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MASTER THESIS

THE IMPACT OF VENTURE CAPITAL ON ECONOMIC DEVELOPMENT: CASE OF LITHUANIA

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Vilnius, 2022

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Venture capital has been a hot topic during the last decade as an alternative investment type and a great contributor to many innovative companies which today lay their footprint all over the globe. We all have heard and, most likely, experienced the services and products of companies such as Airbnb, Uber, Google, Microsoft, Apple, Facebook, WhatsApp, Wish, and Alibaba. One thing that all these mentioned companies have in common is their initial financing instruments. All of them were initially backed and funded by venture capital (hereinafter VC) funds. The venture capitalists risked large amounts of money in companies that were extremely risky, in their early beginnings, with founders who didn't have much entrepreneurship/business experience. Nevertheless, we all know the fate of these companies and how they grew to become among the highest worth entities in the world.

The relevance of this topic stands on the big gap that currently exists in the literature of venture capital impact on economic development, and especially when looking at Lithuania. Due to the private nature of the companies that venture capital invests on, there is a significant lack of public data that can be easily accessible by researchers. In this way, there is a lack of research on the impact that this industry has on the general economy. This research paper brings new empirical evidence on the impact of venture capital investment on Lithuania's economic development. Policy suggestions, for the government, are also brought up based on the empirical results and their interpretations.

Nevertheless, there have been studies about the "features" of a country that mostly attract venture capital investments and the conditions that are more favorable to this industry. In the literature review of this paper, you will find an analysis of an extensive report on country-specific attractiveness of venture capital. Each country has its own characteristics and, consequently, venture capital might have different impacts in each country. But overall, similar impacts are expected in the long-run. The Venture Capital and Private Equity Attractiveness Index is an extensive report which compiles an index for each country based on a set of criteria which is discussed in the literature review. This report presents how each of the countries analyzed performs in 6 different criteria which are based on underlying sub-indicators. Jakusonoka and Zarina (2018) use this report to assess the

attractiveness of the Baltic countries and draw some comparisons between them. Other studies have looked at government sponsored venture capital funds and their impact on innovation in Lithuania. Venckuviene and Snieska (2014) study the government role when it comes to venture capital market and direct/indirect public policy measures they can take to grow this market. They consider the government of significant importance to create a regulatory environment which helps to fund the shortfall that exists in the financing market for young, innovative companies in Lithuania. There have also been significantly more studies for the US, which is a world leader in venture capital investments. Kolmakov, Polyakova, and Shalaev (2015) performed an analysis of the impact of venture capital investment on economic growth and innovation using evidence from USA and Russia. In this research due to lack of data for Russia, they apply a method of extrapolating the US data and results to draw conclusions for Russia. There are also other similar studies which focus on USA, but these studies have been generally conducted in the early 2000s. This raises some implications on their applicability to the current times. Nevertheless, the significance of their results remains high. Romain and Potterie (2003) studied the economic impact of venture capital by analyzing the contribution of venture capital on multi-factor productivity, which is an important part of the production function that pushes economic growth/development forward.

The novelty of this Master thesis stands on its uniqueness and on the lack of a similar study done before with the focus on Lithuania. As mentioned above, there have been earlier studies on Lithuania, but mostly focusing on assessing the country about its attractiveness toward venture capital investments and venture capital impact on innovation. However, there are no studies which look directly at the impact of venture capital on the Lithuanian economic development/growth.

In this way, the main question that this Master thesis raises and tries to answer is: What is the impact of venture capital investments on Lithuania's economic development? The aim of this Master thesis is to find out whether venture capital has a positive or negative impact on the economic development of Lithuania and whether this impact is significant or not. Eventually, the aim is also to derive some recommendations regarding public policies that should be followed based on the empirical results and their interpretations.

Objectives:

- To select the most appropriate dependent variable and independent variables for the statistical analysis based on previous research.
- To choose the right statistical analysis method to estimate the impact of venture capital on economic development, based on the amount of data and the variables used.
- To estimate the impact of venture capital investment on GDP of Lithuania.
- To derive recommendations for public policy on venture capital ecosystem based on the empirical results and their interpretations.

The statistical method that is going to be used for this Master thesis is the Autoregressive Distributed Lag model. The reason behind this choice is that this method has been widely recognized recently for its ability to accurately estimate regressions despite small data samples, stationarity or non-stationarity of the data samples, and ability to estimate long-run coefficients of variables' elasticity. The dependent variable will be the GDP of Lithuania and there will be four other independent variables which are further explained in the methodology section of this thesis.

After this introduction, the thesis will continue with the Literature Review which is divided in three sub-sections for ease of reading and following through. The sub-sections include "Venture capital concept" which explains venture capital and defines it. That will be followed by the sub-section of "Venture capital in Lithuania", which looks in more detail at the venture capital situation in this country and touches on the other Baltic countries too. It also includes some comparisons to other EU countries in various aspects of venture capital market and the economies. Last sub-section is the one that directly looks at the available literature to find conclusions of the impact of venture capital on economic growth/development in different countries, but also in Lithuania. Additionally, establishes a good framework to select the variables for the statistical analysis. Other important sections are the Methodology, Empirical results, and Conclusions. Methodology section will go in more detail to explain all the chosen variables, sources of the data, the statistical method used and the rationale behind it.

2. THEORY OF VENTURE CAPITAL IMPACT ON ECONOMY

2.1 Venture capital concept

The first goal of this literature review is to properly define what VC is and how it distinguishes with other investment types.

VC funds serve as financial intermediaries between those investors who seek to invest in higher risk assets and between businesses that are too young and risky to receive financing from other financial institutions (Juzenaite, 2020). Such businesses that require financing to jumpstart their ideas or to scale, face significant difficulties and sometimes it is nearly impossible for them to receive funding from more traditional sources of financing. In this way, they are left with no other choice but to head to VC funds for support. Kolmakov, Polyakova and Shalaev (2015) argue that banks and other similar lending/investing institutions act more as a passive investor. On the other hand, VC funds not only provide the capital inflow, but they also contribute directly to the project by bringing their own expertise, consulting, and supporting the founders through the development of the business. This can be treated as a "value-added service" which distinguishes VC funds from other financing institutions.

The source of VC funding usually depends on the type of the financial system that these funds exist. For example, if we look at financial systems which are dominated by a bank-oriented system (e.g., Germany and Japan), banks are the main sources of VC funding (Padgureckiene, 2019). That is because in these specific financial systems, banks are the predominant source of financing. This doesn't mean that there no market-oriented approach where funds are raised primarily via the securities markets. However, in bank-oriented systems, banks have a higher relative weight when it comes to financing. On the other hand, in the UK (market-oriented financial system), the most important source of financing for VC funds are pension funds. Same could be said for the US, although even more institutional investors could be mentioned such as insurance companies, and other large corporates.

There are also differences on investments based on the source of financing that VC funds receive. Padgureckiene (2019) distinguishes between the VC funds that receive funding from banks, pension funds, and insurance companies from the ones that receive

funding from individual investors and corporates, in terms of the stage of the startups they invest in. For example, VCs that receive funding from banks, pension funds, and insurance companies tend to invest in later stage startups. In other words, they invest in startups that have already gained some traction, gained some recognition in the market and have already done grown significantly or have received funding earlier from other VC funds. This could be mostly due to the risk profile of such sources of financing as they tend to be more risk averse than other sources of financing. They do have a long-term view on their investments, but at the same time, they need a relatively lower risk than compared to individual investors (angel investors, etc.) and corporates. On the other hand, angel investors and corporates tend to source financing for VC funds which invest mainly in pre-seed, seed, and early-stage startups. Their risk tolerance is relatively higher and thus allows them to invest in startups at a more risky stage.

VC funding used to be considered as an alternative investment strategy, but recent research has emphasized that this is not the case. As mentioned earlier, in most cases entrepreneurs have no other alternative when it comes to choosing the source of funding. Da Rin, Hellman and Puri (2011) studied this statement in detail and concluded that there is insignificant evidence of choice between venture capital and financing from banks. In other words, VC funding has a particular niche in which it does business and it does not interfere with other segments of market which provide capital. The project's characteristics determine which kind of funding source can be used, giving VC funding its niche in capital markets which cannot be filled by other conventional capital providers. Some of the characteristics of the projects that make them more suitable for VC funding include soaring high risk, asymmetry of market and project information, a strong need for detailed studies and diligence from experts before and during the project implementation, relatively low liquidity, limited application of conventional financial modelling instruments, etc. (Kolmakov et al.,2015). In cases when a business doesn't match most of these conditions, then they should search for loan financing. Otherwise, VC investment ends up being the only option/opportunity.

Even though VC funding has its own niche market and there is an obvious need for their financing, VC investments make up a tiny part of total investments. According to Puri and Zarutskie (2012), an analysis of 25-year data of new enterprises in the USA revealed that

only 0.11% of the new enterprises were venture-backed. Other studies show sometimes a higher percentage, but the share of venture-backed companies remains insufficient.

Another important part of VC funds to explain is the way how they operate. In most cases, VC funds have a particular set of activities which are executed in a certain order. Regarding the order of actions that VC funds go through, Kalinowski (2007) identified three main sets of actions. Firstly, there is the deal origination, followed by initial screening, investment committee decision and the first phase of due diligence. After this part, VC funds move on to receive feedback from the supervisory board, get the formal approvals, and again due diligence (second phase). Lastly, is the finalization of the deal, control/monitoring of the portfolio company and in the end, exit at the right time. As we can see, there are many steps included to land a deal when it comes to VC investments. The process is rigorous and with detailed diligence before taking a decision and investing in an idea/business. VC funds also have a specific investment strategy laid out which obliges them to invest only in a specific stage of a business. The stages include early phase, expansion phase, stock market, and public-to-private (Wilson and Silva, 2013). VC funds are mostly known for investing primarily in Early Phase and Expansion Phase which tend to bring more innovation and potential excessive returns.

All in all, we can say that VC investments should not be considered as an alternative to other investments. Such investments have their own niche market, and they fill the financing gap for new entrepreneurships which cannot be covered by other conventional financing institutions. Businesses that need VC funding have a handful of specific characteristics which eliminate other options of funding. This makes VC investments an important tool to drive the funding of young companies with high risk which can potentially bring innovation, rapid growth, and high returns to the investors. Nevertheless, VC is still a relatively young industry which is growing and is facing significant structural changes.

2.2 Venture capital in EU, Baltics, and Lithuania

In this subsection of the literature review, I will present a brief overview of the VC and private equity environment in Europe and Baltics. After that the focus will shift to Lithuania, by drawing from the available literature about the stage of VC development in this country.

Venture capital development in Europe doesn't have a very long history, at least when compared with United Kingdom (UK) and USA. It has lagged them in time and development. In UK, venture capital started to develop in 1970s, mostly due to some liberalizing legal acts in favor of banks, pension funds, and VC funds. In continental Europe, VC became more significant only in the 1990s. Despite the later development in time, Europe also had some other reasons that it lagged UK and USA in this area. Some of these reasons include labor market regulation and tax environment which were unfavorable in most part towards promoting venture capital and investments in these startups (Li, Zahra, 2012). Rigid labor market regulations can disincentivize venture capitalists, especially when it comes to technology companies, as the environment requires high talent and flexibility in structuring and building the young companies. On other hand, tax environment can also have significant positive or negative influence in attracting venture capital investments. Friendly tax environment, focused on startups and venture capital funds can do a great deal of attracting the needed capital and incentivizing entrepreneurs. We will look in more detail at a later point in this thesis on the main characteristics of an economy/country when it comes to establishing the right venture capital environment. Some more reasons that Europe didn't advance quickly are the lack of highly experienced venture capitalists and absence of a liquid market for the exit of venture capital (Gompers, Lerner, 1998). EU, but also other countries such as Canada, Australia, Singapore, Israel, have tried to take action by establishing public VC funds in order to attack and fill the gaps in the VC ecosystem. In EU, some of the initiatives to tackle the market insufficiencies (i.e., increasing asymmetric information, agency costs) include JEREMIE program, EU competitiveness and innovation framework program, and VC measures of EIF (European Investment Fund) (Laurinavicius, 2013).

