and labor market rigidities. Even though many European stock exchanges have tried to replicate its US counterparts, the number of IPOs for young companies are fewer in Europe compared to the US (Hatim and Vijay, 2011). Furthermore, as mentioned in section 3.2.1 *setting up a venture capital fund,* current regulations in several European countries denies pension funds to make investments into venture capital funds, noticeably limiting the venture capital supply. Instead, in Europe, the banks are a much bigger investor and since the banks typically are conservative investors, the possibility for Europe to establish a vibrant venture capital market weakens (Bottazzi et al., 2004). A comparison over venture capital investments between our sample countries and the US is shown in Table I in the Appendix.

3.4 Recent trends in the industry

In the mid and later 20th century, product innovations and semiconductors were the dominating venture capital investments and it wasn't until the late 1990s that the industry really started to grow. With the emergence of the internet in combination with the abundance of IPO offerings for technology companies, the venture capital firms were reaping large returns.

The venture capital industry peaked around year 2000 with investments higher than ever. Then, the internet bubble burst and the world economy went into a deep recession, with negative returns and declining investment levels into the venture capital industry in the years to follow (Hellman and Puri, 2002). In 2015, investments had again returned to their former levels, with the highest number in nearly two decades. The number of deals (8381) and the monetary

amount ($148b) reached its highest levels ever, and while traditional research and development companies failed to stimulate financing, technology-enabled consumer companies dominated among the most attractive investments (EY report, 2015).

Today the venture capital industry has become increasingly important for the innovation systems in advanced economies but also in an increasing number of emerging economies (Bruton et al., 2005). Successful companies like Apple, Google and Facebook are all venture capital funded, which obviously makes both investors and entrepreneurs friendlier towards this way of financing. Venture capital is also important for local job opportunities. There have been several empirical studies showing that venture capital backed start-ups, compared with non-backed start-ups, are more successful when it comes to job creation (Isaksson, 1999; Global insight, 2007). Investment trends within industries are constantly changing, but over the last five years' investments into internet or mobile companies have represented around 60% of the deals made (Kerry, 2016). Gompers and Lerner (1998) highlights venture capital backed companies such as Apple Computer, Cisco Systems, Intel and Microsoft. While these companies are providing their customers with the latest technology, the success stories of technological companies today have another operational thing in common; they're all providing smart online services through technical devices. Companies like Alibaba, Uber, Airbnb and Facebook are all providing customers with services through technical devices and with a business model mainly relying on customers purchasing power over the internet.

4. Data

This paper includes panel data over the time-period 2007-2015. With this time-period and the 20 European countries we have chosen to include in our data, we get 180 observations for each of the variables we use in our model. We use panel data for the possibility to examine both between effects as well as fixed effects. It also helps us control for individual heterogeneity (Torres-Reyna, 2007). Another reason for using panel data is that several recurrent observations of a large enough number of cross-sections allows us to analyse changes over a short time series, which enables us to examine potential trends over different time-periods. We're not missing any data for our observations, which makes it easier to run the required regressions. The countries we use have, on some accounts, been selected due to the availability of data. The data is collected from following countries: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland and the United Kingdom (*see Figure I in the Appendix for data on total venture capital investments by country between 2007-2015*).
This section will focus on the main forces that drive venture capital investments. Apart from the included factors below, we acknowledge the fact that more elements are driving venture capital investments. But due to the absence of fair measurements and data availability for these elements, they have been left out of our analysis.
The data used in this paper on total venture capital investments (*see Table III in the Appendix for data total investments divided by GDP per capita*), investments in start-up stage, investments in seed stage (in this paper, start-up and seed stage investments are merged and termed early stage investments) and investments in later stage are collected from Eurostat.
Investments in early and later stage together refer to total venture capital investments (*see Tables IV and V in the Appendix for data on early and late stage investments divided by GDP per capita*). The data on private equity funds raised are based on all private equity raised in each of the countries included in the data. All the data regarding private equity funds are collected from Invest Europe (EVCA). Labor market rigidities (average tenure) is collected from OECD and are presented as a percentage of the total population that have been with their current employer for more than ten years. Corporate tax rate is referred to the taxation on net profit of companies and the data is gathered from KPMG. The data on GDP is presented as GDP per capita. Considering the large difference in size between the countries, GDP per capita is the fairest and most representative way of presenting this information. The data is collected

in US dollars from OECD. The value of IPO's is provided by EVCA and includes all IPOs that have reach the market, this excludes IPOs that have been announced but later withdrawn.

To try and capture the importance of a liquid stock market, we include a variable representing market capitalization. The variable is market capitalization divided by average GDP per capita and the data on market capitalization is collected from Bloomberg in million US dollars while the data on GDP per capita is collected from OECD. The interest rates are obtained from the European Central Bank (ECB). Some of the data collected was originally presented in other currencies than US dollars, these currencies had to be converted to US dollars. The exchange rates that were used to convert other currencies to US dollars were expressed as currency units per SDR and were provided by the International Monetary Fund (IMF). To analyse the effects connected to the technological developments among companies in different economies, we have included data on both internet access seen to the entire population in the countries, as well as data on online purchase trends. The data that is related to internet access in each country describes the percentage of the entire population who have access to internet connection. The other variable contains data on the percentage of the population that has completed a purchase online within the last three months of the survey date. The data on these variables are collected from Eurostat.

We test our variables for multicollinearity and most of the variables correlate on an acceptable level (*see Table II in the appendix for the correlation matrix*). To avoid too high of a correlation between the variables we use, we have decided to exclude the variables that have a correlation of more than 0.8 (80%). In the correlation matrix, we see that the two technological variables, internet access and internet purchase behaviour correlate on a too high level 0.84 (84%), because of this, we decide to exclude internet access from the regressions that we include in our analysis. We choose to remove internet access because we consider internet purchase to be a more appropriate proxy of the technological effect on venture capital investments. Since a large part of venture capital financed companies build their business model around internet transactions, we believe online purchase to be a more precise measurement in explaining differences between countries and over time.

Descriptive statistics on the data used can be found in Table VI in the Appendix.

Table 1
Summary of variables

Variable	Description	Source
Venture capital: Early stage investments	Seed and start-up investments in million USD divided by average GDP per capita	Eurostat
Venture capital: Late stage investments	Late stage investments from venture capital in million USD divided by average GDP per capita	Eurostat
Private equity funds raised	Total amount of equity raised for private equity funds in million USD divided by average GDP per capita.	Invest Europe (EVCA)
Value of IPOs	The value of IPOs in million USD (excluding the withdrawn) divided by average GDP per capita	Invest Europe (EVCA)
Labor market rigidities and regulations	The percent of the entire working population that has been with the same employer for more than 10 years	OECD
Taxation	The corporate tax rate in percent	KPMG
Interest rate	The end of period interest rate	European Central Bank (ECB)
GDP growth	The percentage increase in GDP per capita	OECD
Market capitalization of GDP	The main stock market capitalization divided by GDP	OECD & Bloomberg
Internet access	The percentage of the entire population that have access to the internet	Eurostat
Online Purchase	The percentage of the entire population that has completed an online purchase within three months of the questionnaire	Eurostat

4.1 Data issues

When selecting countries for the between effects analysis, we had to choose countries based on the availability of data from well-established sources. In our dependent variables, the different value (monetary and non-monetary) from government programs are indirectly included because the venture capital investments used in these variables are total investments in each country. As mentioned in section 2.5 *understanding government's role*, some support programs for start-ups will not appear in these numbers, which makes the data skewed. Since the support programs differ between countries, some programs will add value in monetary terms while others won't. Still, the absolute value to the companies may be the same. When examining the impact of technological change on venture capital investments by including a new variable, the choice was in part based on the availability of data. In the collection of data, some observations were in Euros and others in US dollars, to address this issue, we converted Euros into US dollars by using the average exchange rates over the entire year. This will not be a perfect conversion, since that would have demanded that each investment into venture capital than would have to be converted at the exchange rate at the same day that the transaction occurred.

4.2 Excluded data

In previous research, a variable for the level of pension funds in the economy has been included. This variable is of great importance for the supply of venture capital, since it involves a great deal of money (Gompers and Lerner, 1998; Jeng and Wells, 2000). Although this variable is of great importance when studying venture capital activity in the US, European pension funds do not deal with the same amounts of money (EVCA; Bonini and Alkan, 2006). For this reason, in combination with lack of data, we chose to exclude this from our analysis.

We're also excluding a variable representing accounting standards that has been included in previous papers. We motivate this with the reason that all seed and growth investments are made into private held companies. Therefore, we do not believe that looking at the accounting standards for listed companies in the countries included in our data and then applying a proxy to evaluate the information asymmetry around unlisted companies is accurate enough. Apart from private pension funds and accounting standards we choose to exclude the aspect of capital gains taxation.

The decision to exclude the capital gains tax was based on the difficulty to find a fair measure that could be included in our analysis.

As mentioned in section 3.1 *What is venture capital*, we chose to exclude investments made from business angels due to relatively small investment compared to other sources of financing. Also, we had trouble finding the relevant data to include this variable.

5. Methodology

The methodology used in this paper is similar to the one presented by Jeng and Wells (2000). We start our analysis with the assumption that venture capital investment behaviour doesn't have to be a linear function. This assumption reduces the limitations on the parameters in our nonlinear regressions. All the variables that we include in our regressions are, in one way or another, important for the supply or demand side of venture capital. Therefore, they influence venture capital investments either positively or negatively, that's why we choose to include them in our regressions. Regarding the t-test, since we don't know how each of the independent variables are going to influence venture capital investments (dependent variables), the t-test will be double sided.

