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2015 **Doina Chiselita**

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The Impact of Entrepreneurship on Economic Performance in Central and Eastern Europe

Master thesis

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Abstract

Entrepreneurship is viewed by scholars and policy makers as an important factor contributing to increased levels of economic performance. New businesses are conduits of innovation, connecting resources and ideas within the economy and fostering competition. Central and Eastern Europe is a special case regarding entrepreneurship, due to its communist legacy. The surge in entrepreneurial activities caused by the process of market liberalization ultimately affected economic development in the area. This thesis acknowledges the importance of studying entrepreneurship in Central and Eastern Europe, and aims to analyse the impact of new business formation on economic performance in the region. To do so, the thesis creates a comprehensive guide of theoretical frameworks linking entrepreneurship to measures of economic performance and applies them to the Central and Eastern European area. The thesis also develops an empirical study using regression analysis with regional Eurostat data, which shows that new business formation has a significant, positive impact on GDP levels in Central and Eastern Europe. The results also indicate that entrepreneurial activity should be regarded by policy makers as an important factor that leads to increased economic performance, in addition to measures of research and development and human capital.

Keywords

Entrepreneurship, economic performance, Central and Eastern Europe, post-communist economies, productivity

Abstrakt

Politici a vědci vnímají podnikání jako důležitý faktor přispívající ke zvýšení úrovně ekonomické výkonnosti. Nové podniky jsou zprostředkovatelem inovací, spojují v ekonomice zdroje a myšlenky a posilují hospodářskou soutěž. Střední a východní Evropa představuje zvláštní případ podnikání kvůli jeho zátěži z doby komunismu. Prudký nárůst podnikatelských aktivit v důsledku procesu liberalizace trhu v konečném důsledku ovlivnil hospodářský rozvoj v této oblasti. Diplomová práce zdůrazňuje význam studia podnikání ve střední a východní Evropě s cílem analyzovat jeho dopad na ekonomickou výkonnost v tomto regionu. S tímto cílem prochází komplexně teoretické rámce spojující podnikání s opatření na posílení hospodářské výkonnosti a aplikuje je na prostor střední a východní Evropy. Empirické studium je rozvíjeno s pomocí regresní analýzy pracující s regionálními údaji Eurostatu, které ukazují, že formování nové firmy má významný pozitivní dopad na úroveň HDP ve střední a východní Evropě. Výsledky také ukazují, že podnikatelská činnost by měla být politiky považována za důležitý faktor, který vedle opatření na podporu opatření výzkumu a vývoje a lidského kapitálu vede ke zvýšení ekonomické výkonnosti

Klíčová slova

Podnikání, ekonomická výkonnost, střední a východní Evropa, post-komunistická ekonomika, produktivita

Range of thesis: 59 pages, 20 740 words (without appendices), 21 668 words (with appendices), 139 985 characters

Declaration of Authorship

1. The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.

2. The author hereby declares that all the sources and literature used have been properly cited.

3. The author hereby declares that the thesis has not been used to obtain a different or the same degree.

Doina Chiselita

Prague 15/05/2015

Signature

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I am especially grateful to my supervisor, professor Vladimir Benáček, for his dedicated guidance, comments and suggestions that inspired me to discover the nuances of this topic and reach valuable conclusions. Special thanks to my family, friends, as well as flatmate and fellow IMESSer Bara, for their kind support and encouragements during the past few months.

M.A. DISSERTATION PROJECT

Name: Doina Chiselita
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Title: The impact of entrepreneurship on the economic performance of the Central and Eastern European countries
Supervisor: Doc. Ing. Vladimir Benáček PhD.

Aim of the project (10 lines):

Entrepreneurial activity is considered a contributing factor to increased economic performance and innovation in Western economies, as well as in Central and Eastern Europe. In the latter situation, the transition period was marked by a surge in entrepreneurial activity (a testimonial of market forces, a breath of fresh air after the straight jacket placed by command economies on entrepreneurial talent). Still, entrepreneurship in the area was at times undermined by the dominating position of larger firms or an uncertain institutional environment. In the light of these, this thesis aims to provide a comprehensive view of how entrepreneurship relates to measures of economic performance, apply this view to the Central and Eastern European area, and further support it by empirical evidence from the region.