In general, based on earlier practices, it is evident that the development of VC in a country/region, takes more than simply providing funds. It takes a lot more than that, especially in terms of the mobilization of the society. It is of high significance that important goals are set based on a well-prepared national development strategy. As a prerequisite of success, this strategy must be clearly communicated in order to mobilize the society to reach such goals (Laurinavicius, 2013). VC ecosystem development is a product of many smaller parts, ranging from a strong entrepreneurship mentality in the society, to infrastructure. In 2010, a survey was conducted in Lithuania on VC in this country, and the results showed

that 93# of managers that participated in this survey, were not aware of any VC fund operating in Lithuania. In addition, results showed that 91.5% of these respondents, could not name any Lithuania company which received funding from VC funds (Laurinavicius, 2013). Of course, these numbers should be significantly reduced today as VC activity in Lithuania has created quite a handful of big companies and, so far, one unicorn (Vinted). Additionally, there has been a growing engagement from the government side to enhance this sector through government agencies and infrastructure. In terms of agencies, we could mention Invest Lithuania, Enterprise Lithuania, INVEGA, Lithuanian Private Equity and Venture Capital Association, and Lithuanian Innovation Centre. On the other hand, in terms of infrastructure for startups, today there are 20 incubators/hubs, 6 sandboxes, 21 supporting programs, 11 local VC funds, 7 pre-accelerators/accelerators, 6 government-supported agencies, and 3 science, studies, and business valleys.

Baltic private equity (hereinafter PE) has experienced a rapid growth since 2010 represented by a record of 1.3 billion EUR of new capital raised. Only in 2019, 490 million EUR were raised in this region and there were 800 million EUR available for investment (Deloitte, 2020). This shows a big opportunity for new business development across the Baltics and the increasing attractiveness of these countries for VC investments. Lithuania has managed to raise 148 million EUR by nationally focused funds, which is the largest amount of funds raised in comparison to Latvia and Estonia with each raising 117 million EUR and 37 million EUR, respectively (Deloitte, 2020). Nevertheless, according to the Venture Capital & Private Equity Country Attractiveness Index (2018), Estonia ranks higher than Lithuania and Latvia with a score of 60.2, 59.5, and 58.2 respectively. This ranking is part of much detailed report which lays out six key drivers of the score and provides profiles for each country regarding its attractiveness for VC and PE. The key drivers include economic activity, depth of capital market, taxation, investor protection and corporate governance, human and social environment, and entrepreneurial culture. Based on these key drivers, criteria are assessed and in the end the index is aggregated (Groh, Liechtenstein, Lieser and Biesinger, 2018).

As presented in Table 1, Lithuania turns out to have a higher index score in Taxation, Investor Protection, Human & Social Environment, and Entrepreneurial Opportunities than the Eastern European region. This shows that Lithuania is doing relatively better compared to the Eastern European region average in those areas. More specifically, Lithuania has high

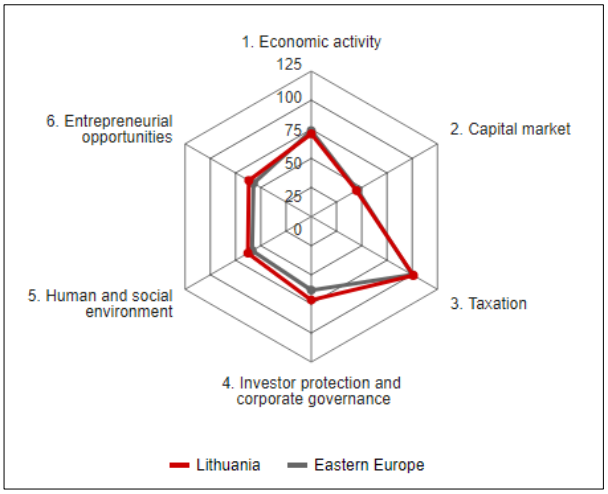
scores in Bribing and Corruption (Human & Social Environment), Tax Incentives and Administrative Burden (Taxation), Security of Property Rights (Investor Protection & Governance), and Burdens of Starting/Running a Business (Entrepreneurial Activities). On the other hand, it lags a bit behind in Economic Activity and Depth of Capital Market. Overall, the VC/PE Index score is higher for Lithuania compared to Eastern Europe region.

Table 1

Lithuania and Eastern Europe venture capital/private equity criteria attractiveness index

	VC/PE Index	Economic Activity	Depth of Capital Market	Taxation	Investor Protection and Corporate Governance	Human and Social Environment	Entrepreneurial Opportunities
Lithuania	59.5	71.1	44.7	101.2	71.7	62.8	61.9
Eastern Europe*	57.5	73.8	45.7	100.1	63.2	58.6	57.2

*Eastern Europe in this report: Albania, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Latvia, Lithuania, Macedonia, Moldova, Montenegro, Poland, Romania, Slovakia, Slovenia, Turkey, Ukraine, Serbia



Source: Groh, Liechtenstein, Lieser, & Biesinger, 2018.

Figure 1. The chart shows both Lithuania and Eastern Europe score in VC/PE Attractiveness Index score.

Source: Groh, Liechtenstein, Lieser, & Biesinger, 2018.

Focusing more on Lithuania, Deloitte in collaboration with the Lithuanian PE and VC Association, presented a report in 2019 on Lithuanian VC and PE market overview. The report presents quite promising figures for a country which is still in its early phase of VC development. Until the end of 2018, Lithuanian PE and VC firms had raised 0.5 billion EUR with the half of the funding coming from public sector investors and international institutions such as European Bank for Reconstruction and Development, European Investment Fund/Bank, Baltic Investment Fund, and INVEGA (Lithuanian Private Equity and Venture Capital Association "LT VCA", 2019).

There were 97 million EUR raised in 2018 which is a drop compared to the previous year of 2017 during which 130 million EUR were raised in Lithuania. Nevertheless, 2018 still shows a significant amount of money raised by VC/PE. In addition, in 2018 there were about 200 million EUR of capital which had not been invested yet. This shows a great opportunity for startups, SMEs, and mature businesses to aim on acquiring the needed financing. It is worth mentioning that new funds are also being formed which further confirms that Lithuanian VC market is growing rapidly and expanding. In 2018, three new funds were established and in 2019, thirteen other funds commenced their activities. In 2019, two of the largest funds ever, in the Baltics, were raised by BaltCap and INVL with 126 million EUR and 142 million EUR, respectively (Deloitte, 2020). Table 2 gives us some more insights on the specific amounts raised, invested, and available for each of the fund's strategies, namely venture, growth, buyout, and infrastructure as of end of December 2018. As we can see from the table, funds with strategy focus on Buyouts and Infrastructure have raised a significantly higher amount than Venture and Growth. This shows the VC/PE in Lithuania is still focused on more mature businesses rather than early-stage ones. Nevertheless, Venture and Growth have higher amounts of capital available for investment than Buyout, but lower than Infrastructure.

Table 2

Capital invested and available for investment by fund's strategy as of 31st of December 2018

*Million EUR	**Venture**	**Growth**	**Buyout**	**Infrastructure**
Amount Invested	30.2	25.8	131.9	34.6
Amount Available	53.3	57.4	49.3	68.5
Total Amount Raised	83.5	83.2	181.2	103.1

Source: Deloitte, 2020.

The investments from VC funds in Lithuania also span through a variety of industries, from consumer goods and retail to construction and life science. Table 3 provides a comprehensive view of all the industries which received investments from VC/PE funds in the period 2010-2018. Consumer goods received most of the investments, followed by communications and consumer services. On the other hand, the industries which received the least investments are financial services, transportation, chemicals, and life science. The highest number of companies invested on belong to communications industry, and the second after communications is the computer and consumer electronics industry. In 2019, there was a growing focus on fast growing IT/internet companies which attracted 24 million EUR of investments out of 91 million EUR total invested in the Baltics. Based on these data, we can imply that the funds are mainly focused on the new technologies and in the industries whose business models are easier to be understood and supported by the VC funds' managers. In addition, VC fund managers are looking for high growth opportunities which would help them realize abnormal profits since they are engaging in high-risk investments. Thus, the businesses they invest in should bring something unique and advanced in the market to be worth their time and money. On average, in 2018, the early-stage venture investment size was around 0.11 million EUR. On the other hand, the average investment amount for growth stage was around 1.56 million EUR (LT VCA, 2019). This clearly shows that venture capitalists are more generous with growth stage investments since they offer a higher chance of reaching a higher value in a short period of time and pose less risk than early-stage investments. In addition, growth stage companies have already established a market for their product/service and received revenue, which is usually not the case with early-stage companies.

Due to some funds reaching their termination year, the number of divestments has been gradually growing and is expected to increase more in the near future. According to Deloitte (2020), from 2010 to 2019 there were 61 exits performed by VC and PE funds in Lithuania. In 2018, 22 exits were made, while in 2019 there was a near 50% decrease resulting in 12 exits. All the exits in 2019 were done by BaltCap (5 exits), Practica Capital (5 exits), and LitCapital (2 exits). From another point of view, the divestments were from four different investment stages. Three of the exits were early ventures, two were late ventures, four were growth investments, and three were buyouts (Deloitte, 2020).

Table 3

VC/PE investments by industry in Lithuania for period 2010-2018

Industry	**Investment Amount (Million EUR)**	**Number of Companies**	**Average Investment (Million EUR)**
Consumer goods and retail	23.0	19	1.21
Communications	22.0	33	0.67
Consumer services	15.8	6	2.64
Business and industrial products	15.7	16	0.98
Business and industrial services	14.2	14	1.01
Computer and consumer electronics	9.7	23	0.42
Energy and environment	5.9	7	0.84
Financial services	1.2	4	0.30
Transportation	0.4	1	0.43
Chemicals and materials	0.3	1	0.30
Life science	0.2	1	0.20
Construction	0.01	1	0.01
Other	7.7	5	1.54

Source: LT VCA, 2019.

To close this subsection of the literature review, we will look more closely to the "Venture Capital & Private Equity Country Attractiveness Index of 2018" which explains in more detail some key criterions which were evaluated in the index and supported by other sources of literature with focus on Lithuania. These key criterions, as mentioned and shown in Table 1, in the beginning of this subsection, include *economic activity, depth of the capital*

market, taxation, investor protection and corporate governance, human and social environment, and entrepreneurial culture and deal opportunities. A brief comparison will be drawn with the two other Baltic countries, Latvia and Estonia for the sake of having a bigger picture of the evaluation.

Economic activity. This criterion comprises 15.8% of the index and the indicators included are the size of the national economy, GDP growth, and unemployment rate. Lithuania, for 2018, held the 74th place among 125 countries included in the Venture Capital & Private Equity Country Attractiveness Index ranking of 2018 (Jakusonoka and Zarina, 2018). These indicators show how well an economy is doing and the number of enterprises depend on the economy and employment rate. This, in turn, indicates the expected flow of VC deals in the country. The economic growth can be considered as one the most important indicators because the VC industry is quite cyclical, and it positively correlates with GDP growth (Romain and Potterie, 2004). In 2018, Latvia took the 43rd place while Estonia the 82nd. In general, the Baltic countries were ranked relatively low and showed an inactive economy in this region which can be a significantly negative sign to attract VC investments.

Depth of the capital market. This criterion is regarded as the most important one for the index and holds 43.8% of the total weight. The reason for this is because stock market is one of the most common "exit" channels for VC investors and they pay a lot of attention to a country's capital market and its development and liquidity. Some indicators that are used to evaluate this criterion include the size of the stock market relative to GDP (%), the size of M&A market, the Initial Public Offering market, and trading volume/liquidity of the stock market. In 2018, Latvia was ranked the highest among the Baltic countries (59th), followed by Estonia and then Lithuania (Jakusonoka and Zarina, 2018). Since after the 2009 financial crisis the IPOs and liquidity in the stock market of Lithuania (and the two other Baltic countries) has declined significantly and the most realistic way for VC investors to realize their investments is through finding another VC fund to buy their shares.

Taxation. The lowest weight of the index is assigned to taxation, only 5.3%. There have been many studies on the impact of taxation when it comes to VC investments, but it doesn't seem that taxation has a direct impact. The general idea is that the larger the difference between individual income tax and corporate income tax, it works as a stimulus for entrepreneurship activity. In this way, it would theoretically lead to a higher start-up

activity and thus, helping the establishment of innovative and fast-growing start-ups (Bruce and Gurley, 2005). Nevertheless, research has shown that there are many countries that have high corporate taxes and, at the same time. attract larger amounts of VC investments, and the opposite. From this we can conclude that taxation doesn't have a significant role when it comes to affecting VC investments. In 2018, Lithuania was ranked the lowest (51st), among the Baltic countries, with Estonia taking second place (40th) and Latvia the first place (30th). Latvia has introduced a specific law on start-ups which intends to give significant tax relief to them and to increase the number of start-ups. Such law has not been introduced yet in Estonia or Lithuania.