This rest of this section will be as follows: First off, we describe the GLS random effects regressions we have implemented in line with previous literature. Secondly, we describe the Hausman test that we include to determine which effects (random or fixed) are the most appropriate to use with our data. Lastly, we describe the between and within effects regressions we implement to examine the differences both between countries but also over time.

The first step of our methodology is running random effects regressions. Since we don't know how our panel data is to be analysed in the most appropriate way until we have conducted a Hausman test, random effects regressions could prove to be the most appropriate. The random effects regression assumes that the data used in the regressions is random. That is, it assumes that the data in our variables are occurring randomly. The random regressions that we implement are,

(1)

$$\begin{aligned}\text{VC\_EARLY}_{it} = {} & \beta_0 + \beta_1 \text{DIVPUOFF\_AVGGDP}_{it} + \beta_2 \text{PEFUND}_{it} + \beta_3 \text{CTAX}_{it} \\ & + \beta_4 \text{ONLPUR\_POP\_3M}_{it} + \beta_5 \text{MCAPOFGDP}_{it} + \beta_6 \text{AVG\_T\_10}_{it} + \beta_7 \text{GDP\_GR}_{it} \\ & + \beta_8 \text{INTR}_{it} + \varepsilon_{it}\end{aligned}$$

(2)

$$\begin{aligned}\text{VC\_LATE}_{it} = {} & \beta_0 + \beta_1 \text{DIVPUOFF\_AVGGDP}_{it} + \beta_2 \text{PEFUND}_{it} + \beta_3 \text{CTAX}_{it} \\ & + \beta_4 \text{ONLPUR\_POP\_3M}_{it} + \beta_5 \text{MCAPOFGDP}_{it} + \beta_6 \text{AVG\_T\_10}_{it} + \beta_7 \text{GDP\_GR}_{it} \\ & + \beta_8 \text{INTR}_{it} + \varepsilon_{it}\end{aligned}$$

(3)

$$VC\_TOT_{it} = \beta_0 + \beta_1 DIVPUOFF\_AVGGDP_{it} + \beta_2 PEFUND_{it} + \beta_3 CTAX_{it} + \beta_4 ONLPUR\_POP\_3M_{it} + \beta_5 MCAPOFGDP_{it} + \beta_6 AVG\_T\_10_{it} + \beta_7 GDP\_GR_{it} + \beta_8 INTR_{it} + \varepsilon_{it}$$

$t = 1,2,\ldots,T$ (where t denoted the time series, in our model years)

$i = 1,2,\ldots,N$ (where i denotes the cross-section dimension, in our model countries)

where,

VC_TOT is total venture capital invested

INTER is the interest rate

GDP_GR is the growth in GDP

AVG_T_10 is the average tenure of the working population

MCAP_GDP is the market capitalization of the largest stock exchange divided by average GDP

DIVPUBOFF_AVGGDP value of IPOs divided by average GDP per capita

CTAX is the corporate tax rate

ONLPUR_POP_3M is the percentage of the population that has made a purchase online within 3 months

PEFUND is the total amount of equity raised for private equity funds divided by average GDP per capita

ε is the error term

Before we can draw conclusions from our random effects regressions, we must be sure that random effects are the most appropriate to use on our panel data. To find the most appropriate effects, we use the generally accepted Hausman test. The Hausman test presents two hypothesises and then shows if H_0 should be rejected or not. $H_{0,}$ which is the first hypothesis, states that both of the two estimations methods, random and fixed effects, are appropriate to use with the presented data. This means that the different effects should show similar coefficients. The other hypothesis, H_1, states that the most appropriate effects to use is the fixed effects and that random effects are not usable. The results of the Hausman test presents us with a Prob>chi2-value. If this value is below 0.005, H_0 should be rejected and the most appropriate effects to use are then the fixed effects. The following equation represents the calculations from the Hausman test,

(4)

$$Chi2 = (b - B)'[(\text{V\_b} - \text{V\_B})^{-1}](\text{b} - \text{B})$$

where,

b is the coefficients from the fixed effects regression

B is the coefficients from the random effects regression

V_b is the variance difference in the fixed effects regression

V-B is the variance difference in the random effects regression

The Hausman test presented us with a Prob>chi2-value of 0.0000, which is lower than 0.005. Therefore, H_0 was rejected, which indicated that the most appropriate effects are the fixed effects. Therefore, we introduced fixed effects regressions into our methodology. Within the fixed effects, we can use both between regressions and within regressions. The between regressions are using cross-sectional information in the data. This means that it analyses the difference between sections, in our case, differences between countries. The between regressions takes the average of a variable over time in a country. The regressions then use these averages when regressing the variables against each other. The original between effects regressions that we implement are,

(5)

$$\begin{aligned}\overline{\text{VC\_EARLY}_i} = {} & \beta_0 + \beta_1\overline{\text{DIVPUOFF\_AVGGDP}_i} + \beta_2\overline{\text{PEFUND}_i} + \beta_3\overline{\text{CTAX}_i} \\ & + \beta_4\overline{\text{ONLPUR\_POP\_3M}_i} + \beta_5\overline{\text{MCAPOFGDP}_i} + \beta_6\overline{\text{AVG\_T\_10}_i} \\ & + \beta_7\,\overline{\text{GDP\_GR}_i} + \beta_8\overline{\text{INTR}_i} + \varepsilon_i\end{aligned}$$

(6)

$$\begin{aligned}\overline{\text{VC\_LATE}_t} = {} & \beta_0 + \beta_1\overline{\text{DIVPUOFF\_AVGGDP}_i} + \beta_2\overline{\text{PEFUND}_i} + \beta_3\overline{\text{CTAX}_i} \\ & + \beta_4\overline{\text{ONLPUR\_POP\_3M}_i} + \beta_5\overline{\text{MCAPOFGDP}_i} + \beta_6\overline{\text{AVG\_T\_10}_i} \\ & + \beta_7\,\overline{\text{GDP\_GR}_i} + \beta_8\overline{\text{INTR}_i} + \varepsilon_i\end{aligned}$$

(7)

$$\begin{aligned}\overline{\text{VC\_TOT}_t} = {} & \beta_0 + \beta_1\overline{\text{DIVPUOFF\_AVGGDP}_i} + \beta_2\overline{\text{PEFUND}_i} + \beta_3\overline{\text{CTAX}_i} \\ & + \beta_4\overline{\text{ONLPUR\_POP\_3M}_i} + \beta_5\overline{\text{MCAPOFGDP}_i} + \beta_6\overline{\text{AVG\_T\_10}_i} \\ & + \beta_7\,\overline{\text{GDP\_GR}_i} + \beta_8\overline{\text{INTR}_i} + \varepsilon_i\end{aligned}$$

$i = 1,2,\ldots,N$ (where i denotes the cross-section dimension, in our model countries)

where,

$\overline{\text{VC\_TOT}_i}$ = the average of total venture capital investments *over time*. This also applies for all other variables with bars over them.

Due to high p-values for both DIVUOFF_AVGGDP and MCAPOFGDP, these two variables were excluded from the between regressions. Since we modified the original regressions, we once again had to conduct a Hausman to see which effects are the most appropriate. From this point out, after all alterations to original regressions, we conducted a Hausman test to assure that the fixed effects were still the most appropriate effects to use. Even though these tests are not included in their respective sections, they can be found in Tables VII-XIV in the Appendix. After the alternation to the original between effects regression were DIVUOFF_AVGGDP and MCAPOFGDP were excluded, we're left with the following regressions,

(8)

$$\overline{\text{VC\_EARLY}_\text{i}} = \beta_0 + \beta_1\overline{\text{PEFUND}_\text{i}} + \beta_2\overline{\text{CTAX}_\text{i}} + \beta_3\overline{\text{ONLPUR\_POP\_3M}_\text{i}} + \beta_4\overline{\text{AVG\_T\_10}_\text{i}} + \beta_5\overline{\text{GDP\_GR}_\text{i}} + \beta_6\overline{\text{INTR}_\text{i}} + \varepsilon_\text{i}$$

(9)

$$\overline{\text{VC\_LATE}_\text{i}} = \beta_0 + \beta_1\overline{\text{PEFUND}_\text{i}} + \beta_2\overline{\text{CTAX}_\text{i}} + \beta_3\overline{\text{ONLPUR\_POP\_3M}_\text{i}} + \beta_4\overline{\text{AVG\_T\_10}_\text{i}} + \beta_5\overline{\text{GDP\_GR}_\text{i}} + \beta_6\overline{\text{INTR}_\text{i}} + \varepsilon_\text{i}$$

(10)

$$\overline{\text{VC\_TOT}_\text{i}} = \beta_0 + \beta_1\overline{\text{PEFUND}_\text{i}} + \beta_2\overline{\text{CTAX}_\text{i}} + \beta_3\overline{\text{ONLPUR\_POP\_3M}_\text{i}} + \beta_4\overline{\text{AVG\_T\_10}_\text{i}} + \beta_5\overline{\text{GDP\_GR}_\text{i}} + \beta_6\overline{\text{INTR}_\text{i}} + \varepsilon_\text{i}$$

$i = 1,2,\ldots,N$ (where i denotes the cross-section dimension, in our model countries)

where,

$\overline{\text{VC\_TOT}_i}$ = the average of total venture capital investments *over time*. This also applies for all other variables with bars over them.