Proposed methodology (20 lines):

The starting point of the research will be an incursion in the theories that link entrepreneurship to economic performance indicators. This is essential in order to gain a good understanding of how entrepreneurship relates to measures of economic performance and to grasp the modelling procedures employed in existing literature. Next, these theoretical frameworks will be applied to the analysis of entrepreneurship in Central and Eastern Europe. By examining different studies, statistics and reports, the thesis will show how the role of entrepreneurship has evolved in the region at different stages of transition. Finally, the impact of entrepreneurship on economic performance will be investigated using regression analysis with data from the region. The empirical model will draw on the theories and studies examined earlier in the thesis. Economic output (GDP) will be expressed as the following function: Y= (E, A, K, L, X), where E represents entrepreneurship, A represents the stock of knowledge, K represents physical capital, L represents labour and X incorporates other factors that impact economic performance. Entrepreneurship will be measured by new business formation, knowledge will be measured by research and development expenditure and human capital, labour will be measured by total employment, physical capital will be measured by total capital stock or gross fixed capital formation. The model will have the following general form: $Y_i = \beta_0 + \beta_1 E_i + \beta_2 A_i + \beta_3 K_i + \beta_4 L_i + \beta_5 X_i + \varepsilon_i$, where i denotes the entities analysed (regions or countries). The sign and significance of the coefficient β_1 will be analysed in order to determine the impact of entrepreneurship on economic performance. The results will be discussed in accordance with the particularities of the Central and Eastern European area.

Proposed structure of chapters:

Chapter 1: Frameworks linking entrepreneurship to measures of economic performance. Literature review

Chapter 2: Entrepreneurship in the post-communist economies of Central and Eastern Europe

Chapter 3: Empirical study

Selected source/primary, secondary (25 commented titles):

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Aproved by:	**Signature**	**Date**
Head of the MA Thesis Seminar		
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INTRODUCTION

As economies nowadays shift from 'big firm capitalism'[1] to 'entrepreneurial capitalism'[2], what role does entrepreneurship play in Central and Eastern Europe, and in particular, how does it impact economic performance in the area? By exploring theoretical frameworks that link entrepreneurship to measures of economic performance, as well as empirical evidence from the area, this thesis aims to establish entrepreneurship as a salient factor driving regional economic advancement in Central and Eastern Europe.

The thesis marries two main intellectual concerns. The first one relates to entrepreneurship, and how new business formation can lead to increased levels of economic performance. Entrepreneurs achieve this by successfully transposing an innovative idea into a marketable product or by replicating existing business models, but ingeniously adapting them to particular economic environments. Entrepreneurship is a fascinating combination of individual ambition and systemic predispositions, the blend of which leads to new businesses that can challenge incumbent firms through product or process novelty. The economic contribution of entrepreneurs, new ventures or small and medium businesses has received, however, little attention from policy makers and scholars up until recent years. In the post-war decades, big firms were seen as the main contributors to economic performance in capitalist economies. Research in industrial economics at the time showed large firms to be more efficient when compared to their smaller counterparts, as well as have the ability to provide higher levels of compensation, the financial capacity to invest in research and development activities, the ability to better hedge the risks arisen from uncertain research and development outcomes and the market power to efficiently manage supply and demand at a large scale (Audretsch, 2006; Benáček and Michalíková, 2010). As a result, in the capital-based Solow[3] economy (Solow, 1956) and the knowledge-based Romer[4] economy (Romer, 1986), entrepreneurship played a limited role. By the 1990s, this disproportionate focus on big firms lead to an 'economic sclerosis', characterised by stagnating growth rates and low innovation activities. Large companies were tempted to just 'live off their cash flow without innovating [and] leverage their power in one market into other markets, thereby