Investor protection and corporate governance. One of the most significant factors when it comes to attracting VC investments (and investments in general) is a good quality legal system which ensures property rights and protection to the investors. More specifically, Cumming, Flemming and Schweinbacher (2006), after performing in-depth analysis of the legal systems differences among several countries came to conclusion that legal system and accounting standards have a significant influence on VC/PE investments. Thus, if investors are not convinced that their investments are protected, they would avoid investing their capital in the country. The weight of this criterion in the index stands at 15.8%. For this criterion, in 2018, Estonia ranked in the 21st place, followed by Lithuania in the 33rd and Latvia in 41st position. The rankings slightly change when looking at different indicators of this criterion (such as protection of minority investors, corporate disclosure, property, intellectual property rights, etc.). Nevertheless, in each of the indicators, among the Baltic countries, Lithuania ranks either 2nd or 3rd.

Human and social environment. For this criterion there are some highly important indicators which were considered. Based on the research of Schertler (2003), the labor market law rigidity is of high importance when it comes to incentivizing people to start up a business. The Venture Capital and Private Equity Country Attractiveness Index authors also believe that rigid labor law can negatively affect the development of VC market. Other indicators with high influence are also corruption, size of the grey economy, and institutional bureaucracy. For this criterion (human and social environment), Lithuania ranked the highest among the Baltic countries, in 2018, aided also by the quality of the educational system and of science and research. Second after Lithuania was Estonia and then Latvia. Although Latvia was ranking quite far behind Lithuania and Estonia, it has made the largest progress

in relative terms (Jakusonoka and Zarina, 2018). The criterion itself holds a weight of 15.8% in the index.

Entrepreneurial culture and deal opportunities. This is the last criterion we are going to look at and which holds a significant weight of the total index, 26.3%. The demand for VC funds is among the leading factors when it comes to attracting the VC investments. In this way, there should be an entrepreneurial environment in the country for new start-ups to come into the scene and for more innovation to happen. R&D employees and the number of patents is positively and significantly related to VC activity, according to Schertler (2003). In addition, the activity of the start-ups is related to the R&D capital, technological opportunities, and number of patents. Some of the indicators of this criterion include innovation, number of scientific/technical journals, ease of starting and running a business, and corporate R&D. In 2018, Lithuania ranked the highest (40^{th}) in comparison to the other Baltic countries regarding this criterion. Also, the World Bank report "Doing Business 2020", ranked Lithuania in the 11^{th} place among 190 countries for the ease of doing business, while Estonia took the 18^{th} place, followed by Latvia in the 19^{th} place. Estonia ranks higher the two other Baltic countries when it comes to innovation; however, the Baltics still have problems when it comes to innovation and R&D which leads to a lack of innovative projects to be financed which, in turn, does not result in establishing of new start-ups (Jakusonoka and Zarina, 2018).

2.3 Venture capital impact on economy

VC investments when compared to the total amount of investments in a country is quite insignificant. This is the case not only for the countries which have a new VC industry but also for countries like the USA (Kolmakov et al., 2015). In Lithuania's case, based on World Bank database, the total investment in 2018 amounted to 2 billion EUR while the amount of VC investments for that year, according to Deloitte report was around 96.9 million EUR. Clearly there is a huge difference between these two amounts. In addition, we can find a significant difference also between the VC investment amounts on a yearly basis and the total R&D expenditure in Lithuania. The R&D expenditure for Lithuania in 2018 was around 508 million EUR, nearly 410 million EUR more than VC investments. Nevertheless, we cannot arrive at the conclusion that VC investment doesn't affect the economic development/growth simply because of the relatively low VC investments.

One of the first aspects of economic development that VC directly influences is technological knowledge and innovation. There have been many studies which support this causal relationship between VC investments and innovation/technology. A proxy of innovation and technological advancement is the number of patent applications (Gurgul and Lach, 2012). Patent applications is quite often used to measure a country's competitiveness and is generally considered a proper indicator of technological progress. In other words, the more patent applications that there are, the higher is the technological progress in a country/region. Additionally, this specific feature of an economy, combined with proper patent laws can encourage investors to invest more in R&D, because at some point those patents are going to be quite profitable for them. Also it is going to attract VC investors who notice this positive development. Antonelli and Teubal (2008) in their study observed that VC contributed to the reshaping of the knowledge sharing by "creating knowledge-intensive property rights and new knowledge sharing market" (Juzenaite, 2020). VC funds have the ability to allocate new technological knowledge from young entrepreneurs and transform it in huge technological companies. Examples of this which we are quite aware of are companies in the likes of Google, Facebook, Airbnb, Uber, and many other huge tech companies. To reinforce this argument, Samila and Sorenson (2010), used panel data of the USA and the results showed that increase in VC investments lead to an increase in government spending on grants for R&D and in new innovation patents. In other words, VC funds serve as a way to commercialize new technologies and innovations, which in turn increase the number of new patents and R&D spending. These bring to market new ideas which will eventually, if successful, help and push forward the economic development.

Padgureckiene (2019) argues that often promising technologies and patents cannot be further developed due to lack of funding. This claim further emphasizes the importance of VC funds in order to make use of such technologies and patents, otherwise, would be high possibility that these advancements would fade away and never be utilized in the economy. As a matter of fact, VC has started to become (and already is in some countries) an instrument which could be used to invest in scientific research. This is the case of Israel where VC has contributed to the development of the national high-tech industry and economic growth (Zhang, Zhang, Wang, and Huang, 2013). Israel has lately grown to be one of the most developed countries when it comes to VC development and its effects have been clearly noticed in the level of patent applications, unicorn startups, internationally

recognized high-tech companies, and economic growth. Israel has also been a good example of how a high level of scientific and technological research development leads to the development of VC in the country, and in turn, VC development further fosters technological progress and GDP growth (Padgureckiene, 2019). These events feed into other, similar to how advancements in microchips help to build better AI and Machine Learning, and these in turn, help to develop better and more robust microchips and so on. The main lesson here is that VC and different economic components must be considered and studied together and not isolated from each other.

Statistical analysis performed by Kolmakov et al. (2015) shows that VC investments (hereinafter VCI) affect economic growth and this effect is significantly stronger when we look at a 4 to 6-year period. In other words, statistically significant VCI effect on economic growth is reached at a distant time period (is lagged). Kolmakov et al. (2015) study went further to see whether similar results would come up when using data for Russia. Findings showed similar results for Russia, when compared to the US, meaning that the effect of VCI on economic growth is statistically more significant with a lag of 6 years. Furthermore, Kolmakov et al. (2015) statistically analyzed the relationship between number of patent applications (indicator of innovation) and VCI. Again, the results showed a statistically strong correlation between these two variables and there were no major differences between the US and Russia on this aspect. These results proved the authors hypothesis that the innovation development depends more on VCI than on "conventional" investment. Innovation/technology is one of components of the Cobb-Douglas production function, together with labor and capital. Hence, we can say that the VCI has a dominant role on economic growth despite its relatively insignificant amount when compared total investment in an economy.

Another study conducted by Alemany and Marti (2005) in Spain regarding the economic impact of VC, revealed some interesting findings. The study initially evaluates past research done in this area and points out the main flaws which are related to survivorship biases, and samples that do not decently represent what the authors intended to study. In this way, Alemany and Marti tried to bring a study which would remove such flaws as much as possible. They tested two main hypotheses, based on statistical analysis and comparison between VC-backed companies and a control group which were not backed by VC. The results showed that employment, sales, gross margin, total assets, intangible assets

and corporate taxes grew faster in VC-backed firms than in the control group. Growth in these variables for the VC-backed firms turned out to be persistently higher than for the control group firms. In addition, these above-mentioned variables tend to grow together with the growth of cumulative VC investments over time (Alemany and Marti, 2005). In other words, firms which manage to attract VC investments have higher chances, proven empirically, that they would grow faster regarding number of employees, sales, gross margin, total assets, intangible assets (a proxy for innovation), and corporate taxes paid compared to other similar firms which didn't receive VC investments. Consequently, this would translate in higher impact of these firms to the general economy which leads to the realization of the impact that VCI have on economy.

Considerable attention is paid, by many research papers, to the impact of VCI on the innovation of companies they have as part of their portfolios. Innovation is a major component of economic growth and thus increase in innovation can help a country surge in economic growth and develop faster than other countries that lack it. A research paper from Venckuviene (2014) deals specifically with the impact of government-sponsored venture capital funds (hereinafter GSVC) on innovation in Lithuania. Based on a qualitative study conducted with experts of GSVC funds in Lithuania and also looking at past research done in this area, Venckuviene (2014) brings some important results. One of them is that VC influences at least five aspects of technological innovation, namely "introduction of new products/technologies, managing intellectual property, automation of processes, and investments in R&D" (Venckuviene, 2014, page 6). As we can see from Figure 2, these five aspects had the highest ratings among eight in total, with introduction of new product and technologies leading.

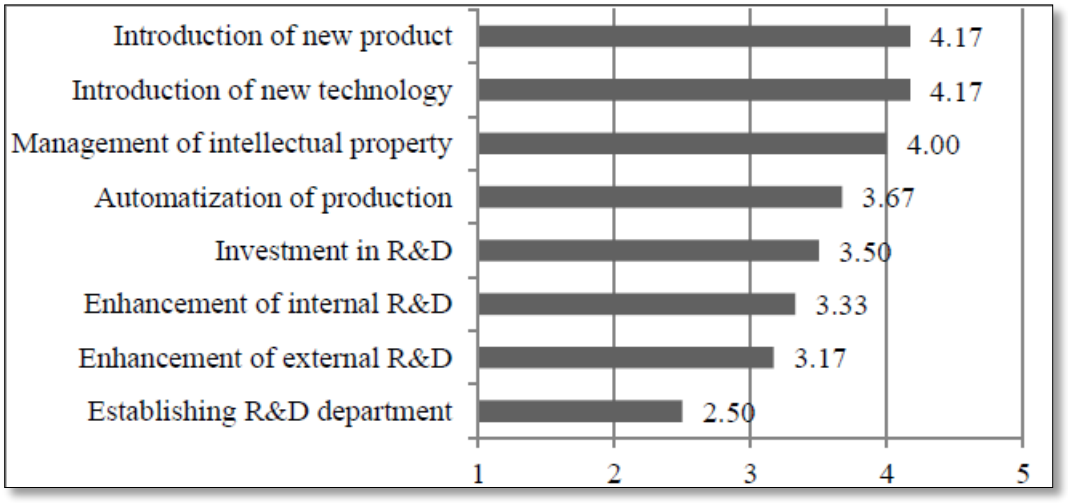


Figure 2. Average expert's ratings on the technological innovations' aspects.

Source: Venckuviene, 2014.

In addition, experts showed significant agreement in the assessment of networking-related innovations by rating the aspect of "Looking for international partners" as the highest, followed by "Involvement in networking projects" with EU and other platforms (Venckuviene, 2014). This shows that when we talk about impact of VC on innovation of portfolio companies, it is not only about the number of new patents, but also about networking opportunities, organizational innovation, recruitment of qualified personnel, etc. In this way, we get a more qualitative understanding of the VC influence in the economy. An exception from the statistical Kendall concordance coefficient, is the impact of VCI on marketing related innovations which shows no significant agreement on ratings among the experts. In other words, VCs do not generally have an expertise in marketing and thus innovation in this direction is not that present in regards to the startups they fund.

Additional support to the idea that innovation and innovative efforts contribute to a country's development come from Belke, Fehn and Foster-McGregor (2003) working paper. They point out to the structural change that was happening in the economies around the world which included a shift from standardized industrial products to more services and personalized products/services, more attention to high technology areas in the economy such as biotechnology, information and computer technology, and other areas too. This shift changed the demand for labor as companies started to look for more highly qualified and versatile individuals. In addition, the institutions themselves had to change their approach and flexibility to be able to respond quickly to microeconomic shocks and new opportunities

in their economies (Belke et al., 2003). Countries which have an inflexible and ineffective set of institutions that suffocate innovative entrepreneurship will eventually fall behind in terms of economic development measured in growth of GDP per capita and employment. In other words, in order for a country to ensure and support its economic development, it is crucial for them to recognize the shift in the economy that is happening (among advanced economies and not only) and adapt their institutions so that to continue supporting innovation and innovative entrepreneurship in their economies.