After both the random and the between effects have been tested, we now introduce within effects regressions. The within effects regressions analyses the change within sections, instead of between sections as in the between effects regressions. The within effects work similarly to the between effects when it creates averages over time for a variable within a country. But instead of using the average when running the regression, the within effects subtracts the average from each of the individual values that together have been used to calculate an average. The within effects regression that we implement are,

(11)

$$VC\_EARLY_{it} - \overline{VC\_EARLY_i} = \beta_0 + \beta_1(PEFUND_{it} - \overline{PEFUND_i}) + \beta_2(CTAX_{it} - \overline{CTAX_i}) + \beta_3(ONLPUR\_POP\_3M_{it} - \overline{ONLPUR\_POP\_3M_i}) + \beta_4(AVG\_T\_10_{it} - \overline{AVG\_T\_10_i}) + \beta_5(GDP\_GR_{it} - \overline{GDP\_GR_i}) + \beta_6(INTR_{it} - \overline{INTR_i}) + \varepsilon_{it}$$

(12)

$$VC\_LATE_{it} - \overline{VC\_LATE_i} = \beta_0 + \beta_1(PEFUND_{it} - \overline{PEFUND_i}) + \beta_2(CTAX_{it} - \overline{CTAX_i}) + \beta_3(ONLPUR\_POP\_3M_{it} - \overline{ONLPUR\_POP\_3M_i}) + \beta_4(AVG\_T\_10_{it} - \overline{AVG\_T\_10_i}) + \beta_5(GDP\_GR_{it} - \overline{GDP_{GR_i}}) + \beta_6(INTR_{it} - \overline{INTR_i}) + \varepsilon_{it}$$

(13)

$$VC\_TOT_{it} - \overline{VC\_TOT_i} = \beta_0 + \beta_1(PEFUND_{it} - \overline{PEFUND_i}) + \beta_2(CTAX_{it} - \overline{CTAX_i}) + \beta_3(ONLPUR\_POP\_3M_{it} - \overline{ONLPUR\_POP\_3M_i}) + \beta_4(AVG\_T\_10_{it} - \overline{AVG\_T\_10_i}) + \beta_5(GDP\_GR_{it} - \overline{GDP\_GR_i}) + \beta_6(INTR_{it} - \overline{INTR_i}) + \varepsilon_{it}$$

$t = 1,2,\ldots,T$ (where t denoted the time series, in our model years)

$i = 1,2,\ldots,N$ (where i denotes the cross-section dimension, in our model countries)

where,

$\overline{VC\_TOT_i}$ = the average of total venture capital investments *over time*. This also applies for all other variables with bars over them.

Since we want to compare the results from the between effects regressions with the results from the within effects regression, the two variables DIVUOFF_AVGGDP and MCAPOFGDP were excluded from the within effects regressions as well.

Due to the large differences in online purchases over time in each of the countries, using a shorter time-period will present us with more reasonable averages over time since the increase and therefore, the large difference gets smaller as the technological levels in the countries develops. The subpanel we introduce contains data from the years 2012 through 2015 for all the countries included in our data. For this to be a more precise measure of online purchases effects on venture capital, the time-period is selected based on internet access. The time-period from 2012 until 2015 is selected because from 2012, more than 50 percent of the population in

all the countries in the data have access to internet (*see Table XV in the Appendix for data on internet access and online purchase between countries*).

To find the most appropriate effects we once again use the Hausman test. In this Hausman test, when we are using a subpanel of data between 2012-2015, the results show us that the most appropriate effects to use are random effects. We therefore use random effects regressions when examining the shorter time-period. When regressing the new sub panel, we used the equations 11,12 and 13 again, since we wanted the same regressions but with a shorter time span. From these regressions, we saw that the p-value of the variable interest rate (INTR) was too high to be included in the regressions. We therefore excluded the variable representing interest rate, leaving us with the following regressions,

(14)

$$VC\_EARLY_{it} = \beta_0 + \beta_1 PEFUND_{it} + \beta_2 CTAX_{it} + \beta_3 ONLPUR\_POP\_3M_{it} + \beta_4 AVG\_T\_10_{it} + \beta_5 GDP\_GR_{it} + \varepsilon_{it}$$

(15)

$$VC\_LATE_{it} = \beta_0 + \beta_1 PEFUND_{it} + \beta_2 CTAX_{it} + \beta_3 ONLPUR\_POP\_3M_{it} + \beta_4 AVG\_T\_10_{it} + \beta_5 GDP\_GR_{it} + \varepsilon_{it}$$

(16)

$$VC\_TOT_{it} = \beta_0 + \beta_1 PEFUND_{it} + \beta_2 CTAX_{it} + \beta_3 ONLPUR\_POP\_3M_{it} + \beta_4 AVG\_T\_10_{it} + \beta_5 GDP\_GR_{it} + \varepsilon_{it}$$

$t = 1,2,\ldots,T$ (where t denoted the time series, in our model years)

$i = 1,2,\ldots,N$ (where i denotes the cross-section dimension, in our model countries)

6. Results

6.1 Random regression results

Table 2
Random effects regressions

Independent variables	Dependent variables		
	1	2	3
	VC_EARLY	VC_LATE	VC_TOT
DIVPUBOFF_~P	0.209**	0.447*	0.635*
	(1.85)	(2.00)	(2.00)
PEFUND	0.000906	0.00875*	0.00867*
	(0.81)	(4.15)	(2.81)
CTAX	0.0264*	0.0422*	0.0731*
	(3.70)	(3.91)	(4.10)
ONLPUR_PO~3M	-0.00293***	-0.00480***	-0.00866**
	(-1.54)	(-1.58)	(-1.80)
MCAPOFGDP	-0.000323	0.00129	0.000698
	(-0.47)	(1.06)	(0.38)
AVG_T_10	0.0491	-0.0105	0.0545
	(1.24)	(-0.18)	(0.56)
GDP_GR	0.00132	0.00311	0.00451
	(0.40)	(0.48)	(0.49)
INTR	0.00475	0.00935	0.0131
	(0.65)	(0.67)	(0.65)
_cons	-0.0119***	-0.00493	-0.0205
	(-1.52)	(-0.46)	(-1.10)
R2	0.1062	0.3914	0.2391
N	180	180	180

Random effects regressions of 20 countries. The dependent variables are venture capital investments in early stage (seed and start-up) (VC_EARLY), venture capital investments in late stage (VC_LATE) and total venture capital investments (VC_TOT). All the dependent variables are divided by average GDP per capita. The independent variables are (1) Divestment by public offering divided by average GDP per capita (DIVPUBOFF_~P), (2) private equity funds raised divided by average GDP per capita (PEFUND), (3) corporate tax rate (CTAX), (4) online purchase within the last three months (ONLPUR_PO~3M), (5) market capitalization divided by average GDP per capita (MCAPOFGDP), (6) average tenure over 10 years of entire working population (AVG_T_10), (7) GDP growth (GDP_GR), (8) interest rate (INTR). The t-statistics for the coefficients are in parenthesis.
***Significant at 15% level, **Significant at 10% level, *Significant at 5% level

Table 2 above reports the results from the between regressions of early (early stage), late (late stage) and total (total) venture capital investments on divestment by public offering, private equity funds raised, corporate tax rate, online purchase, market capitalization of GDP, average tenure, GDP growth and interest rate. The early stage regression has a low R-square of only

0.1062. The total regression shows a slightly higher R-square value of 0.2391 while the late regression has the highest R-square value of 0.3914. We also observe that in all three regressions, the corporate tax rate is statistically significant at a 5% level. Looking at the private equity funds raised we see that in both the late and total regression it is statistically significant at a 5% level. Worth noticing is that the divestment by public offering is statistically significant at a 5% level in both the late and total regression while it's only significant at a 10% level in the early regression.

6.2 Hausman test results

Table 3
Hausman test

	--------Coefficients--------			
	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_bV_B)) S.E.
DIVPUBOFF_~P	.5710789	.6354083	-.0643294	.
PEFUND	.0034526	.0086749	-.0052223	.
CTAX	.0597922	.0731205	-.0133284	.012255
ONLPUR_PO~3M	-.0265181	-.0086576	-.0178606	.0034589
MCAPOFGDP	-.0027726	.0006976	-.0034701	.
AVG_T_10	.1920367	.0544836	.1375531	.0769303
GDP_GR	.008629	.0045124	.0041166	.
INTR	-.0037128	.0131271	-.0168399	.

b = consistent under H_0 and H_a; obtained from xtreg

B = inconsistent under H_a, efficient under H_0; obtained from xtreg

Test: H_o: difference in coefficients not systematic

chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 62.63

Prob>chi2 = 0.0000

Table 3 above reports the results from the Hausman test for the random and fixed effects regression with the depended variable being total venture capital investments. These regressions also include all the original variables. This test is conducted to select the most appropriate effect (random or fixed effects). This test is very effective and the results are clear. For the null hypothesis to be rejected, which is that random effect is the most appropriate, the prob>chi2 should be below 5 percent (0.005). This is the case in our Hausman test and therefore, we reject the null hypothesis. Results from all the Hausman tests can be found in Tables VII-XIV in the Appendix.