[1] An economic system dominated by the activity of big firms, also known as oligopolistic capitalism
[2] An economic system with a large number of entrepreneurial firms, which have incentives to innovate and commercialize new ideas
[3] Physical capital and labour are the main factors that increase the performance of an economy
[4] Knowledge capital replaces physical capital as the main determinant of economic performance

stunting the growth of new technology and handicapping entrepreneurs who could commercialize it' (Baumol et al., 2007, p. 87). The tendency not to innovate turned out to be the 'Achilles' heel of big firm capitalism', but also the turning point towards 'entrepreneurial capitalism' (Baumol et al., 2007, p. 84). Gradually, policy makers shifted their focus away from large firms towards small enterprises and new ventures, viewing the latter as prime drivers of innovation, employment and economic advancement. Indeed, there has been an entrepreneurial revolution going on in the world. From Silicon Valley to Tech City London, new business ventures aim to disrupt industries, and reach out to consumer demand in new and improved ways. For example, in Tech City London, the number of new digital companies grew by 76% between 2009 and 2012[5]. Moreover, young firms and small businesses are seen as key drivers of economic recovery after the 2009 recession. Research from the Kauffman Foundation regarding the American economy shows that 'without start-ups net job creation would be negative in all but a handful of years' (Stangler and Litan, 2009, p. 2). Finally, entrepreneurs are now, more than ever, able to access resources that help them build a business with an impact. Globalisation and technological advancements have transformed the way a business can be built, making key resources, such as funding, human capital, technology or even business acumen, more readily accessible. As a result, this is the most fascinating time to study entrepreneurship and investigate the nature and the magnitude of its impact on economic performance.

The second intellectual concern relates to Central and Eastern Europe, a region marked by its communist past and even more so, by the complex transition process that turned formerly centrally planned economies into market economies. While the capitalist world was biased towards large firms prior to the 1990s, the communist world was practically devoid of entrepreneurship all together. In a talk on the deficiencies of socialist economies, Austrian school economist Jesus Huerta De Soto underlined their faulty rapport to entrepreneurship. De Soto defined socialism as 'aggression against the natural state of entrepreneurship', which in turn transforms socialist economies into 'an intellectual error, a scientific impossibility'. Furthermore, the economist identified entrepreneurial freedom as 'humanity's distinctive capacity'[6]. The liberalization of the centrally planned economies resulted in a boom of new enterprises, mainly 'necessity-

[5] See more at: http://www.techcityuk.com/investors/#sthash.grMS2QLe.dpuf
[6] Extracted from this author's notes on the speech given by De Soto at the Academy of Economic Studies in Bucharest in 2010

driven'[7] at the start of the transition period, but with potential to turn into 'opportunity-driven'[8] enterprises towards the end of the transition period. The creation of sustainable small and medium enterprises played a salient role in the successful metamorphosis of post-communist economies from vacuums of innovation and entrepreneurship to environments conductive of competition and new business formation. The start-up scene is currently growing in the area, with famous companies such as Skype and Prezi coming out of Central and Eastern European markets. In the light of these, entrepreneurship is clearly a special case in Central and Eastern Europe. Yet, given the complex history of the area, placed in the context of an increasingly entrepreneurial world economy (as discussed in the previous paragraph), what impact does entrepreneurship have on measures of economic performance in Central and Eastern Europe? Moreover, given the institutional environment of Central and Eastern European economies, combined with their ardent strive to catch up with the Western economies, is the praise of entrepreneurship vindicated? Should policy makers in the area consider entrepreneurship as a factor that leads to increased economic performance? These questions inspired the research conducted for this thesis.