Belke et. al (2003) also performed a statistical analysis to see the impact of VC investment on employment growth. The results showed that VCI significantly increase employment growth and job creation in new and innovative companies. In addition, it helps to eventually change the structure towards a new economy, as mentioned above. This, nevertheless, wouldn't help much, if at all, on reintegrating those people who have been unemployed for a relatively long-time and lack qualifications (Belke et. al, 2003). That is mainly because there would be a large skill gap between those people and the market, which would keep growing further. Thus, such unemployed people could even suffer from being not relevant to the job market and potentially have a negative effect on the overall consumption power of the economy.

One of the first research papers to have evaluated the economic impact of VC is the paper from Romain and Potterie (2003). Their main conclusion, based on panel data analysis, is that VC might account for a significant part of the residual in the traditional Cobb-Douglas production function Romain and Potterie (2003). The residual is also known as the Solow residual, and it accounts for the productivity growth in an economy which contributes to overall economic growth. In other words, VC may account for a large part of the productivity growth, thus impacting the growth in economy. Especially for developed countries, productivity growth is one of the main "tools" to achieve a sustainable economic growth.

Moreover, the econometric results show that VC contributes to economic growth through two main channels: bringing new products/services/processes in the market and increasing the usability of the knowledge provided by public and private research institutions Romain and Potterie (2003). VC has the ability to take the already available knowledge, combine it with new research and knowledge, then come up with new products and processes which create an upward spiral of development/growth. In addition, VCI in many cases have

spillover effects and positive externalities in knowledge and technology which increase the social return of such investments.

When analyzing the impact of VC on an economy, there are quite some issues related to lack of public data, accuracy of the data, understatement/overstatement of results/effects, and different biases in data (most common one is survivorship bias). Nevertheless, recognizing such issues, Will Gornall and Ilya Strebulaev from University of British Columbia and Stanford University, in 2015 wrote a white paper on the economic impact of VC. The study was based on public companies which right away reveals the survivorship bias of the dataset, meaning, only companies that were successful and manages to go into IPO were considered in this research. Also, the companies that were acquired were not considered, although acquisition is the most common exit channel for VC funds. Gornall and Strebulaev (2015) argue that even though many VC-backed companies fail, the ones that succeed are almost always huge in size. By August 2015, three out of five largest public companies by market capitalization were VC-backed (Table 4). For the sake of comparison, these three companies today have a market capitalization of 2.82 trillion USD (Apple), 1.82 trillion USD (Google), and 2.35 trillion USD (Microsoft) (Ycharts, 2021). These companies also have created hundreds of thousands of high-skilled jobs, rapid innovation, billions of dollars in returns for the investors, trillions of dollars of benefit for the US economy, and countless positive externalities/spillovers (Gornall and Strebulaev, 2015). These arguments are in line with other research that we have looked at and analyzed so far in this research paper.

Table 4
Five largest public companies by market capitalization (as of August 28, 2015)

Rank	Company	VC-backed	Market Cap. ($B)	# of Employees
1	Apple	Yes	646	93,000
2	Google	Yes	449	54,000
3	Berkshire Hathaway	No	356	316,000
4	Microsoft	Yes	351	128,000
5	Exxon Mobil	No	314	75,000

Source: Gornall and Strebulaev, 2015.

Some other interesting data of 2015 from this research show the percentages of various elements of VC-backed companies out of all US public companies. Such elements include number of employees, revenue, R&D spending, taxes, etc. (Figure 3). We can notice from these data that VC-backed companies make up one-fifth of the total market cap of US public companies and nearly half of the R&D spending which is a critical aspect when it comes to making new products/services/processes, innovation, and consequently, economic growth. However, these percentages change dramatically when instead of using total US public companies, we consider total US public companies founded after 1974. The reason for using this specific year is because in 1979 the Prudent Man Rule was eased out and thus, pension funds and other similar types of funds could then invest in VC funds. This regulatory change led to more than 10 times increase in the level of money invested in VC funds. Figure 4 shows the VC-backed percentages as part of the US public companies founded after 1974.

	VC-backed	%	Total
Number	665	17%	3,832
Enterprise Value $b	4,647	18%	26,111
Market Capitalization $b	4,824	21%	23,140
Employees	4,111,000	11%	38,070,000
Revenue $b	1,461	10%	14,628
Net Income $b	168	16%	1,062
Research and Development $b	131	44%	298
Total Taxes $b	66	11%	589

Figure 3. VC-backed companies as a percentage of the US public companies.

Source: Gornall and Strebulaev, 2015.

	VC-backed	%	Total
Number	556	42%	1,339
Enterprise Value $b	4,136	58%	7,200
Market Capitalization $b	4,369	63%	6,938
Employees	3,083,000	38%	8,121,000
Revenue $b	1,222	38%	3,224
Net Income $b	151	61%	247
Research and Development $b	115	85%	135
Total Taxes $b	57	59%	98

Figure 4. VC-backed companies as a percentage of the US public companies founded after 1974.

Source: Gornall and Strebulaev, 2015.

Market capitalization, R&D, Taxes, Employees increased by 42%, 41%, 48%, and 27%, respectively, compared to VC-backed companies as a percentage of the US public companies. R&D is the most impressive figure since it makes up around 85% of the overall R&D spending from US public companies founded after 1974. Such increases also illustrate how important the government regulation is when it comes to VC industry.

In summary, VC investments, in absolute terms, are quite insignificant when compared to total investments in a country. However, this doesn't mean the VC doesn't play a major role when it comes to economic growth and development. Most of the literature reviewed in this sub-section point out that VC investment directly impacts the level of innovation in a country. They manage to do this through investing in potentially hi-tech growth companies and young entrepreneurs who bring extensive technological knowledge to the company. In addition, companies backed by VC are more likely to utilize already available theoretical research knowledge from academics and bring new products/services to the market based on the knowledge gained. Other authors argue that, based on empirical data, VC-backed companies tend to outperform other similar companies which are not backed by VC in terms of revenue, employment, market cap, total assets, and corporate taxes paid. VC-backed companies tend to hire highly skilled people which can eventually change the structure of an economy. Such companies can also produce immeasurable spillovers and positive

externalities to other participants in the market. The impact, however, of VC investments on the economy tend to lag, in some cases from 4 to 6 years. Nevertheless, VC plays an important role in innovation, employment, and research development. Having in mind that technological progress is one of core components of Cobb-Douglas production function model, we can derive the significant importance of VC in economic development.

2.4 Countries' determinants for Venture Capital investments

When it comes to attracting VC investments in a country, there are several factors which could be deliberately influenced to help with that. There exists a large amount of literature when it comes to this area on determinants of VC investments and countries' attractiveness. For the purpose of this paper, we will go through a few of such studies to build a framework of the most important determinants that need to be considered, especially by policymakers, when they are aiming to build a functional VC and startup ecosystem. These factors will help us to also analyze the results of our study better and to provide some concrete conclusions and recommendations specifically for Lithuania.

The importance of VC investments for the economy has already been established earlier in this literature review. However, it is worth coming back to this to share some more interesting findings from other studies. Samila and Sorenson (2011) in their study estimates show that investing in an additional firm would stimulate the entry of two to twelve new companies/startups. In other words, funding a single startup significantly incentivizes other to-be entrepreneurs to step up and act in order to establish their own companies. This can potentially lead to a bigger pool of opportunities to invest for VC firms, making a certain market more attractive in this aspect. Additionally, it can also increase the competition to receive funding between the startups, which could increase the quality of the startups and their development until they receive funding from VC firms. The main point we would draw from here is that there is a circle of increasing number of VC investments in order to increase the number of startups, which in turn would attract more VC investments. Nevertheless, there are more characteristics of a market which attracts or not VC investments.

Gompers and Lerner (1998) identified two main factors which increased the sum of available VC funds. Those are the existence of a sufficiently strong IPO market and the level of tax on capital profits. Black and Gilson (1998) also support the conclusion that IPO

market is a strong determinant of the level of VC funds available for investments. IPO market is one of the most common exit ways for VC firms and in this way, they could realize their returns on the investments in a relatively quick way and with positive results. In European market, trade sale divestments are the most common way of exiting an investment instead IPO divestment (Felix et. al., 2013). Thus, in case of European market, it is this variable that has similar impact and significance to the IPO divestment. The level of taxes on capital profits is also crucial, because too high taxes on this aspect could disincentivize VC firms to come to a market or lead them to reduce the number of investments undertaken in that market. Reduction on such a tax has shown boosted results in terms of availability of VC funds for investments.

Additionally, there are few more factors identified as important when it comes to positively affect the available funds for VC investments. One of them is reductions in restrictions to the pension funds (Gompers and Lerner, 1998). More specifically, economies which put tight restrictions on what pension funds can invest, especially those restrictions which affect investments in venture capital. We know examples of the US and the UK, whose VC ecosystem has significantly developed and taken an upside, in terms of funds available for investment, since restrictions on pension funds were reduced. Academic and business R&D are also important as such expenditures drive further the innovation and technological advancement which can create a better environment for startups to grow and scale quickly but also to make use of findings of R&D. Also, the general knowledge produced by academic and business R&D and spillover effects spread among the society and can be a good resource for many new startups. Lastly, the performance of the VC funds is also quite significant. Studies show that when there is good performance of the VC funds, then this leads to a larger availability of capital and higher attractiveness for other VC funds to join. Thus, it is not only important to build an efficient ecosystem but also, we have to pay attention to the performance of the funds in order to be able to attract more capital.

Felix, Gulamhussen, and Pires (2013) in their study argue that the startup stage towards which VC investments are directed, differ when it comes to the effects that various policies have on them. For example, early-stage investments are highly sensitive to labor market regulations/laws. Startups at this stage need flexibility in regard to labor and, in this way, rigidity in the labor market can have negative effect on them. This wouldn’t apply to late-stage investments. The opposite holds for IPO divestments, which is an important factor

for late-stage investments, but not that important and doesn't have significant impact on early-stage investments. As we can see, policymakers have to pay special attention when thinking of the policies to be implemented, as it is needed to consider and have a clear aim for whom these policies are intended. In general, early-stage and late-stage investments' attraction require different approaches.

Another interesting fact that these authors received from their statistical analysis is that GDP growth rate is not statistically significant in most models they used when it comes to determining VC investments. GDP growth has been regarded and empirically proved in some other studies (Gompers and Lener, 1998; Romain and La Potterie, 2004), as a determinant of VC investments. Nevertheless, Felix et. al. (2013) claim that GDP growth rate is statistically significant especially for high-tech investments (when this is set as a dependent variable).

Unemployment rate is also a critical variable to be looked at when studying the determinants of VC investment. Based on Felix et. al. (2013) results, unemployment rate has a strong negative impact on the VC investments. Thus, countries/regions which tend to have high unemployment rates when compared to other similar economies, might struggle more to attract VC investments. In addition, this result tells us that even the increase in self-employment which might occur during periods of high unemployment rate, cannot sufficiently balance out the impact that the unemployment rate may have on the supply of VC funds. Earlier we also mentioned the importance of the rigidity of the labor market. Generally, countries with more rigid labor markets tend to have higher unemployment rate in the long-term, which in turn can negatively affect the attraction of VC investments.

Another aspect we will look at are interest rates. In the models which include only macroeconomic variables, Felix et. al. (2013) find that interest rates have a negative impact on VC investments. In other words, increasing interest rates would be associated with a decrease in VC investments and vice-versa. This relationship of the interest rate would be usually associated with stock market. VC investments, as we have already mentioned in this paper, are a niche type of investment and should not necessarily be associated in this way with interest rates, despite being an equity investment. Other models (i.e., random effect models) used by Felix et. al. (2013) in their study, return a positive impact of interest rates on VC investments. According to this study, the early stage and high-tech investments are

two of the areas mostly affected by long-term interest rates and levels of unemployment rate. This could be explained by these types of investments consisting of huge risk compared to late-stage investments and their constant need for a non-rigid labor market. If we would assume the claim that the level of unemployment rate is related to labor market rigidity holds true, then this conclusion would be in line with the conclusion drawn by Jeng and Wells (2000). They concluded that labor market rigidities affect early-stage investments. Additionally, the high risk of such investments would require certain considerations for long-term outlook of the economic activity and interest rates.