6.3 Between regression results

Table 4
Between effects regressions

Independent Variables	Dependent variables		
	1 VC_EARLY	2 VC_LATE	3 VC_TOT
PEFUND	0.0161*	0.0286*	0.0446*
	(3.71)	(6.97)	(5.45)
CTAX	0.0552*	0.0495*	0.105*
	(2.94)	(2.79)	(2.95)
ONLPUR_PO~3M	0.0110**	0.00702	0.0180**
	(2.15)	(1.45)	(1.86)
AVG_T_10	-0.0761	-0.0715	-0.148
	(-1.07)	(-1.06)	(-1.10)
GDP_GR	0.134*	0.115**	0.249**
	(2.18)	(1.98)	(2.14)
INTR	0.0886	0.0757	0.164
	(1.42)	(1.28)	(1.39)
_cons	-0.00679	-0.00477	-0.0116
	(-0.54)	(-0.40)	(-0.49)
R2-between	0.7782	0.8736	0.8395
N	180	180	180

Between regressions of 20 countries. The dependent variables are venture capital investments in early stage (seed and start-up) (VC_EARLY), venture capital investments in late stage (VC_LATE) and total venture capital investments (VC_TOT). All the dependent variables are divided by average GDP per capita. The independent variables are (1) private equity funds raised divided by average GDP per capita (PEFUND), (2) corporate tax rate (CTAX), (3) online purchase within the last three months (ONLPUR_PO~3M), (4) average tenure over 10 years of entire working population (AVG_T_10), (5) GDP growth (GDP_GR), (6) interest rate (INTR). The t-statistics for the coefficients are in parenthesis.
***Significant at 15% level, **Significant at 10% level, *Significant at 5% level

Table 4 above reports the results from the between regressions of early (early stage), late (late stage) and total (total) venture capital investments on private equity funds raised, corporate tax rate, online purchase, average tenure, GDP growth and interest rate. All the regressions have a high R-square-between, ranging from 0.7782 to 0.8736. Both private equity funds raised and corporate tax rate have positive coefficients in all three regressions and they are both statistically significant at a 5% level. Apart from private equity funds raised and corporate tax, GDP growth is statistically significant at a 5% level in the early stage regression. GDP growth also shows the highest positive coefficients in all three regressions. It is also worth noticing that the technological variable that we introduced in addition to previous research (online

purchase), is statistically significant at a 10% level in both the early stage regression and in the total regression.

6.4 Within regression results

Table 5
Within effects regressions

Independent Variables	Dependent variables		
	1	2	3
	VC_EARLY	VC_LATE	VC_TOT
PEFUND	-0.000410	0.00394*	0.00353*
	(-0.71)	(3.62)	(2.23)
CTAX	0.0198	0.0465***	0.0662
	(1.06)	(1.53)	(1.39)
ONLPUR_PO~3M	-0.00815*	-0.0178*	-0.0259*
	(-2.22)	(-2.39)	(-2.43)
AVG_T_10	0.0691	0.121	0.190
	(1.32)	(1.37)	(1.47)
GDP_GR	0.00125	0.00443	0.00567
	(0.64)	(1.13)	(1.04)
INTR	0.000894	-0.000761	0.000133
	(0.10)	(-0.04)	(0.00)
_cons	-0.0123	-0.0263***	-0.0386
	(-0.97)	(-1.50)	(-1.37)
R2-within	0.2556	0.3255	0.3265
N	180	180	180

Within regressions of 20 countries. The dependent variables are venture capital investments in early stage (seed and start-up) (VC_EARLY), venture capital investments in late stage (VC_LATE) and total venture capital investments (VC_TOT). All the dependent variables are divided by average GDP per capita. The independent variables are (1) private equity funds raised divided by average GDP per capita (PEFUND), (2) corporate tax rate (CTAX), (3) online purchase within the last three months (ONLPUR_PO~3M), (4) average tenure over 10 years of entire working population (AVG_T_10), (5) GDP growth (GDP_GR), (6) interest rate (INTR). The t-statistics for the coefficients are in parenthesis.
***Significant at 15% level, **Significant at 10% level, *Significant at 5% level

Table 5 above reports the results from the between regressions of early (early stage), late (late stage) and total (total) venture capital investments on private equity funds raised, corporate tax rate, online purchase, average tenure, GDP growth and interest rate. The R-square-within ranges between 0.2556 to 0.3265 in all three regressions, with the total regression having the highest R-square-within value. Only one independent variable is statistically significant on a 5% level in all three regressions, and that is online purchase. Besides online purchase, the only

other variable that is statistically significant at a 5% level is private equity funds raised, in both the late and total regressions.

The most interesting result from Table 5, we believe comes from the variable online purchase. For us to examine this result further, we divide the data into subpanels and use a shorter time-period.

6.5 Random regression 2012-2015 results

Table 6

Random effects regression 2012-2015

Independent Variables	Dependent variables		
	1	2	3
	VC_EARLY	VC_LATE	VC_TOT
PEFUND	0.00814*	0.0121*	0.0201*
	(7.12)	(11.21)	(9.60)
CTAX	0.0232*	0.0209*	0.0440*
	(6.03)	(5.75)	(6.23)
ONLPUR_PO~3M	0.00568*	0.00395*	0.00967*
	(5.50)	(4.06)	(5.11)
AVG_T_10	-0.0270*	-0.0257*	-0.0526*
	(-5.12)	(-5.13)	(-5.43)
GDP_GR	0.00441	0.00662***	0.0108
	(0.97)	(1.51)	(1.30)
_cons	0.00000580	0.00000960	0.0000152
	(0.02)	(0.04)	(0.03)
R2	0.6578	0.7032	0.6986
N	180	180	180

Random regressions of 20 countries between 2012-2015. The dependent variables are venture capital investments in early stage (seed and start-up) (VC_EARLY), venture capital investments in late stage (VC_LATE) and total venture capital investments (VC_TOT). All the dependent variables are divided by average GDP per capita. The independent variables are (1) private equity funds raised divided by average GDP per capita (PEFUND), (2) corporate tax rate (CTAX), (3) online purchase within the last three months (ONLPUR_PO~3M), (4) average tenure over 10 years of entire working population (AVG_T_10), (5) GDP growth (GDP_GR). The t-statistics for the coefficients are in parenthesis.

***Significant at 15% level, **Significant at 10% level, *Significant at 5% level

Table 6 above reports the results from the between regressions of early (early stage), late (late stage) and total (total) venture capital investments on private equity funds raised, corporate tax rate, online purchase, average tenure and GDP growth between the years 2012-2015. In the three regressions presented in Table 6, the R-squared ranges between 0.6578 and 0.7032.

What can also be seen in Table 6 is that private equity funds raised, corporate tax and online purchase all have positive influence on all stages of venture capital investments. These are also significant at a 5% level. While these variables are positive, the variable representing labor market liquidity is negative and at the same time statistically significant at a 5% level for all three stages of venture capital investment. The most interesting result from these regressions is the influence that online purchases have on venture capital investments. These are the only regression where online purchases have a positive influence on venture capital investments in all three stages while at the same time being highly significant (5% level).

7. Analysis

The following section consists of an analysis of our main results. In the random effects, between effects and fixed effects regressions, we found significant results for online purchases, corporate tax rate, private equity funds raised, GDP growth, IPOs and labor market rigidities. We did not find any significant results for interest rates or market capitalization, these variables are therefore excluded from this analysis. Our main result is that we find significant and positive explanatory value for the online purchase variable in the random effects regression 2012-2015 (Table 6). As can be seen in Tables 7 and 8 below, the results vary across different regressions, we therefore discuss each significant variable separately.

Table 7

Results table 1

	Random regression			Between regression		
	Early	Late	Total	Early	Late	Total
IPO	Positive**	Positive*	Positive*	n/a	n/a	n/a
Private equity funds raised	Not significant	Positive*	Positive*	Positive*	Positive*	Positive*
Corporate tax	Positive*	Positive*	Positive*	Positive*	Positive*	Positive*
Online purchase	Negative***	Negative***	Negative**	Positive**	Not significant	Positive**
Market capitalization/GDP	Not significant	Not significant	Not significant	n/a	n/a	n/a
Average tenure	Not significant	Not significant	Not significant	Not significant	Not significant	Not significant
GDP growth	Not significant	Not significant	Not significant	Positive*	Positive**	Positive**
Interest rate	Not significant	Not significant	Not significant	Not significant	Not significant	Not significant

***Significant at 15%, **Significant at 10%, *Significant at 5%

Table 8

Results table 2

	Within regression			Random regression 2012-2015		
	Early	Late	Total	Early	Late	Total
IPO	n/a	n/a	n/a	n/a	n/a	n/a
Private equity funds raised	Not significant	Positive*	Positive*	Positive*	Positive*	Positive*
Corporate tax	Not significant	Positive***	Not significant	Positive*	Positive*	Positive*
Online purchase	Negative*	Negative*	Negative*	Positive*	Positive*	Positive*
Market capitalization/GDP	n/a	n/a	n/a	n/a	n/a	n/a
Average tenure	Not significant	Not significant	Not significant	Negative*	Negative*	Negative*
GDP growth	Not significant	Not significant	Not significant	Not significant	Positive***	Not significant
Interest rate	Not significant	Not significant	Not significant	n/a	n/a	n/a

***Significant at 15%, **Significant at 10%, *Significant at 5%

7.1 Online purchases

In the random effects regressions (Table 2), online purchases are highly significant but, surprisingly, have negative coefficients for all investment stages. The negative impact from online purchases could be explained by distortions in the data. Due to large differences, both between and within the countries, the data becomes deceptive when using random effects regressions. By instead running regression models where we either control for country or time, this distortion can be handled correctly. In our between effects regressions (Table 4), one can see that online purchase now has a positive effect on early stage of venture capital investments as well as the total investments. Our belief is that the most recent upturn in companies focusing on applications with internet driven business models has helped stimulate the demand for venture capital investments. Studying the recent years in the EVCA report between 2007-2015 there has been an increase in invested capital into technological companies. The increase in these markets has led to a new start-up setting forming in many European countries (Riggins, 2016), with a higher demand for venture capital investments. We believe this to be particularly true for early stage investments since the development in this sector has created an industry specific knowledge around how to come up with innovative business models over the internet. This reasoning is supported by the regressions in (Table 4). Why online purchases are insignificant in later stage investments could be because these later investments are mostly

made towards other industries and the effect of later stage investments are not yet established in all the countries due to differences in technological conditions.