The investigated hypothesis is, therefore, as follows: entrepreneurship yields a positive, significant impact on regional economic performance in Central and Eastern Europe. To explore this hypothesis, this thesis will start with a rigorous analysis of theoretical frameworks that link entrepreneurship to measures of economic performance. The thesis provides a comprehensive map that guides the reader through the gradual inclusion of entrepreneurship in main economic growth models: from the neoclassical models, which left little room for the manifestation of entrepreneurship, to the knowledge spillover theory of entrepreneurship, which views new businesses as conduits of knowledge spillovers in the economy. The paper also reviews relevant empirical studies in the field, in order to understand the modelling procedures employed by scholars when investigating the relationship between entrepreneurship and economic performance. All these are to be found in Chapter 1 and are essential in order to gain solid knowledge of how entrepreneurship relates to measures of economic performance. This will also establish the base for the empirical study later developed in the paper. Next, the theoretical frameworks investigated in Chapter 1 are applied to the Central and Eastern European

[7] Entrepreneurs have no other source of income, thus form new businesses to support themselves
[8] Entrepreneurs actively pursue market opportunities, and choose to start a business as opposed to being employed by other firms (this form of entrepreneurship is more innovative)

area, in order to grasp the dynamics of entrepreneurial activities in the region and to examine the effect of start-ups and small businesses on economic outcomes, conditional of the particularities of the area. Chapter 2 incorporates this analysis at length. Finally, Chapter 3 contains an empirical study based on regression analysis aiming to measure the impact of entrepreneurship on economic performance, using data from Central and Eastern Europe. The study yields two main conclusions: at national level, given the heterogeneity of the data extracted from Central and Eastern Europe, the effect of entrepreneurship in hard to distinguish; at regional[9] level, the impact of entrepreneurship is clearly observed, due to a more discrete level of aggregation that better captures the nuances and variations of entrepreneurial activities in Central and Eastern Europe. Thus, a cross-sectional regression analysis is performed using regional data from the Eurostat database; the results indicate that entrepreneurship has a positive and statistically significant effect on the level of regional GDP. Moreover, the estimates show that this effect is enhanced by investments in research and development, as well as by the existence of a well-educated work force that engages in life-long learning activities. These findings are consistent with the theories analysed in Chapter 1, demonstrating that in Central and Eastern Europe entrepreneurship enhances macro-level economic performance by engaging educated individuals in creative business activities; in turn entrepreneurs recognize the commercial value of ideas generated through research and development and transpose them into products and services that cover existing market demand, or even expand that demand beyond current levels. As a result, Central and Eastern European policy makers should not ignore the role of entrepreneurship when designing mechanisms to enhance regional economic performance. The approach employed by this empirical analysis is novel, with regard to previous studies, in two primary ways. First, it examines newly available regional data provided by the Eurostat database, which is a first among previous analyses and assesses the impact of entrepreneurship at a more discrete level; second, it analyses entrepreneurship in a very specific area, Central and Eastern Europe, which breeds an economic environment shaped by its communist legacy. Finally, this thesis provides sound theoretical and empirical evidence of how economic performance is affected by a key element absent from the region's economic activity 25 years ago, but actively present today. The main contribution of this work lies, therefore, in its diligent

[9] Regions within counties

focus on the Central and Eastern European area, while examining entrepreneurship in a habitat that experienced tremendous economic transformations over the past two decades.

CHAPTER 1: FRAMEWORKS LINKING ENTREPRENEURSHIP TO MEASURES OF ECONOMIC PERFORMANCE. LITERATURE REVIEW.

Measures of economic performance encompass an array of indicators referring to economic growth (levels of GDP, growth of GDP), trade performance (share of exports in GDP) and levels of employment or unemployment. The indicators can be measured at country level or regional level, depending on the scope of the conducted research. The relationship between entrepreneurship and these indicators will be investigated in this chapter, with the aim of providing a theoretical framework and relevant literature review that will serve as base and context for the empirical model developed in the dissertation.

The theory in the field focuses mainly on drivers of economic growth. Over the past 70-80 years, many models of economic growth have been developed, yet their rapport with entrepreneurship varies. A good understanding of those is essential in order to be able to connect entrepreneurship to measures of economic performance. This chapter aims to provide a comprehensive map guiding the reader through various economic growth models and their relationship with entrepreneurship. As a result, I pinpoint the way scholarly attitudes towards entrepreneurship have changed over the years and gain solid theoretical background, which will be used in Chapter 3 to develop the empirical study of entrepreneurship in Central and Eastern Europe.