To a have a more wholesome understanding of the determinants of VC investments in an economy, we will shift our focus to another relevant area. Now we will look at the effect that geographical distance, cultural and institutional differences have on attraction of VC investments. For that, we will need to talk briefly about financial intermediaries in general. Such institutions have inherently applied what is called, local bias. Local bias is the need for spatial proximity and relying heavily on local expertise mainly to mitigate the agency costs and problems (Hain, Johan, and Wang, 2016). Financial intermediaries have always reflected a strong need for such proximity and local expertise. In this way, local bias has been and still is a significant hurdle to pass when markets seek to accelerate their development by tapping foreign capital and knowledge (Avnimelech, Kenney, and Teubal, 2006). However, VC is not a simple financial intermediary, the same with what we have got to consider as such. VCs have a strong need to be close to their investees and have a close proximity relationship and discussions with them, which is necessary to build successful companies and realize significant positive returns on their investments. Thus, the local bias can be, in theory, even more emphasized in this niche investment. To this extent, local bias can behave as a big hurdle to attract more VC investments, knowledge, and even disincentivize entrepreneurs of startups. Nevertheless, there is a growing body of literature arguing that the VC investment pattern has already started to shift, becoming more globally distributed (Cumming and Dai 2010; Engel and Keilbach 2007). One explanation for this shift are the network effects. Network effects encompass the practice of foreign VCs teaming up with domestic VC investors in a syndicate, in this manner, making use of their local expertise and maintaining interaction with the investees. This tendency keeps growing, helped significantly by the growth in digitalization and the availability of tools and technologies to collaborate in distance. The pandemic has been an evident catalyzer of this

growth in collaboration tools which has also transformed the way we work and made working from home or at distance, a “new normal”.

There are two main indicators which are identified as variables of this paradigm shift, the institutional trust and relational trust (Hain et. al., 2016). Institutional trust indicated the overall trust in the institutional structures of a country and the behavior of citizens that live in this country. On the other hand, relational trust indicates network-based strategies, and the trust assumed between parties involved in the syndicate. Countries strong in one of these indicators, or both of them, tend to attract more VC investments compared to other countries which are weak in both of these. Hain et. al. (2016), based on the statistical analysis, were able to come up with some important conclusions, which shed more light on how these indicators are related to VC investment activity. Firstly, it is identified that the geographical, cultural, and institutional distance negatively affects VC investment activities between countries. This negative impact is found to be less present when analyzing cross-border VC investments that include only a domestic syndication partner. In other words, presence of a domestic partner in a syndication, reduces the negative impact that geographical, cultural, and institutional distance has on VC investments. This clearly shows how crucial these networking strategies can be to change the perception of foreign investors when it comes investing in a distant country. It is also found that institutional and relational trust positively affect these cross-border investments and diminish the negative effects of geographical, cultural, and institutional distance (Hain et. al., 2016). However, institutional trust’s positive effects become weaker when looking VC investments syndicated with domestic VCs. That is mostly due to such syndication being mostly based on relational trust. In addition, institutional trust has no significant effect when doing the analysis with developed countries. This is because developed countries ex-ante established, meaning, there is enough certainty of the viability of investing in such countries. The opposite would apply for emerging countries, where the institutional trust has a strong positive impact on VC investments in these jurisdictions. Overall, based on statistical analysis of different studies, it is found that for developed economies, relational trust is more relevant and has a stronger impact than institutional trust, as the latter is ex-ante established. The view changes for emerging economies, which due to their present corruption and other institutional issues, lead to institutional trust being the main determinant for the foundation of cross-border VC investment and establishment of foreign-domestic syndicates. It is crucial for policy makers

of emerging economies to instill institutional trust which appears to be a precondition for tapping foreign sources of knowledge and capital (Hain et. al., 2016).

To conclude, in this section we looked at some of the main determinants of VC investments in a market. The empirical studies cited here used data from European market, however we also saw a few comparisons with other markets, such the US and the UK. We can distinguish 9 determinants which have shown strong and significant impact on VC investments. Despite being many more determinants, these ones were mostly mentioned in the literature cited in this section and we deem them as the most impactful ones. We looked at the importance of growing VC investments as a tool to attract even more VC investments. In other words, investing in an additional startup could potentially lead 2 to 12 new startups being founded. In this way increasing the opportunity pool of investments and attracting more VC investments. Performance of the startups also plays a role in attracting more capital investment and incentivizing new companies. Then, we looked at the reduction of restrictions especially for pension funds, as they direct large sums of money to VC funds and increasing their need to deploy these funds into startups. Academic and business expenditure in R&D was also recognized as an important determinant as they can contribute to innovation, increased overall knowledge in the community, technological advancement, and spillover effects of knowledge in the startup community and not only. GDP growth was also discussed; however, its impact is seen as significant only when it comes to hi-tech startups. Among the top determinants stood IPO divestments/trade sale divestments, unemployment rate, interest rates, and the level of tax on capital profits. IPO and trade sale divestments are the most common exit way for VCs from their investments, thus it is crucial for the market where they invest to have a developed IPO market or in the case Europe, trade sale divestment takes the place of IPO. Unemployment rate also shows a significant negative relationship with VC investment. We connected unemployment rate to labor market rigidities and also found that especially hi-tech and early-stage startups are mostly impacted by these variables. Interest rates also have shown significant impact on VC investments. This holds true especially when looking at very high-risk investments and investments which could take relatively long-term. Again here, early-stage and hi-tech VC investments are mostly affected by long-term interest rates. The level of taxes on capital gains is also quite important. Too high taxes on the profits for the investors can disincentivize and lead them to other markets. Lastly, we looked at institutional and relational trust as two indicators which

are closely related with VC investments, specifically with cross-border ones and foreign-domestic syndicates. For developed economies, relational trust is of higher importance while for emerging economies, both indicators are relevant, but institutional trust is more critical and something which should be paid attention to closely by policy makers of such economies.

3. METHODOLOGY FOR ANALYSING THE IMPACT OF VENTURE CAPITAL ON ECONOMIC DEVELOPMENT

In this chapter, the methodology of the study will be covered in detail including explanations/descriptions of the research model, purpose of the research, hypotheses, dependent and independent variables, the statistical method and its appropriateness, and the limitations of the method. Additionally, the sources of the data that are going to be used will be presented, the sample size, and the needed transformations to conduct the statistical analysis. Studies, already cited in literature review, will be used to better understand the advantages and disadvantages of choosing a specific statistical method and the type of data that would help to avoid over/under-estimating the statistical results. This chapter is split in three sub-sections, as follows: (a) the purpose and model of the empirical research, and the variables selected; (b) the empirical research methods, techniques, and data collection; and (c) analysis of the statistical method appropriateness.

3.1 The purpose and model of the empirical research, and the variables selected

For this empirical research, the purpose of it is to find out whether venture capital investment impacts economic development of Lithuania, and if yes, to what extent does that occur, and which independent variables have the most significant relationship with the dependent variable. Based on the results of this empirical research, then we will be able to refer back to literature review and make the necessary connections to arrive to some specific and plausible conclusions.

The model chosen for this empirical research is the quantitative one. More specifically, a cointegration analysis is conducted in order to study the chosen variables for the relationships between the independent and dependent ones. This is deemed to be the most appropriate method in order to achieve the aim and purpose of this empirical research, based on the past research done in this area. Panel data is also quite often used in similar studies; however, it applies to studies which has observations about different cross sections across time (e.g., cross-sectional data). Thus, it wouldn't be a good fit for our study and the variables we are going to use. The variables that went into this empirical research are presented in Table 5 below, together with their sources. Detailed description for each of the variables follows.

Table 5
Dependent and Independent Variables and the Sources of Data

Variable	Unit of measurement	Dependent/Independent	Data Source
GDP	Millions of EUR	Dependent	World Bank
VC investment	Millions of EUR	Independent	Deloitte VC Report; Lithuanian Venture Capital Association; Dealroom.co
Employees in R&D, private sector	Number of employees	Independent	Statistics Lithuania
Employees in R&D, public sector	Number of employees	Independent	Statistics Lithuania
Business sector R&D expenditure	Millions of EUR	Independent	Statistics Lithuania

Based on previous research reviewed for this thesis, there is a mix of the variables chosen as the dependent one. In some of them, variables representing the technological advancement of a country were chosen as the dependent variable. This would include total factor productivity (hereinafter TFP) or number of patent applications which serve as a representation of the innovation/productivity/technology in a country. However, in case of Lithuania, TFP is a variable for which no data can be found. On the other hand, there are detailed data for number of patent applications, but this variable wouldn't best fit with the purpose of this empirical research, which is to find the presence of an impact of venture capital on economic development and its extent. Number of patent applications is usually used as a proxy of innovation rather than a proxy of economic development. Additionally, to establish reliable results, you would have to distinguish between patent applications approved and rejected, and also the industries these patent applications are aimed at or coming from. The latter would be necessary, because VC investments are usually limited to a small number of industries which have the characteristics which are needed for their investments to have significant positive returns. Thus, for this thesis, GDP of Lithuania is

chosen as the dependent variable, which is also a common variable chosen by other authors in their research, when analyzing the relationship of venture capital and economic growth/development. World Bank database was used to extract GDP data and the numbers were expressed in millions of EUR.

Moving on to the independent variables, there is a variety of them chosen in different research papers. Two of independent variables most used are the venture capital investments and total taxes paid by VC-backed companies. Venture capital investments is the amount of venture capital invested in Lithuania on a yearly basis. For this variable, the data was collected from several secondary sources, utilizing different reports prepared by renowned companies and agencies such as Deloitte, Lithuanian Venture Capital Association, Startup Wise Guys (startup accelerator), and Dealroom.co (a database of venture capital investments). Total taxes paid by VC-backed companies would have been an interesting and important variable that could have been utilized for this study. However, this type of data is not reliable in the current moment and data availability goes back only a few years, because it relies heavily on startups reporting these taxes to the database owners (e.g. Dealroom.com, Startup Lithuania). Two other independent variables chosen for this research are number of employees in R&D in private sector and in public/education sector. With the growth of VC investments, more jobs are created especially in research and development areas, as the fast-growing startups need to innovate and grow quickly. Also, the public and educational sector tends to help with their own research and development, especially through student and professors' research which could be further used in the economy. Both these variables are generally found to be affected by VC investments and are used here as proxies. The data were extracted from Statistics Lithuania. Lastly, the amount of business R&D expenditure is a variable which was also used in Romain and Potterie (2003) research paper. The amount of expenditure in R&D, specifically from businesses, would also be a good indicator and proxy of VC investments. The reason for that, as already mentioned briefly above, is because startups tend to invest large sums of money in their growth and product/service development. If the startups are to have a strong innovative product/service, R&D is crucial to help with that. Thus, we can expect a significant part of R&D expenditure from VC-backed companies. The data for this variable was also collected from Statistics Lithuania database. All these independent variables were chosen based on three main criteria: 1) usage

in previous research with similar scope and purpose of research; 2) data availability; 3) and the degree of representation of VC in Lithuania.

Initially, all the data were collected on a yearly basis frequency. Nevertheless, venture capital in Lithuania only started being active from 2009-2010. In this way, we can gather data for venture capital investments and other venture capital related variables only from 2009 until 2019. Data for 2020 have not yet been compiled and published by the main reporters of such data. In addition, some of the variables would have available data for 2020 and some other variables wouldn't have, thus, 2020 had to be removed as a year from the data scope. Due to this overly small sample of only 11 time series (yearly basis), some transformations must be done in order to increase the number of time series. Using EViews software, all the variables were transformed from low frequency (yearly) to high frequency (quarterly) using quadratic method. The quadratic method fits the low frequency data into higher frequency data by interpolation, in the way that the sum of those higher frequency data (4 quarters) is the same as the number of the low frequency data (year). In this way, we get 44 observations instead of only 11, which will significantly help to get more reliable results from the statistical analysis method chosen. The downside of this necessary transformation is that the data now is not an actual observation of each quarter, but rather a calculation based on the yearly observed data.