When running the within effect regressions (Table 5), we see the same kind of behaviour as in the random effects regression model. In all three of the regressions online purchase has negative effect on venture capital investments and it is also highly significant. Again, we believe that this behaviour occurs due to the large discrepancy in the data regarding online purchase. Even though the data is collected from countries within Europe, the technological possibilities that enables access to the internet differs greatly between the countries (*see Table XVI in the Appendix for the internet access between countries*). Also, because the data on online purchases is collected from the entire population, even parts that don't have access to the internet, it gets a bit skewed. In our data, we also see that the percentage of the population that has made a purchase online is increasing rapidly over the sample period (*see section XVI in the Appendix for online purchase between countries*). To better interpret the results, we instead used a subpanel containing data from a shorter time-period (*see section 5 Methodology*). As can be seen in (Table 6), online purchase now has a positive effect on the venture capital investments in all three of the regressions, while at the same time being significant. This lends support to the idea that the rise in online activity and the increasing number of companies providing products and services online will help drive venture capital investments. Using online purchase as an approximation for the technological development has provided us with the results that an increasing development in technology as well an increasing use of more technological based business models will, in fact, influence the demand side of venture capital investments positive.

7.2 Corporate tax rate

In the between effects regression (Table 4) one can see that the independent variable, corporate tax rate, has a positive influence on all three of the regressions. We argue that this positive correlation between corporate tax rate and venture capital investments occurs because investors would want to supply more capital to funds when corporate tax rates are higher. One easy way to understand this relation is to imagine an investor who chooses between allocating capital to either a venture capital fund or to buy stocks in a company. The returns from stocks are dependent on the company performance, which in turn is dependent on the corporate tax rate. The returns from a venture capital fund is based on the divestments of portfolio companies. Because most portfolio companies aren't yet profitable the corporate tax rate doesn't affect the performance of the venture capital fund. With this reasoning, we can conclude that when corporate tax rates increase the alternative cost for venture capital fund investments decrease.

In the modified random effects regressions (Table 6), one can also see that corporate tax rate is significant in all three regressions and that it has a positive influence on venture capital investments, even when the data is divided into a subpanel consisting of a shorter time-period. As presented by Djankov et al. (2010), a lower corporate tax rate will not lower the investments into services, which is also were a large part of the technology investments end up (EVCA report). This lends further support to the idea that corporate tax rate influences the supply side of venture capital investments positive.

7.3 Private equity funds raised

From the between effects regressions (Table 4) private equity funds raised have a significant impact in all three regressions. This is expected since the private equity industry also focuses on investments that yields returns. As private equity funds traditionally are more risk averse than venture capital investors, we have a reason to believe that when private equity funds are increasing in size, the market can be seen by investors as less risky (*see section 2.4.2 supply side*). This will in return drive up the venture capital funds investments as they see opportunity to find higher returns with lower risk. From both the within effects regressions (Table 5) and the modified random effects regression (Table 6), one can see the same results for private equity funds raised, namely that it's significant while also having a positive influence on the investment from venture capital. Based on these results, one can draw the conclusion that private equity funds raised are influencing the supply side of venture capital investments in a positive way.

7.4 GDP growth

As can be seen from the between effects regressions (Table 4), even though the R-squared-between is low, GDP growth is highly influential when examining venture capital investments. The results we get on GDP growth are in line with results from both Gompers and Lerner (1998) and Schertler (2003). We believe that the reason GDP growth has a positive impact on venture capital investments is that a higher economic growth rate will increase the venture capital markets willingness to invest as they become more risk-tolerant when the economy is strong (Campbell and Cochrane, 1999). Potential high growth companies associated with uncertainty and risk may seem as a more attractive investment when the economy is flourishing than when it's not. Another explanation could be the fact that in a thriving market, measurements such as future earnings growth could be overestimated due to the current financial strength. This will

have the effect that valuations often become high and the probability of overvaluation increases (Barsky and De Long, 1993). This could lead investors to set aside larger, well established, companies for smaller and riskier ones and in that way, supply more capital into high risk venture capital investments. This theory can partly be confirmed in (Table 4) as the GDP growth is most significant in the early stage of venture capital investment.

7.5 Initial public offering (IPO)

In the random effects regressions (Table 2), we find that IPOs are significant and have a high impact, especially on later stage venture capital investments. As concluded by Jeng and Wells (2000), this seems appropriate as the exit possibility through an IPO becomes more relevant for mature start-ups. Unfortunately, the p-values for the IPO variable are too high in the other regressions and are therefore excluded. Solely based on the results from the random effect regressions we can conclude that IPOs are a positive influencer for venture capital investments.

7.6 Labor market rigidities

The modified random effects regressions (Table 6), presents us with results on labor markets that are in line with previous research. These results are namely that labor market rigidities will have a significant negative influence on venture capital. This lends support to the idea that an inflexible labor market will reduce venture capital investments. This is something that is supported by both Jeng and Wells (2000) and Sahlman (1990). Sahlman (1990) means that employees that choose to pursue a different path, independent of their current employment, will be considered dishonourable. Also, a loss of rank as well as the risk of not finding new employment after a failed attempt at entrepreneurship will leave the venture capital markets less attractive for entrepreneurs. We also find that labor market rigidities will be an obstacle for venture capital investments, something that is likewise supported by Jeng and Wells (2000). Apart from labor rigidities, strict labor market regulations will impact the venture capital markets as investors will take these regulations into consideration when deciding on investment allocations (Cumming, 2012). The regulations that prevail in the labor market will influence the demand from firms looking for venture capital investments as well as rising expenses for firms that are fast growing and with strained liquidity. These regulations could create an obstacle for entrepreneurship and hinder the growth of new start-ups. Apart from previous research, there have also been statements that the rigidities in the labor markets are one of the most considerable aspects of why venture capital activity is not more frequent in Europe (The Economist, 1997).

8. Conclusion

The purpose of this study has been to evaluate which factors that influence venture capital investments in Europe, both over time and between countries, and if the recent technological trend has helped increase the venture capital investments. The results indicate that there are a few factors that affect venture capital investments more than others and that online purchasing is, indeed, increasing the venture capital investments.

Our results indicate that the two most prominent factors influencing venture capital investments are private equity funds raised and corporate tax rate. Both between countries and over time they are the most significant factors, where the corporate tax rate has the most effect of the two. Solely looking at our between regression model, GDP growth is also a driving positive factor when it comes to venture capital investments. We also conclude that over time, illiquid labor markets have a negative impact on the industry as it forms a barrier for entrepreneurship. IPOs are not significant in either our between or within regressions, one reason for this could be the fact that trade sales are more common in Europe than they are in the US (EVCA, 2016).

The most intriguing result from our study is that we show that the variable we use as an approximation for the technological trend has a positive influence on venture capital investments over time. The results from the time-period 2012-2015 show that the early stage of venture capital investments is more influenced by the online purchase variable. In Table 6, we also see that the random effects regressions between 2012-2015 have a R-squared value ranging between 0.6578 and 0.7032. This supports the idea that the increase number of start-ups focusing on internet based business models will indeed increase the amount of investments from venture capital. To the best of our knowledge, this has not yet been put forward by anyone else.

9. Further research

In this paper, we're including government support in all our regressions, one could argue that this is not appropriate when studying the venture capital industry. Since government's expected rate of return are different from the expected rate of return that venture capital firms have, the results could be misleading. We suggest that further researchers should focus on finding data to study the effect of venture capital investments without government funding.

Being able to isolate venture capital funding without government support could lead to more variables being significant and a higher explanatory value (R-squared) could be achieved in the regression models.

Furthermore, we believe more work can be done in respect to research and development activities as a strong influencer when it comes to venture capital activity. Schertler (2003) includes this variable and finds evidence for human endowments as a significant positive factor for the industry. Unfortunately, we couldn't find data to study this any further.

By looking at the venture capital investments that are made today, a considerable amount of these are invested into consumer application companies. Even though our online purchases variable captures these effects at some level, one could argue that a more appropriate variable to consider is smartphone usage. We suggest further research in this area to examine these affects more closely.

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Databases:

Bloomberg (Database acceded during spring 2017)

11. Appendix

Table I

Comparison over venture capital investments between Europe and US

Country	2007	2008	2009	2010	2011	2012	2013	2014	2015
Austria	38005	31850	35604	29132	24827	24640	25901	24719	27185
Belgium	125150	68000	73050	42000	98000	15000	14000	76000	76000
Bulgaria	0	11473	6260	3328	200	88	1598	1440	800
Czech Rep.	2026	4333	1446	11578	8203	724	779	5586	3987
Denmark	214157	178326	118177	141690	165243	177365	198323	195827	290217
Finland	131347	114683	86885	98635	77433	80297	99967	99704	97872
France	956935	1138005	929228	847372	725475	674701	784431	750894	744466
Germany	864013	1004523	704454	751153	770493	590699	658838	613427	756708
Greece	583	4500	13178	5000	9291	0	1129	198	0
Hungary	6112	10677	529	17900	30495	66840	17210	29897	23798
Ireland	66123	46111	45229	28286	41327	75069	86584	64381	88739
Italy	116665	60776	64920	63029	50310	67187	42977	31801	33050
Netherlands	307378	242350	174818	165845	185525	168266	157578	191760	219792
Norway	285714	183308	133816	162050	122223	130261	81438	96769	91743
Poland	19846	57509	2102	8063	25449	8319	22426	24942	29181
Portugal	137130	92141	42203	65358	12846	17371	28643	45363	69833
Spain	365481	496214	135872	105124	125270	89833	84690	83312	105271
Sweden	421538	348215	218389	246161	235007	216612	223667	198367	150143
Switzerland	438814	496843	331091	227346	262487	128652	215122	178509	282837
UK	1641124	1769518	875410	801919	839822	678464	532749	775018	833207
US	23475020	20798733	14670318	17767422	21504842	21551693	22818863	38502703	53936202

Table I show the venture capital investments between the different countries in the data and the United States over the time-period 2007-2015. As can be seen in the table US has the largest venture capital investments over the whole time-period. The second largest investments can be found in the United Kingdom, followed by France and Germany. There are also a few countries that have zero investments during some years. Both Bulgaria and Greece have years with zero venture capital investments. The data is collected from OECD, NVCA and EVCA.