1.1 Entrepreneurship Then and Now. Theories of Economic Performance and Their Inclusion of Entrepreneurship

Acs and Szerb (2010) eloquently note that 'for over a century there has been a trend in economic activity exhibited in virtually every developing country toward larger firms' (p. 4). By contrast, in recent years an increasing attention has been directed towards new ventures and small enterprises, with scholars and policy makers challenging the conventional wisdom that corporations are the main drivers of innovation and economic growth. Countries finally experience a shift from the 'managed economy'[10] to the

[10] A system characterized by economies of scale, where large corporations are seen as key factors leading to higher economic performance

'entrepreneurial economy'[11] (Van Stel, 2005, p. 312), which reinforces the need to investigate the economic impact of entrepreneurship. Economic literature suggests that entrepreneurship leads to higher levels of economic performance by recognizing the commercial value of ideas developed in other organizations (private or public), by introducing innovations based on those ideas, by disrupting industries, challenging existing firms and enhancing competition. Still, empirical studies regarding entrepreneurship have been scarce up until 20 years ago and main economic growth models did not include entrepreneurship until recently.

There are many approaches to the study of entrepreneurship. Some scholars analyse it at the individual level, by looking at the behaviour, psychological traits and skills of entrepreneurs. A second group of scholars, such as Belitski and Korosteleva (2011a), Benáček and Michalíková (2010; 2011), Estrin et al. (2012), Hashi and Krasniqi (2010), Gries and Naude (2009), Radosevic et al. (2008), Spillan and Ziemnowics (2002), Audretsch and Mahmood (1995), Audretsch and Acs (1994), Audretsch (1991), analyse the impact of different factors on entrepreneurial activity, including business start-up levels, growth rates and survival rates of new ventures and small enterprises. These factors can be internal (gross capital returns per value added, human capital, in-house innovation, size, age and type of ownership) or external, referring to institutional characteristics (indexes regarding property rights, financial, monetary and business freedom), access to finance, industry-specific characteristics, technological conditions within industries, market characteristics, and degrees of urbanisation. A third category of papers, which is of particular interest to this study, investigate the way entrepreneurial activities enhance economic performance and come from works such as Acs et al. (2013), Acs et al. (2012), Acs (2006), Audretsch (2006), Audretsch and Keilbach (2004), Baumol (2014), Baumol (1968), Braunerhjelm et al. (2010), Mueller (2007), Naude (2013), Van Stel et al. (2005), Wennekers et al. (2005), Wennekers and Thurik (1999), Wong et al. (2005).

The process that lead to the inclusion of entrepreneurship within existing economic growth models is a fascinating one. Starting with the neo-classical models, where growth was seen as the result of hard input – labour and capital – and the exogenous effect of technological progress, growth models nowadays acknowledge entrepreneurship as a conduit of knowledge spillovers, as a source of creativity and innovation. In Wong

[11] A system in which knowledge replaces classic factors of production as the main source of competitive advantage; entrepreneurs facilitate enhance economic performance by facilitating knowledge spillovers

et al.'s (2005) perspective, mid-20th century is when 'entrepreneurship lost its lustre in the face of mounting evidence that large-scale production increased efficiency' (p. 337). The situation changed as the financial and debt crisis hit European countries, which prompted them to turn to authentic entrepreneurship as a solution for economic revival (Benáček and Michalíková, 2010). Entrepreneurs are ultimately agents of change, who can direct markets towards improved efficiency and unlock their creative potential. László et al. (2013) emphasize that entrepreneurs are most incentivised to challenge the status-quo, since they have least to gain from maintaining current market structures, as opposed to governments and larger firms who extract their rents from an already established dominating position. The globalization and digitalization of the modern world has shifted paradigms in labour markets (one can source potential employees from all over the world), in capital markets (the internalisation of finance has opened up new sources of finance for entrepreneurs) and in the way technology integrates with society. Entrepreneurs are now, more than ever, able to access resources that can help them build businesses with a potent impact on economic performance. This is the intuitive role of entrepreneurship, yet what role do economic growth models assign to it?