Last point for this sub-section is to present the hypotheses which are going to be tested with the chosen statistical analysis method. These hypotheses have been derived by reviewing many different research papers and always having in check the aim of this thesis paper, which is to find out the impact of venture capital on economic development of Lithuania. Hypotheses are stated below.

H1: VC investment has a significant positive short-term relationship with GDP of Lithuania.

H2: Employees in R&D (private sector) has a significant positive short-term relationship with GDP of Lithuania.

H3: Employees in R&D (public sector) has a significant positive short-term relationship with GDP of Lithuania.

H4: Business R&D expenditure has a significant positive short-term relationship with GDP of Lithuania.

H5: VC investment has a significant positive long-term relationship with GDP of Lithuania.

H6: Employees in R&D (private sector) has a significant positive long-term relationship with GDP of Lithuania.

H7: Employees in R&D (public sector) has a significant positive long-term relationship with GDP of Lithuania.

H8: Business R&D expenditure a significant positive long-term relationship with GDP of Lithuania.

3.2 The empirical research methods, techniques, and data collection

As also mentioned in the previous sub-section, the data for this empirical research were collected from different secondary sources. To find available data in a private sector such as VC is highly complex, especially in environments where this form of financing is relatively new. That is exactly the case of Lithuania. Most of the data about amounts of VC investments on a yearly basis were extracted from reports prepared by Deloitte Baltics in collaboration with national VC associations. In addition, for this research, a yearly report from Startup Wise Guys, a startup accelerator in the Baltics, was also used to collect some data. Another source used to collect data focused on VC, is Dealroom.co. This is one of the only databases that has specific data on Lithuania's startup ecosystem and venture capital/private equity. Lastly, for data on various national indicators, official database of "Statistics Lithuania" was used. This is an open database that enabled to collect data on number of employees in R&D, number of employees in public/educational institutions, and business R&D expenditure.

Regarding the empirical research methods employed, Autoregressive Distributed Lag (ARDL) method is chosen to evaluate the relationships between the variables of the study. In addition, Augmented Dickey-Fuller (ADF) test was utilized to evaluate the stationarity of the chosen variables before applying ARDL method. In this way, we minimized the risk of getting a spurious regression.

3.3 Evaluation of the statistical method appropriateness

Initially, more variables were planned to be included in the statistical analysis, however, two of these variables had to be removed from the model, since the unit root tests performed, showed that these variables are non-stationary at levels and at first difference. This will be explained in more detail in the following chapter where the empirical results will be analyzed.

The statistical method chosen to analyze these variables is the Autoregressive Distributed Lag (hereinafter ARDL) method. The method was developed by Pesaran, Shin, and Smith in 2001 and is intended to bring a new approach to the problem of testing the existence of a level relationship between a dependent variable and a set of regressors, when it is not known with certainty whether the underlying regressors are level- or first-difference stationary (Pesaran, Shin, and Smith, 2001). This method searches to find whether cointegration exists between the dependent variable and independent variables in the long-run and also to present short-run dynamics. It has gained popularity due to its ability to accept variables integrated at level and first difference. In addition, this statistical method works well with small data samples, which is the case of this research paper. ARDL method can work properly with at least 30 observations. The "autoregressive" part in the name of the method, means that the dependent variable, itself, is lagged to find out its previous period effects on the following period. In this way, not only the independent regressors are lagged but also the dependent one. ARDL method takes the simple multiple regression method to a higher level and helps with avoiding some necessary transformations which would be unavoidable while doing a regular multiple regression analysis. Past research papers have also used panel data analysis, but this is more applicable when you are looking at several countries at the same time, or cross-sectional data and analysis. Thus, it is not applicable in our case.

4. EMPIRICAL RESULTS OF THE IMPACT OF VENTURE CAPITAL ON ECONOMIC DEVELOPMENT ANALYSIS

4.1 Unit root test

First thing to be done before moving ahead with the ARDL analysis, is to test the variables for their stationarity, known as Unit Root test or Augmented Dickey-Fuller (hereinafter ADF) test. As mentioned in the previous section, one of the benefits/advantages of ARDL method is its ability to use data stationary either at level or first difference (Pesaran et al., 2001). If the variable is stationary at second difference, then this variable will have to be removed from the equation. To check for stationarity, ADF test was performed. Table 6 below presents the results of the ADF test. For a variable to be considered stationary, the p-value of ADF test should be below 5% (0.05) at either "intercept" or "trend & intercept". As we can see from the table, variables representing venture capital rounds and ecosystem value, are non-stationary at level and 1st difference. Thus, both these variables must be excluded from the model. The rest of the variables are stationary at 1st difference which enables us to move ahead with a model including only those variables, so that to avoid a spurious regression.

Table 6
Results of Augmented Dickey-Fuller Test (ADF)

	Level		1st Difference		
Variables	**Intercept**	**Trend & Intercept**	**Intercept**	**Trend & Intercept**	**Stationarity**
GDP	0.3934	`0.249	0.0171	0.0819	Stationary at 1st diff
Employees in R&D (private sector)	0.9974	0.4963	0.1402	0.0007	Stationary at 1st diff
Employees in R&D (public sector)	0.3588	0.228	0.0071	0.1023	Stationary at 1st diff
Business R&D expenditure	0.1268	0.0206	0.0003	0.0025	Stationary at 1st diff
Venture capital rounds	0.2716	0.5168	0.1332	0.2937	Non-stationary
Ecosystem value	0.9992	0.9944	0.9566	0.9635	Non-stationary
Venture capital investment	0.9999	0.934	0.3231	0	Stationary at 1st diff

In order to perform the ARDL method, we need to decide on the number of lags for each of the variables, including the dependent variable. For this process, Akaike Information Criteria was used to automatically decide on the optimal lag number for each variable. Around 2500 models were calculated and then the optimal version was chosen automatically. In Figure 5, we can see the graph of the top 20 models evaluated. The first lag model with the lowest value (y-axis) is chosen as the optimal model based on the data that is going to be used for the analysis. ARDL (2,4,0,4,1) means that GDP will have 2 lags, business R&D expenditure will have 4 lags, employees in R&D (public sector) will have 0 lags, employees in R&D (private sector) will have 4 lags, and lastly the amount of venture capital investment will have a lag of 1. For example, if we take the independent variable "VC investment", our ARDL equation will have the variables VCI_t and VCI_{t-1}, where "t" stands for the time period.

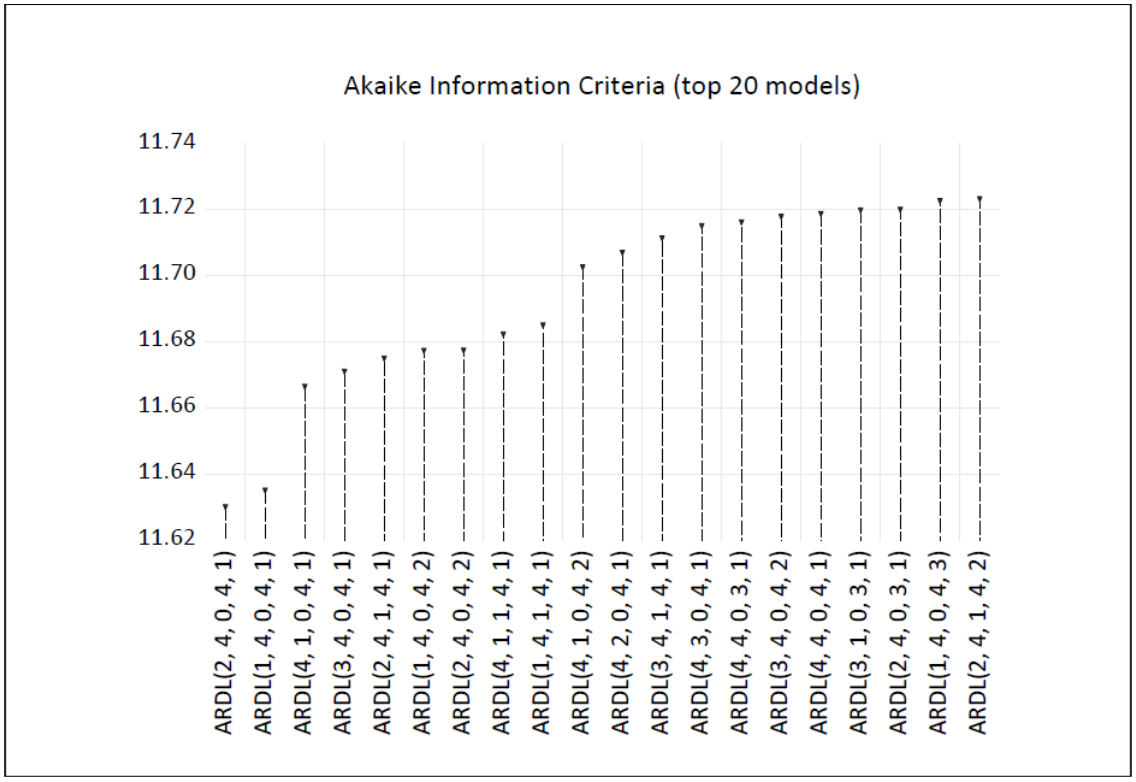


Figure 5. Results of Akaike Information Criterion lag selection.

After the number of lags was decided upon, the first estimations were done for the model and the results are presented in Figure 6. This figure shows the short-run estimations for all the variables and their respective lags. Two important things to point out for the whole model, based on the results, is that the model we have selected is of best fit with a R-

squared of 0.998. This mean that the variance of GDP is explained to an extent of 99.8% by the selected independent variables. The second things to note is the p-value, which confirms that our model fits and is significant.

Moving on to the variables, we see that the ones with a p-value equal to or smaller than 0.05 (5%) include: business R&D expenditure with lags of 1 and 4, number of employees in R&D (private sector), number of employees in R&D (public sector) without lag and with lag of 1, and VC investment without lag and with lag of 1.

4.2 Short-run results

VC investment (without lag) result is in line with our hypothesis, in the short-run. We notice a significant positive relationship with the GDP of Lithuania. The coefficient indicates that a 1 million EUR increase in business R&D expenditure would increase the GDP by 17 million EUR in short-run. The lagged variable of VC investment, although significant, has a negative coefficient which raises a contradiction with its non-lagged version. However, this could be explained by the nature of VC investment itself, which tends to bring results at some time later after the investment is placed. The lag of a quarter indicates that in a timeframe of one quarter, those VC investments can slightly affect the GDP in a negative manner, as those resources don't bring much return, if at all. The concept of lagged effect of VC investment on GDP is not a new one and it has been proven by other authors too. Kolmakov et. al. (2015) in their paper explain that the effect of VC investment on economic growth is delayed and is much stronger when we look at a 4-to-6-year period (in other words, 4 to 6 years after the investment is done). Having in mind that our sample of data covers only 10 years, and the data is on quarterly basis, we can safely assume that there is not enough data to show us the delayed long-term effect of VC investment on economic growth. However, we can still notice a similar pattern of delayed effect, although the lagged version of VC investment has a negative coefficient. This could also be due to VC investments being focused on the capital city of Lithuania, which can have its own implications in the results we see.

Business R&D expenditure results with a significant negative relationship only when lagged by 1 period (quarter) and 4 periods, with a stronger effect on the first lag. In addition, the non-lagged variable doesn't have a significant relationship in the short-run. Both these results are not in line with our hypothesis. Best explanation we can give for this case is that,

despite business expenditure in R&D is important for economic growth, in the short-run, it is difficult to see results of such investments positively affecting the economy. In addition, this might also be related to structural changes that are needed in the entire economy for such investments to be more fruitful. Belke, Fehn and Foster-McGregor (2003) in their paper pointed out that for a country to ensure and support its economic development, it must recognize the shift in the economy that is happening (among advanced economies and not only) and adapt their institutions to continue supporting innovation and innovative entrepreneurship in their economies. Nevertheless, we can confirm more on this when we look at the direction of the relationship in the long-run.