Table II

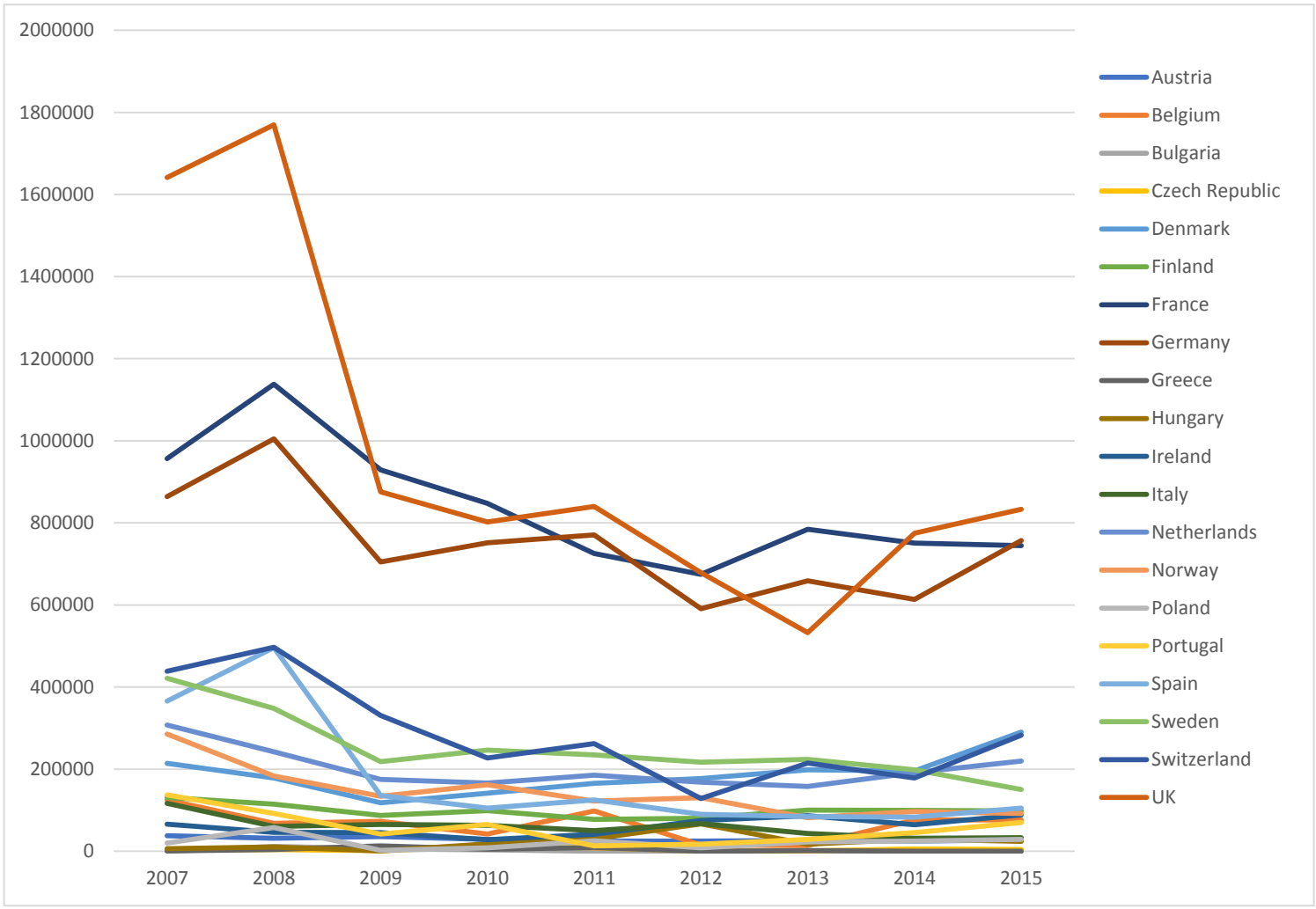
Correlation matrix

	DIVP	INTR	GDPgr	AVGT	MCAP	CTAX	INTA	ONLP	PEFUN	VC_LAT	VC_EAR	VC_TO
DIVPUBOFF_~P	1.0000											
INTR	-0.1143	1.0000										
GDP_GR	-0.0217	-0.1197	1.0000									
AVG_T_10	0.1300	-0.0510	0.2028	1.0000								
MCAPOFGDP	0.1921	-0.3804	0.0446	0.1597	1.0000							
CTAX	0.4032	-0.1614	0.1983	0.6011	0.1035	1.0000						
INTACC_POP	0.0823	-0.5832	0.0581	0.2386	0.3948	0.1862	1.0000					
ONLPUR_PO~3M	0.1170	-0.5767	0.0255	0.1887	0.7165	0.1103	0.8411	1.0000				
PEFUND	0.3405	-0.1154	0.0091	0.0031	0.3080	0.1650	0.1401	0.2646	1.0000			
VC_LATE	0.4590	-0.1326	0.0002	0.1004	0.3002	0.3805	0.0979	0.2573	0.6734	1.0000		
VC_EARLY	0.4423	-0.2307	-0.0225	0.1610	0.3103	0.4391	0.2803	0.4055	0.5682	0.9020	1.0000	
VC_TOT	0.4632	-0.1784	-0.0097	0.1291	0.3120	0.4154	0.1794	0.3279	0.6445	0.9823	0.9669	1.0000

Table II represents a correlation matrix between all the variables in the data. The meaning of a correlation matrix is to see if two or more variables correlate on a to high level. This will affect the analysis in a negative way and therefore the variables should be tested for correlation. As can be seen in the table above internet access (INTA) and online purchase (ONLPUR_PO~3M) correlate on a high level (0.8411). Because of this, the internet access variable had to be excluded. Other variables that were not excluded but still correlated above 0.50 was corporate tax rate (CTAX) and average tenure (AVGT).

Figure I

Venture capital investments by country between 2007-2015



In Figure I, the venture capital investments from 2007 until 2015 between the countries in the data is represented. In difference to Table I, US is excluded from the countries represented. The countries United Kingdom, Germany and France stand due to their large investments in comparison to the other countries included. From the above figure, we see that a range of countries in Europe have venture capital investments levels that are extremely low. The data is collected from EVCA.

Table III

Venture Capital total investments divided by GDP per capita

Country	2007	2008	2009	2010	2011	2012	2013	2014	2015
Austria	0,0012	0,0011	0,0011	0,0009	0,0008	0,0007	0,0008	0,0007	0,0007
Belgium	0,0063	0,0066	0,0062	0,0030	0,0038	0,0040	0,0033	0,0041	0,0017
Bulgaria	0,0000	0,0010	0,0005	0,0003	0,0000	0,0000	0,0001	0,0001	0,0001
Czech Republic	0,0001	0,0002	0,0000	0,0005	0,0004	0,0000	0,0000	0,0003	0,0001
Denmark	0,0067	0,0059	0,0037	0,0043	0,0052	0,0052	0,0060	0,0059	0,0073
Finland	0,0045	0,0043	0,0030	0,0032	0,0027	0,0026	0,0033	0,0033	0,0027
France	0,0351	0,0448	0,0347	0,0301	0,0271	0,0232	0,0279	0,0267	0,0222
Germany	0,0280	0,0350	0,0233	0,0236	0,0254	0,0180	0,0207	0,0193	0,0199
Greece	0,0000	0,0002	0,0008	0,0000	0,0003	0,0000	0,0001	0,0000	0,0000
Hungary	0,0004	0,0007	0,0000	0,0011	0,0019	0,0038	0,0010	0,0017	0,0012
Ireland	0,0019	0,0014	0,0013	0,0008	0,0012	0,0020	0,0024	0,0018	0,0020
Italy	0,0041	0,0024	0,0027	0,0024	0,0019	0,0026	0,0016	0,0012	0,0012
Netherlands	0,0091	0,0077	0,0053	0,0033	0,0056	0,0047	0,0045	0,0055	0,0052
Norway	0,0064	0,0044	0,0030	0,0035	0,0028	0,0027	0,0018	0,0021	0,0017
Poland	0,0012	0,0039	0,0001	0,0005	0,0016	0,0005	0,0014	0,0015	0,0015
Portugal	0,0069	0,0050	0,0021	0,0032	0,0007	0,0008	0,0014	0,0022	0,0028
Spain	0,0152	0,0222	0,0057	0,0042	0,0053	0,0035	0,0034	0,0034	0,0036
Sweden	0,0133	0,0118	0,0070	0,0075	0,0075	0,0064	0,0068	0,0060	0,0038
Switzerland	0,0108	0,0131	0,0082	0,0054	0,0065	0,0030	0,0051	0,0043	0,0056
UK	0,0601	0,0696	0,0325	0,0286	0,0300	0,0231	0,0190	0,0275	0,0244

Table III represents the total venture capital investments in each country dived by its GDP per capita. Even though the data is divided by GDP per capita we can see a distinct difference between the United Kingdom and the other countries. The UK has almost double the investments compared to the second ranked county on the list, France. Another interesting aspect is that Spain, which had lower total venture capital investments measured in total terms compared to Sweden, now shows a higher value after the total investments has been divided by average GDP per capita. The data is collected from EVCA and OECD.