Lastly, we look at the results received for number of employees in R&D for private and public sector variables. For the number of employees in R&D in private sector, we see a relationship in line with our hypothesis for the short term. A significant positive relationship is detected with a coefficient of 1.3. This means that if the number of employees in R&D (private sector) would add an additional employee, who would be associated with 1.3 million EUR increase in GDP. This reinforces the theory reviewed on the positive effects of R&D in economic growth and advancement of a country. R&D findings can also have other positive externalities in the economy and can be adopted by other companies in the industry. According to Romain and Potterie (2003) one of the channels through which VC contributes to economic growth is the usability of the knowledge provided by public and private research institutions. This would include companies, universities, agencies, and other types of institutions. As more innovation is done through R&D, those findings can also be adopted by other players in the market and serve as catalysts for further innovation. The European Innovation Scoreboard 2020 report emphasizes that one of the innovation dimensions in which Lithuania scored high is population with tertiary education. This can explain, firstly, the increase in the number of employees engaged with R&D, as in general the population is more educated and specialized. Secondly, it can also explain to some extent the positive impact they have on GDP.

Back to the statistical results, for employees in R&D of public sector, both the non-lagged and the lag of 1 are significant based on p-value. The non-lagged version of the variable has a positive coefficient, in line with our hypothesis, with a value of 0.99. There is no clear explanation why the variable with a lag of 1 has a negative coefficient in short-run. However, it might be related to R&D in public sector not being as efficient as in the private

sector. In addition, public R&D in Lithuania is more focused on basic research which is then further used to do more applied research and experimental development, usually in private sector. R&D infrastructure is another focus of public R&D whose function is to lay the ground for the R&D to be done and which tends to show benefits in much longer timespan than our data covers.

Dependent Variable: GDP
Method: ARDL
Date: 05/19/21 Time: 23:01
Sample (adjusted): 2010Q1 2019Q4
Included observations: 40 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): BRD EIRD ERDIED VCI
Fixed regressors: C
Number of models evalulated: 2500
Selected Model: ARDL(2, 4, 0, 4, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GDP(-1)	0.862502	0.162857	5.296083	0.0000
GDP(-2)	-0.152951	0.131288	-1.165005	0.2555
BRD	1.298694	0.725958	1.788939	0.0863
BRD(-1)	-4.557865	1.033706	-4.409246	0.0002
BRD(-2)	0.688389	0.958363	0.718297	0.4795
BRD(-3)	-0.129780	0.669215	-0.193928	0.8479
BRD(-4)	-1.277217	0.527175	-2.422758	0.0233
EIRD	1.312726	0.212364	6.181503	0.0000
ERDIED	0.992702	0.075146	13.21039	0.0000
ERDIED(-1)	-0.841284	0.191993	-4.381850	0.0002
ERDIED(-2)	0.130069	0.170466	0.763021	0.4529
ERDIED(-3)	-0.044117	0.110627	-0.398788	0.6936
ERDIED(-4)	0.137798	0.072575	1.898688	0.0697
VCI	17.49789	3.426587	5.106507	0.0000
VCI(-1)	-10.06977	3.679714	-2.736564	0.0115
C	754.1531	276.0214	2.732227	0.0116

R-squared	0.998281	Mean dependent var	11482.35
Adjusted R-squared	0.997207	S.D. dependent var	1328.643
S.E. of regression	70.21463	Akaike info criterion	11.63016
Sum squared resid	118322.2	Schwarz criterion	12.30572
Log likelihood	-216.6033	Hannan-Quinn criter.	11.87442
F-statistic	929.3677	Durbin-Watson stat	2.125261
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

Figure 6. Results of ARDL test (short-run).

4.3 Long-run results

Now that we looked at the ARDL results in the short-run, we move to the long-run cointegration results. Cointegration is a statistical property which is used to check for the existence of a long-run relationship between two or more variables. At this stage we will be able to see what relationships hold between the independent and dependent variables, their long-run coefficients and test the null hypothesis with the F-bounds statistic. If the F-statistic will be above the upper bound, then we will be able to reject the null hypothesis of no levels

relationship. Figure 7 presents the results of the long-run estimations. First thing we can notice is that the coefficients of each of the independent variables are highly significant in the long-run. The F-statistic value is 7.13 which is higher than the upper bound of 3.49 at 5% significance level. This leads to rejection of null hypothesis that there is no levels relationship. In other words, all these independent variables, in the long-run are significantly cointegrated with GDP.

Number of employees in R&D in private and public sector, and VC investment relationships are positive, significant, and in line with our long-run hypothesis for these variables. VC investment has the highest coefficient of 25.57 which would be translated as 25.5 million EUR increase in GDP from a 1 million EUR increase in VC investment, in the long-run. Similarly, to the short-run, the coefficients for employees in R&D in private sector is higher than the one for public sector in the long-run. This can reinforce the idea that employees in R&D from the private sector tend to be more efficient and resultative in the long-run, thus having a higher impact on economic development than the public sector R&D. In addition, as mentioned previously, employees in R&D in private sector are usually more involved with applied research and development rather than with basic research which usually is conducted in public institutions. However, this doesn't diminish the effect of public R&D in economy. As mentioned also during the short-run results, employees in public sector R&D are mostly focused on basic research and R&D infrastructure which tends to have significant delays on affecting GDP or economic growth.

The only variable whose sign of the relationship cannot be explained straightforward is business R&D expenditure. The coefficient is quite high, however with a negative sign which doesn't conform to common expectations of the R&D expenditure effect on GDP. This result is not in line with our hypothesis and raises some uncertainties about its interpretation. Literature has shown that in general, R&D in long-run has a positive relationship with GDP. Kim's (2011) empirical study on the economic growth effects of R&D activity in Korea, shows that R&D stock has a contribution ratio of 35% to economic growth. The rest, 65%, come from labor and capital. In addition, public and private R&D stocks account for 16% and 19%, respectively, towards this economic growth (Kim, 2011). Nevertheless, a plausible explanation that we can give for this case is that business R&D in Lithuania has not yet yielded returns needed in the long-run. It can also indicate that more work is needed in this area to increase its efficiency and produce results which would benefit

the economic growth and create positive externalities in the society. As Hall and Lerner (2010) confirm, usually small and new innovative firms experience high costs of capital when it comes to innovation and R&D. Lastly, we cannot exclude the option that the coefficient might be affected by the autocorrelation and multicollinearity problem which based on the chosen variables of our model can be plausible. Table 7 below, summarizes the short-run and long-run results in terms of hypotheses acceptance or rejection.

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BRD	-13.69526	2.628328	-5.210637	0.0000
EIRD	4.519640	0.620726	7.281222	0.0000
ERDIED	1.291681	0.122936	10.50698	0.0000
VCI	25.57458	6.061861	4.218932	0.0003
C	2596.505	621.1847	4.179925	0.0003

EC = GDP - (-13.6953*BRD + 4.5196*EIRD + 1.2917*ERDIED + 25.5746*VC + 2596.5054)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
		Asymptotic: n=1000		
F-statistic	7.133445	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
Actual Sample Size	40	Finite Sample: n=40		
		10%	2.427	3.395
		5%	2.893	4
		1%	3.967	5.455

Figure 7. Results of ARDL test (long-run).

The highest coefficient observed in the long-run belongs to the variable of VC investment, with a coefficient of 25.57. The second highest coefficient belongs to number of employees in R&D (private sector) with a coefficient of 4.52. Lastly, number of employees in R&D (public sector) has a coefficient of 1.29. Business R&D has a negative coefficient of -13.70. Both these variables' results, number of employees in R&D (private and public), indicate to us that GDP can slightly increase, the more people get involved with R&D. This

could be explained by the idea that as more people in a country get involved in R&D, as they move between different companies and institutions, they can share their knowledge and further contribute to improvements in the places they go. Thus, helping to introduce new products, services, etc. Based on some studies, VC is responsible for a big part of employees hired in R&D but also R&D expenditure. Belke et. al. (2003) concluded, based on empirical results, that VC significantly increases employment growth and job creation in new and innovative companies. Furthermore, it helps to gradually change the structure of the economy towards a new one which supports innovation. VC look to invest in fast growth companies which integrate technology in their operations and aim for groundbreaking innovation. All this research is mostly funded by VC investments and utilized to make a company as valuable as possible and increase the returns for the fund. An important player here is also the public sector as they usually invest in basic research, which is a starting point for more applied research and experimental development, and in R&D infrastructure.

Table 7
Summary of hypotheses acceptance/rejection based on empirical results

Hypothesis	Accepted	Rejected
	Short-run	
H1	X	
H2	X	
H3	X	
H4		X
	Long-run	
H5	X	
H6	X	
H7	X	
H8		X

4.4 Error correction model and CUSUM statistics

The last two things that we will look at, are the error correction model and the cumulative sum (CUSUM) statistics. In Figure 8, the error correction model helps us to understand the short-run and long-run dynamics. It estimates the speed at which the dependent variable deviations from the long-run equilibrium are corrected through a series of partial short-run adjustments. Our error correction term [CointEq (-1)] is equal to -0.29. This negative and significant coefficient further confirms that there is a long-run equilibrium relation between the independent and dependent variables at 5% level of significance. The

coefficient itself, indicates the speed of adjustment of any disequilibrium towards a long-run equilibrium so that 29% of the disequilibrium in GDP is corrected each quarter. Most importantly, the negative and significant error correction coefficient indicates the existence of a long-run causality between the variables that we are studying.

ARDL Error Correction Regression
Dependent Variable: D(GDP)
Selected Model: ARDL(2, 4, 0, 4, 1)
Case 2: Restricted Constant and No Trend
Date: 05/20/21 Time: 06:32
Sample: 2009Q1 2019Q4
Included observations: 40

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	0.152951	0.099965	1.530051	0.1391
D(BRD)	1.298694	0.624979	2.077980	0.0486
D(BRD(-1))	0.718608	0.795512	0.903328	0.3753
D(BRD(-2))	1.406997	0.439110	3.204205	0.0038
D(BRD(-3))	1.277217	0.431279	2.961465	0.0068
D(ERDIED)	0.992702	0.056174	17.67181	0.0000
D(ERDIED(-1))	-0.223750	0.107097	-2.089233	0.0475
D(ERDIED(-2))	-0.093681	0.063241	-1.481322	0.1515
D(ERDIED(-3))	-0.137798	0.058947	-2.337660	0.0281
D(VCI)	17.49789	2.744129	6.376483	0.0000
CointEq(-1)*	-0.290449	0.040388	-7.191486	0.0000

Figure 8. Results of error correction model (ECM) showing short and long-run dynamics.

Lastly, the stability statistics of cumulative sum (CUSUM) and cumulative sum of squares (CUSUMQ) are shown in Figure 9 and Figure 10, respectively. These stability statistics are used to check whether our model is stable and within the 5% level of significance. As we can see from the pictures, both CUSUM and CUSUMQ lines are within the 5% level of significance borders and do not intercept and any point. Thus, it proves that the analyzed model is stable and not spurious or inconclusive. This comprises the last step in our statistical analysis.

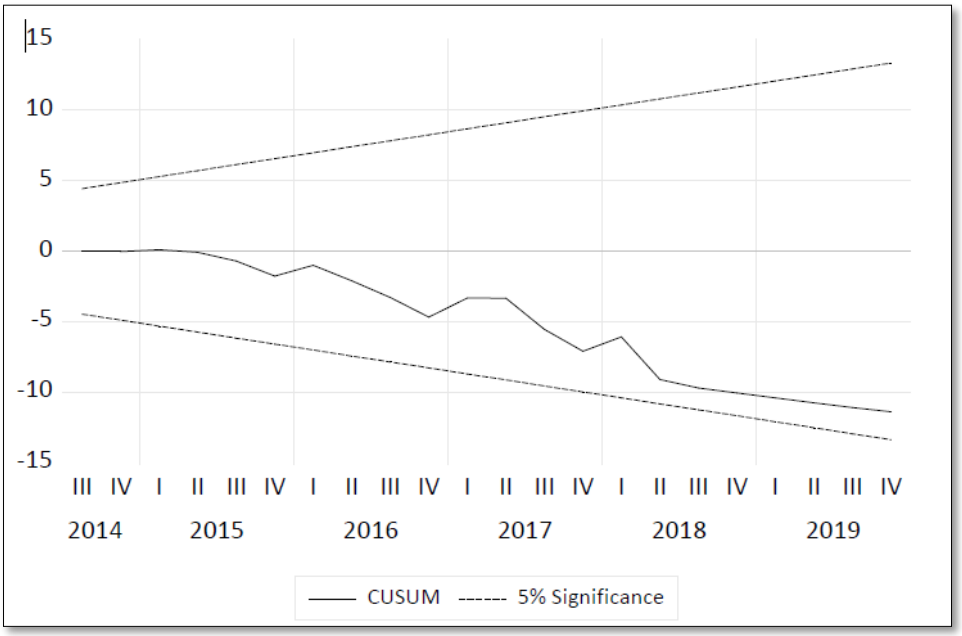


Figure 9. Results of cumulative sum stability statistic.

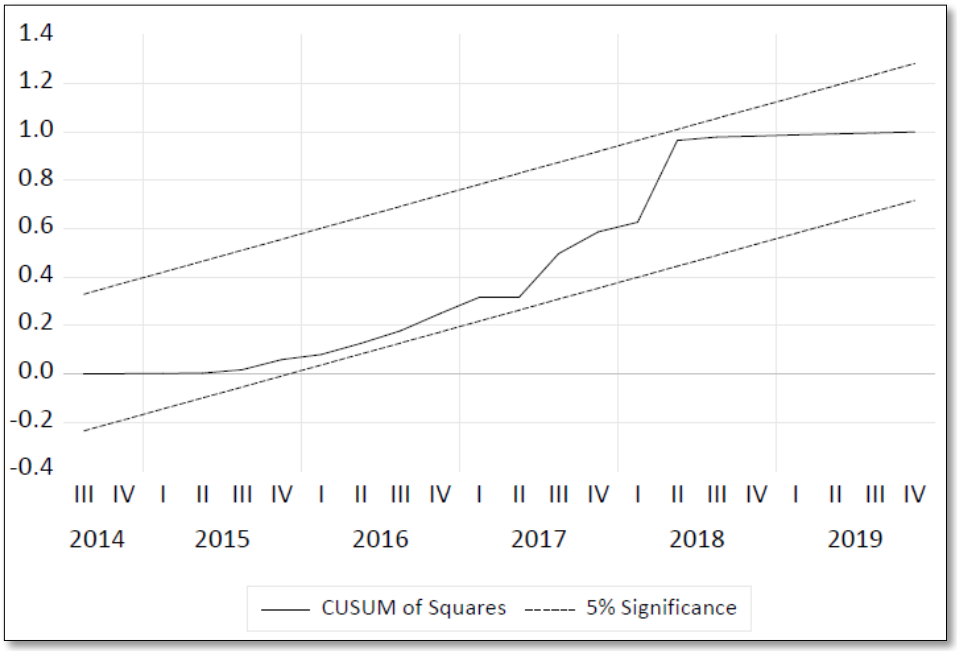


Figure 10. Results of cumulative sum of squares stability statistic.

To conclude this chapter, our statistical analysis has shown that the results we received are in line with the hypotheses we laid down, except the variable representing business R&D expenditure, in the long run. On the short run, again business R&D expenditure which wasn't in line with our hypothesis. Additionally, the lagged variables of employees in R&D in public sector and VC investment, showed negative relationships with GDP. Nevertheless, their non-lagged version was in line with our hypothesis. The variables are cointegrated in the short and long-run, which means that there exists a relationship between the variables (dependent and independent) whose distance remains relatively the same over time. In addition, the statistical results of error correction model indicate a causal relationship in the long-run between the variables studied. We can confidently derive that VC investments have a significant positive impact on GDP in both short and long-run. Furthermore, the number of employees in R&D (both private and public sectors) have a positive impact on GDP, in the long run long-run. In the short run, some of these variables show some opposite results when compared to their lagged version. These results help to further feed the importance of VC investment as they are, in practice, heavily focused on high innovation, R&D intensive companies and not only. The only variable whose impact is questionable is the business R&D expenditure. It has a high significance, but it also has a negative relationship with GDP, which is contrary to the literature. The negative effect can be related to high costs of R&D that commonly small and new innovation-focused companies face. These high costs can eventually fail to bring returns which, in turn, can have a negative effect on GDP. The results of this empirical study are more applicable to government institutions and agencies rather than VC funds and companies themselves. Our results show that government of Lithuania should continue promoting and investing in the development of VC environment in Lithuania and extend it in other cities except the capital. This, in fact, is slowly progressing as also startups from Kaunas are receiving investments from VC funds but it is still significantly lower when compared to Vilnius. In addition, Lithuanian government should continue building and expanding the R&D infrastructure in order for more people to get into this area and to give more opportunities for the companies to be part of such an activity. On the other hand, it is of great importance that the structure of the Lithuanian economy also transforms progressively to adapt to the changing environment, as economy moves further towards innovation and technological development. Underestimating this aspect can have significant negative results on the economy and work

in the detriment of good R&D progress. Taxation, intellectual property rights, investor protection, are among some of the areas which needs constant attention and review in order to be attractive to VC funds and the investors. In addition, support for startups is important as it attracts even more VC funds or supports their creation. Taking all these into consideration and acting on these points, would ensure a viable and constantly growing VC environment, which in turn will impact economic growth and develop the country further.

5. CONCLUSIONS AND RECOMENDATIONS

In this section of the thesis, we will present all the conclusions and recommendations that we have based on the empirical results of our study and the literature analysis we have conducted earlier in the paper. In addition, we have tried to look at the most recent situation in Lithuania in terms of venture capital investments to provide some concrete recommendations for policymakers and other relevant stakeholders. Lastly, limitations of the study and further research suggestions are presented.

5.1 Conclusions

1. VC investments have a positive impact on GDP in the long-term and contribute significantly in the economy, especially towards innovation and R&D. By financing companies which bring unconventional innovation in the economy and have high potential to grow exponentially, VC helps to advance the technology, create large companies which pay significant amount of taxes, and employ people in high-growth areas and R&D.
2. The most appropriate dependent variable dependent variable for a case like Lithuania, is GDP. Patent applications can also be a potential candidate; however, it serves mostly as a proxy of innovation and might risk not accounting for other aspects of economic development. Total factor productivity is another variable which could potentially work in this case, although it is complex to be calculated and prone to error.
3. Autoregressive distributed lag (ARDL) statistical analysis is the most appropriate method to analyze the data, having in mind the extremely small amount of data available and the main aim and objectives of this study. Other methods reviewed mostly require large amount of data or simply wouldn't bring results which would help with the aim of the study. ARDL is relatively simple to understand, robust even with small amount of data, and indifferent towards the stationarity of the variables, whether those are at level or 1^{st} difference stationary.
4. Besides VC investments, also some other factors can positively affect GDP in the long-run, such as the number of people employed in R&D, both in private and public sector. More people are involved in this area, the higher the opportunities to bring innovation in the economy and to distribute the knowledge quickly among the society. Lithuania is a country with a high rate of population with tertiary education, which makes it possible to develop such talents and engage them more with innovation and technological advancement, for the benefit of the whole economy.
5. Lastly, in order to develop the VC environment in a country, there are many different factors to be considered and paid attention. Looking at the big picture of the whole chain of dynamics and interactions in the VC and startups environment, there are many ways to enhance the investments and at the same time build successful companies which bring huge innovation and contribute to overall growth in the economy. More on this is written in the recommendation's subsection.

5.2 Recommendations

1. Policymakers or responsible government agencies involved in the VC area, must establish a clear strategy to be followed for the whole country, in order to be clear on what needs to be done and which paths to be taken, with the aim of building a successful and growing startup and VC ecosystem. It is important to look at the big picture and consider different components in the economy, society, and culture.
2. Being still in infant phase of VC industry development, Lithuania must focus on building a solid institutional trust as a country in order to attract more foreign capital and knowledge in its ecosystem. This would help to finance even more startups and at the same time bring new practices and know-how to further improve the companies and the ecosystem.
3. With the increase in digitalization, it is important to consider ways to connect more with foreign investors and utilize technology for collaboration and attracting capital and knowledge.
4. Tax incentives are important to be considered and reviewed in order accommodate startups and VC funds and Lithuanian market more attractive than compared to peers in the region. This could be done either through reductions in tax applied on capital gains, tax deductions for activities in R&D, or other appropriate methods.
5. Labor laws are also a crucial point when it comes to developing startup and VC ecosystem. Thus, reduction of rigidity in labor laws is also an important point which if leveraged could bring significant results in terms of benefits for the ecosystem. Of course, high prudence is required when considering review of such laws; however, data and research shows that markets with low rigidity of labor laws, tend to be more successful on attracting VC capital and developing successful startups.
6. Lastly, ensuring that the population of Lithuania receives proper education and entrepreneurship is fed more in the society are also critical in enabling startups to happen and to efficiently deploy and make use of the VC investments. Successful VC investments incentivize more startups to be founded and attract even more VC capital.

5.3 Limitations and further research suggestions

1. First limitation is the small amount of data and lack of centralized and standardized database. This led to more difficulties to conduct statistical analysis and also reduces the ability of receiving results which could be relied on with high confidence. In addition, the lack of a centralized and standardized database for VC investments, especially, makes the data collection process complex.
2. The independent variables used might not be the best ones for the purpose of this study. However, those have been chosen based on their capacity to capture of effects of VC investments in the economy. Nevertheless, more consideration can be put into this task and look at a broader set of independent variables to get a fuller picture of the impacts.
3. For this type of study, with a focus on Lithuania, it might be appropriate to perform the study in a similar country/economy as Lithuania, but which has more data available. Then to apply the findings in a proper way to Lithuania as well. Our literature review has

shown examples of such studies done for example for Russia, by studying and applying studies from the US with the right aspects of comparison.

4. Lastly, total factor productivity could be more relevant as a dependent variable, thus, its calculation and usage in future studies can potentially be more revealing in terms of VC investments' impact on economy, and more specifically on technological development.

RIZIKOS KAPITALO POVEIKIS EKONOMIKOS PLĖTRAI LIETUVOJE

Mateo LAMNIJE

Baigiamasis Magistro Darbas

Finansų ir Bankininkystės Magistrantūros Programa

Ekonomikos ir Verslo Administravimo Fakultetas, Vilniaus Universitetas

Prižiūrėtojas Dr. A. Laurinavičius, Vilnius, 2022

6. SANTRAUKA

58 lapai, 7 lentelės, 10 grafikų, 40 šaltinių.

Šios disertacijos pagrindinė paskirtis yra išsiaiškinti ar rizikos kapitalas įtakoja ekonominę plėtrą Lietuvoje. Papildomai, autorius stengėsi identifikuoti ar rizikos kapitalo įtaką ekonominei plėtrai yra pozityvi ar negatyvi ir jos reikšmę.

Disertaciją sudaro keturios pagrindinės dalys; rizikos kapitalo įtakos ekonomikai teorija, metodika naudojama analizuoti rizikos kapitalo įtaką ekonominei plėtrai, statistinės analizės empiriniai rezultatai ir išvados su rekomendacijomis.

Rizikos kapitalo įtakos ekonomikai teorija yra padalinta į keturias dalis, kuriose autorius analizuoja rizikos kapitalo idėją, jos plėtros padėtį Europoje, Baltijos šalyse, Lietuvoje; rizikos kapitalo įtaka ekonomikai ir šalių determinatyvai rizikos kapitalo investicijoms.

Teorijos analizėje, autorius atsižvelgė į labiausiai atitinkančią metodiką naudojama tokio tipo tyrime, nusprendė ties geriausiais kintamaisiais statistinei analizei ir atliko empirinę analizę, kad patikrinti turimą hipotezę. Autorius išanalizavo kokią įtaką įvairūs kintamieji, susiję su rizikos kapitalo investicijomis, turi ties Lietuvos BVP. Iš gautų empirinių rezultatų, autorius nutarė, kad rizikos kapitalas turi teigiamą poveikį Lietuvos BVP ateičiai. Taipogi, buvo nutarta, kad rizikos kapitalo investicijos žymiai prisideda ties inovacija, tyrimu ir plėtra.

Galiausiai, išvadų ir rekomendacijų sutraukia pagrindinius faktorius literatūrinėje analizėje ir statistinės analizės empirinius rezultatus. Autorius įvardija, kad šios disertacijos išvados ir rekomendacijos gali būti naudingos politikos formuotojams ir kitiems akcininkams rizikos kapitale ir Lietuvos ekosistemos paleistyje. Papildomai, šis tyrimas gali itin suinteresuoti

naujų verslų steigėjus norint išmokti daugiau apie rizikos kapitalą ir kaip pritraukti rizikos kapitalo investicijas.

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