Table IV

Venture capital early stage investments divided by GDP per capita

Country	2007	2008	2009	2010	2011	2012	2013	2014	2015
Austria	0,0007	0,0005	0,0006	0,0003	0,0004	0,0006	0,0005	0,0004	0,0006
Belgium	0,0038	0,0029	0,0040	0,0023	0,0029	0,0021	0,0018	0,0016	0,0009
Bulgaria	0,0000	0,0004	0,0004	0,0003	0,0000	0,0000	0,0001	0,0001	0,0001
Czech Republic	0,0000	0,0000	0,0000	0,0005	0,0002	0,0000	0,0000	0,0001	0,0001
Denmark	0,0042	0,0033	0,0026	0,0027	0,0030	0,0038	0,0032	0,0041	0,0060
Finland	0,0021	0,0023	0,0020	0,0022	0,0018	0,0021	0,0022	0,0024	0,0020
France	0,0142	0,0180	0,0137	0,0137	0,0133	0,0116	0,0128	0,0138	0,0113
Germany	0,0128	0,0169	0,0147	0,0143	0,0152	0,0113	0,0125	0,0127	0,0112
Greece	0,0000	0,0001	0,0003	0,0000	0,0003	0,0000	0,0000	0,0000	0,0000
Hungary	0,0001	0,0001	0,0000	0,0004	0,0014	0,0032	0,0005	0,0014	0,0010
Ireland	0,0009	0,0009	0,0010	0,0007	0,0012	0,0016	0,0019	0,0011	0,0011
Italy	0,0015	0,0009	0,0019	0,0020	0,0014	0,0020	0,0012	0,0009	0,0007
Netherlands	0,0045	0,0050	0,0035	0,0031	0,0037	0,0025	0,0029	0,0040	0,0037
Norway	0,0041	0,0030	0,0021	0,0023	0,0019	0,0017	0,0010	0,0012	0,0007
Poland	0,0002	0,0011	0,0001	0,0001	0,0003	0,0004	0,0004	0,0005	0,0008
Portugal	0,0014	0,0028	0,0015	0,0026	0,0005	0,0007	0,0011	0,0019	0,0020
Spain	0,0038	0,0041	0,0021	0,0019	0,0026	0,0024	0,0017	0,0015	0,0022
Sweden	0,0076	0,0062	0,0038	0,0043	0,0040	0,0026	0,0033	0,0029	0,0024
Switzerland	0,0046	0,0056	0,0051	0,0036	0,0040	0,0017	0,0035	0,0032	0,0028
UK	0,0206	0,0276	0,0146	0,0106	0,0114	0,0128	0,0098	0,0102	0,0092

Table IV represents all early stage investments into venture capital, divided by average GDP per capita. The data is collected from EVCA and OECD.

Table V

Venture capital late stage investments divided by GDP per capita

Country	2007	2008	2009	2010	2011	2012	2013	2014	2015
Austria	0,0004	0,0006	0,0005	0,0005	0,0003	0,0002	0,0003	0,0003	0,0001
Belgium	0,0025	0,0037	0,0022	0,0007	0,0009	0,0018	0,0015	0,0024	0,0008
Bulgaria	0,0000	0,0007	0,0002	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Czech Republic	0,0001	0,0002	0,0000	0,0000	0,0002	0,0000	0,0000	0,0001	0,0000
Denmark	0,0025	0,0027	0,0011	0,0016	0,0022	0,0014	0,0027	0,0018	0,0013
Finland	0,0024	0,0019	0,0010	0,0011	0,0009	0,0005	0,0012	0,0009	0,0007
France	0,0209	0,0268	0,0210	0,0164	0,0138	0,0116	0,0152	0,0129	0,0108
Germany	0,0153	0,0180	0,0086	0,0093	0,0103	0,0067	0,0083	0,0066	0,0087
Greece	0,0000	0,0002	0,0005	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Hungary	0,0002	0,0006	0,0000	0,0006	0,0006	0,0006	0,0005	0,0004	0,0001
Ireland	0,0010	0,0005	0,0003	0,0001	0,0001	0,0004	0,0005	0,0007	0,0009
Italy	0,0027	0,0015	0,0007	0,0004	0,0005	0,0006	0,0004	0,0003	0,0005
Netherlands	0,0046	0,0026	0,0018	0,0002	0,0019	0,0022	0,0017	0,0015	0,0015
Norway	0,0023	0,0014	0,0010	0,0012	0,0008	0,0011	0,0008	0,0009	0,0010
Poland	0,0010	0,0028	0,0000	0,0004	0,0013	0,0002	0,0010	0,0010	0,0008
Portugal	0,0055	0,0022	0,0006	0,0006	0,0002	0,0002	0,0003	0,0002	0,0007
Spain	0,0114	0,0181	0,0036	0,0023	0,0027	0,0011	0,0018	0,0019	0,0014
Sweden	0,0057	0,0055	0,0032	0,0032	0,0035	0,0037	0,0035	0,0032	0,0015
Switzerland	0,0062	0,0075	0,0031	0,0018	0,0026	0,0013	0,0016	0,0010	0,0028
UK	0,0395	0,0420	0,0179	0,0179	0,0186	0,0102	0,0092	0,0173	0,0152

Table V represents all late stage investments into venture capital, divided by average GDP per capita. The data is collected from EVCA and OECD.

Table VI

Descriptive statistics

variable	mean	p50	sd	min	max	N
DIVPUBOFF_~P	.0005935	.0000491	.001496	0	.011498	180
INTR	.0377427	.03465	.0268086	-.0007	.225	180
GDP_GR	.03038	.0321939	.0422989	-.1008771	.3351205	180
AVG_T_10	.2024243	.206	.0122238	.163	.225	180
MCAPOFGDP	.610275	.4833	.4638568	.0769057	2.67	180
CTAX	.2423067	.25	.0648612	.1	.384	180
INTACC_POP	.7210778	.755	.1617464	.254	.966	180
ONLPUR_PO~3M	.3536667	.33	.2201343	.02	.91	180
PEFUND	.0702446	.0134525	.1870684	0	1.679936	180
VC_LATE	.0035936	.0010536	.0064467	0	.0420167	180
VC_EARLY	.0035912	.0020201	.0047283	0	.0275526	180
VC_TOT	.0071849	.0032797	.0109045	0	.0695692	180

Table VI presents the descriptive statistics for all the variable included in the data. From the data presented in the table we see that all the variables have the same amount of observation (180), which eases the analysis. Looking at the minimum values of all the variable we see that all three of the depended variables, VC_EARLY, VC_LATE and VC_TOT have a minimum value of zero. The only other variable that also has a minimum value of zero is Divestments by public offering (DIVPUOFF_~P). Looking at the standard deviation, the variable representing market capitalization (MCAPOFGDP) has the largest value. The smallest standard deviation is shown by divestments by public offering (DIVPUOFF_~P).

Table VII

Hausman test on all variable in early stage investment

	--------Coefficients--------			
	(b)	(B)	(b-B)	sqrt(diag(V_bV_B))
	fixed	.	Difference	S.E.
DIVPUBOFF_~P	.1992036	.208854	-.0096504	.0154492
PEFUND	-.0003939	.000906	-.0012999	.0002823
CTAX	.0177008	.0263603	-.0086594	.005125
ONLPUR_PO~3M	-.008392	-.0029279	-.0054642	.0014732
MCAPOFGDP	-.0011774	-.0003226	-.0008548	.0002845
AVG_T_10	.069691	.0490515	.0206396	.0311569
GDP_GR	.0024547	.0013168	.0011379	.0005441
INTR	-.0006725	.0047527	-.0054252	.0024325

b = consistent under Ho and H_a; obtained from xtreg

B = inconsistent under Ha, efficient under H0; obtained from xtreg

Test: H_o: difference in coefficients not systematic

chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 39.08

Prob>chi2 = 0.0000

Table VIII

Hausman test on all variable in late stage investment

	--------Coefficients--------			
	(b)	(B)	(b-B)	sqrt(diag(V_bV_B))
	fixed	.	Difference	S.E.
DIVPUBOFF_~P	.3718753	.4472082	-.0753329	.0573914
PEFUND	.0038464	.0087477	-.0049013	.0009994
CTAX	.0420913	.042227	-.0001357	.014101
ONLPUR_PO~3M	-.0181261	-.0048035	-.0133226	.0038027
MCAPOFGDP	-.0015952	.0012867	-.0028819	.0008812
AVG_T_10	.1223456	-.0105051	.1328507	.0839815
GDP_GR	.0061743	.0031121	.0030622	.0017776
INTR	-.0030403	.0093453	-.0123856	.0066693

b = consistent under H_o and H_a; obtained from xtreg

B = inconsistent under Ha, efficient under H0; obtained from xtreg

Test: H_o: difference in coefficients not systematic

chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 50.36

Prob>chi2 = 0.0000

Table IX

Hausman test without excluded variables in total investment

	--------Coefficients--------			
	(b)	(B)	(b-B)	sqrt(diag(V_bV_B))
	fixed	.	Difference	S.E.
PEFUND	.003533	.0105749	-.0070419	.0012355
CTAX	.0662271	.0825287	-.0163015	.018326
ONLPUR_PO~3M	-.0259081	-.0063009	-.0196072	.005267
AVG_T_10	.1900547	.025933	.1641217	.1118791
GDP_GR	.005672	.0045542	.0011178	.0021316
INTR	.0001328	.0148491	-.0147164	.0083863

b = consistent under H_o and H_a; obtained from xtreg

B = inconsistent under Ha, efficient under H0; obtained from xtreg

Test: H_o: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 51.18

Prob>chi2 = 0.0000

Table X

Hausman test without excluded variables in early stage investment

	--------Coefficients--------			
	(b)	(B)	(b-B)	sqrt(diag(V_bV_B))
	fixed	.	Difference	S.E.
PEFUND	-.0004101	.0012716	-.0016817	.0003228
CTAX	.0197545	.0295529	-.0097984	.0054024
ONLPUR_PO~3M	-.0081525	-.0024846	-.0056679	.001583
AVG_T_10	.0690538	.0404817	.0285721	.0332892
GDP_GR	.0012456	.0007679	.0004776	.0005795
INTR	.0008937	.0054774	-.0045837	.0024653

b = consistent under H_o and H_a; obtained from xtreg

B = inconsistent under Ha, efficient under H0; obtained from xtreg

Test: H_o: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 40.30

Prob>chi2 = 0.0000

Table XI

Hausman test without excluded variables in late stage investment

	--------Coefficients--------			
	(b)	(B)	(b-B)	sqrt(diag(V_bV_B))
	fixed	.	Difference	S.E.
PEFUND	.0039432	.0104819	-.0065388	.0011293
CTAX	.0464726	.0480011	-.0015284	.0147076
ONLPUR_PO~3M	-.0177556	-.0025371	-.0152185	.0041624
AVG_T_10	.1210008	-.0255576	.1465584	.0889323
GDP_GR	.0044264	.0041143	.0003122	.0018384
INTR	-.0007609	.0106937	-.0114546	.0069077

b = consistent under H_o and H_a; obtained from xtreg

B = inconsistent under Ha, efficient under H0; obtained from xtreg

Test: H_o: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 54.89

Prob>chi2 = 0.0000

Tables VII through XI all presents the results from different Hausman tests. The tests were conducted to determine if random or fixed effects were most appropriate in the regressions. This was done for each of the regression conduced to make sure that the most appropriate and correct regression were performed. In all the test regarding these tables, the results presented us with the fact that fixed effects were preferred before random effects.

Table XII

Hausman test without excluded variables between 2012-2015 in total investments

	--------Coefficients--------			
	(b)	(B)	(b-B)	sqrt(diag(V_bV_B))
	fixed	.	Difference	S.E.
PEFUND	.019317	.0200368	-.0007198	.0007063
CTAX	.0438538	.044333	-.0004792	.0025323
ONLPUR_PO~3M	.0102512	.0099613	.0002899	.0007919
AVG_T_10	-.0537611	-.0540415	.0002804	.0037578
GDP_GR	.0099311	.0113282	-.0013971	.0013309
INTR	.0042375	.0031864	.0010511	.0037083

b = consistent under H_o and H_a; obtained from xtreg

B = inconsistent under Ha, efficient under H0; obtained from xtreg

Test: H_o: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 51.18

Prob>chi2 = 0.8262

Table XIII

Hausman test without excluded variables between 2012-2015 in early stage investments

	--------Coefficients--------			
	(b)	(B)	(b-B)	sqrt(diag(V_bV_B))
	fixed	.	Difference	S.E.
PEFUND	.0078601	.0081061	-.000246	.0003603
CTAX	.023005	.023237	-.000232	.0012933
ONLPUR_PO~3M	.0058278	.005747	.0000808	.0004044
AVG_T_10	-.0270853	-.0273265	.0002413	.0019185
GDP_GR	.0037865	.0044994	-.0007129	.000676
INTR	.0011795	.000776	.0004035	.001888

b = consistent under H_o and H_a; obtained from xtreg

B = inconsistent under Ha, efficient under H0; obtained from xtreg

Test: H_o: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 51.18

Prob>chi2 = 0.9005

Table XIV

Hausman test without excluded variables between 2012-2015 in late stage investments

	--------Coefficients--------			
	(b)	(B)	(b-B)	sqrt(diag(V_bV_B))
	fixed	.	Difference	S.E.
PEFUND	.0114569	.0120612	-.0006043	.0004349
CTAX	.0208488	.0211497	-.0003008	.0015537
ONLPUR_PO~3M	.0044235	.0041521	.0002713	.0004862
AVG_T_10	-.0266759	-.0266939	.000018	.0023085
GDP_GR	.0061446	.0069746	-.00083	.0008317
INTR	.003058	.0022372	.0008208	.002299

b = consistent under H_o and H_a; obtained from xtreg

B = inconsistent under Ha, efficient under H0; obtained from xtreg

Test: H_o: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 51.18

Prob>chi2 = 0.7155

Tables XII through XIV all presents the results from different Hausman tests. The tests were conducted to determine of random or fixed effects were most appropriate in the respective regression. This was done for each of the regression conduced to make sure that the most appropriate and correct regression were presented. In all the test in these tables the results presented us with the fact that random effects were preferred before fixed effects.

Table XV

Data summary of internet access and online purchase between countries

	Austria		Belgium		Bulgaria		Czech Republic		Denmark	
	Internet access	Online purchase	Internet access	Online purchase	Internet access	Online purchase	Internet access	Online purchase	Internet access	Online purchase
2007	**60%**	26%	**60%**	15%	34%	2%	32%	8%	**78%**	43%
2008	**69%**	28%	**64%**	14%	40%	2%	46%	13%	**82%**	47%
2009	**70%**	32%	**67%**	25%	45%	3%	**54%**	12%	**83%**	50%
2010	**73%**	32%	**73%**	27%	46%	3%	**61%**	15%	**86%**	54%
2011	**75%**	35%	**77%**	31%	48%	5%	**67%**	16%	**90%**	57%
2012	**79%**	39%	**78%**	33%	**52%**	6%	**65%**	18%	**92%**	60%
2013	**81%**	46%	**80%**	36%	**53%**	8%	**73%**	21%	**93%**	65%
2014	**81%**	43%	**83%**	41%	**56%**	10%	**78%**	25%	**93%**	66%
2015	**82%**	46%	**82%**	42%	**58%**	12%	**79%**	26%	**92%**	67%

	Finland		France		Germany		Greece		Hungary	
	Internet access	Online purchase	Internet access	Online purchase	Internet access	Online purchase	Internet access	Online purchase	Internet access	Online purchase
2007	**69%**	33%	**55%**	25%	**71%**	41%	25%	5%	38%	7%
2008	**72%**	33%	**62%**	28%	**75%**	42%	31%	6%	47%	8%
2009	**78%**	37%	**69%**	32%	**79%**	45%	38%	8%	**53%**	9%
2010	**81%**	41%	**74%**	40%	**83%**	48%	46%	9%	**58%**	10%
2011	**84%**	45%	**76%**	40%	**83%**	54%	**50%**	13%	**63%**	12%
2012	**87%**	47%	**80%**	42%	**86%**	55%	**54%**	16%	**67%**	15%
2013	**89%**	49%	**82%**	44%	**88%**	60%	**56%**	17%	**70%**	17%
2014	**90%**	53%	**83%**	49%	**90%**	61%	**66%**	20%	**73%**	20%
2015	**90%**	49%	**83%**	49%	**90%**	64%	**68%**	24%	**76%**	23%

	Ireland		Italy		Netherlands		Norway		Poland	
	Internet access	Online purchase	Internet access	Online purchase	Internet access	Online purchase	Internet access	Online purchase	Internet access	Online purchase
2007	**57%**	26%	43%	7%	**83%**	43%	**78%**	48%	41%	11%
2008	**63%**	30%	47%	7%	**86%**	43%	**84%**	46%	48%	12%
2009	**67%**	29%	**54%**	8%	**90%**	49%	**86%**	54%	**59%**	18%
2010	**72%**	28%	**59%**	9%	**91%**	52%	**90%**	53%	**63%**	20%
2011	**78%**	34%	**62%**	10%	**94%**	53%	**92%**	57%	**67%**	20%
2012	**81%**	35%	**63%**	11%	**94%**	52%	**93%**	62%	**71%**	21%
2013	**82%**	37%	**69%**	14%	**95%**	55%	**94%**	56%	**72%**	23%
2014	**82%**	43%	**73%**	15%	**96%**	59%	**93%**	60%	**75%**	24%
2015	**85%**	44%	**75%**	18%	**96%**	59%	**97%**	61%	**76%**	24%

	Portugal		Spain		Sweden		Switzerland		UK	
	Internet access	Online purchase	Internet access	Online purchase	Internet access	Online purchase	Internet access	Online purchase	Internet access	Online purchase
2007	40%	6%	44%	13%	**79%**	39%	**77%**	78%	**67%**	44%
2008	46%	6%	**50%**	13%	**84%**	38%	**79%**	81%	**71%**	49%
2009	48%	10%	**53%**	15%	**86%**	45%	**81%**	83%	**77%**	58%
2010	**54%**	10%	**58%**	17%	**88%**	50%	**84%**	84%	**80%**	60%
2011	**58%**	10%	**63%**	19%	**91%**	53%	**85%**	88%	**83%**	64%
2012	**61%**	13%	**67%**	22%	**92%**	58%	**85%**	87%	**87%**	64%
2013	**62%**	15%	**70%**	23%	**93%**	57%	**86%**	88%	**88%**	71%
2014	**65%**	17%	**74%**	28%	**90%**	62%	**87%**	89%	**90%**	72%
2015	**70%**	23%	**79%**	32%	**91%**	56%	**87%**	91%	**91%**	75%

Table XV presents the data on both internet access and online purchasing in all the countries included in our analysis. The data on internet access is bolded since it works as a determinant when we are conduction the random effects regression with data from 2012-2015. As can be seen in the data regarding internet access, there is a heavy increase in earlier years in many of the countries. This increase then weaknesses in later years. The data in Table XV is collected from Eurostat.