Schumpeter (1934) actively emphasized the role of the entrepreneur as an innovator and thus, as a driver of economic development. In his vision, new business ventures are 'new combinations' and 'the individuals whose function it is to carry them out we call entrepreneurs' (Schumpeter, 1934, p. 74). Moreover, the entrepreneur challenges existing firms by 'introducing new inventions that make current technologies and products obsolete' (Van Stel et al., 2005, p. 313). Thus Schumpeter recognized the importance of the creative aspect of entrepreneurship in generating innovative ideas, products and business solutions. Moreover, Schumpeterian entrepreneurship is 'a function of innovation opportunities, which are a key precondition for the generation of entrepreneurial rents, and their erosion through subsequent imitation processes' (Radosevic and Yoruk, 2013, p. 1017). This view of entrepreneurship is closer to current thought in the field. At the time, however, economic growth models failed to capture the economic contribution of entrepreneurship[12].

When looking at the corresponding literature and economic thought during the mid-20th century, Schumpeter's views stand out from the general theories of economic development. In the neoclassical model of Solow (1956), the entrepreneur is seen as an

[12] Van Stel et al. (2005) argue that it was because Schumpeter's views were too theoretical and less applicable through econometric models

agent that leads markets to equilibrium through his or her activities (Wennekers and Thurik, 1999). This makes the entrepreneur no different from any other economic agents. The capital-labour ratio is regarded as the main factor influencing economic growth. The model assumes perfect competition, lack of information asymmetries and an underlying pursuit of a general equilibrium. This leaves no room for 'creative destruction', for the innovative activity of entrepreneurs that Schumpeter was talking about (as opposed to Solow, Schumpeter believed that entrepreneurs distort the existing equilibrium). In Solow's model, the entrepreneur is a simple allocator of production factors, thus no difference can be made between the entrepreneur, the businessman and the manager. In this context, new businesses have the primary role of re-establishing equilibrium in the markets. 'The model is essentially an instrument of optimality analysis of well-defined problems […] which need no entrepreneur for their solution' (Baumol, 1968, p. 67).

In this context, Baumol et al. (2007) differentiate between 'growth by brute force' and 'smart growth' (p. 38). In the first case, economic performance is increased by additional inputs, such as labour and capital. This approach, however, doesn't take into account that over time, diminishing returns to scale reduce the potent impact of additional production factors. In the second case, economic performance is enhanced by innovation and technological advancements. Baumol et al. (2007) assert that this method 'can rescue an economy from diminishing returns' (p. 39). This is also a potential linkage between entrepreneurship and economic performance: through the creative drive of entrepreneurs, new products are developed, along with improved business processes, which increase productivity (positive effect on the supply side) and bring innovations to markets (better satisfy consumer demand or expand it by offering new products). As a result, businesses are able to generate more value added, which in turn, increases the economic performance at the macro level.

This way, as an improvement from the Harrod-Domar model[13], Solow (1956) observed that contributions made by additional units of labour and capital alone can't fully explain the dynamics of economic performance over time. After computing an equation that linked output to measures of capital and labour using data from the U.S. economy, Solow found that the estimated equation explained only 12.5% of the variation in output. This left room for an 'unexplained effect', which Solow named 'technical residual'. This effect further emphasised the importance of technological progress in

[13] The Harrod-Domar model (1934; 1946) explains economic growth only in terms of the ravings rate and productivity of capital

improving the performance of an economy. In the context of Baumol et al.'s (2007) reasoning voiced earlier, Solow recognised the importance of 'smart growth' and placed technological progress among factors enhancing economic performance. While this acknowledgement is very important, the major drawback consisted in the fact that the mechanisms behind technological progress remained unexplained. The 'technical residual' was considered an exogenous factor, not included in the model and 'beyond the reach of policy influence' (Acs et al., 2013, p. 760). This way, neoclassical economics investigated the existence of factors that lead to improved economic performance, but didn't inquire into the cause of their existence. This is an area where entrepreneurship could play a key role.

This gap in understanding economic factors was later addressed by the endogenous growth theory, developed through the works of Romer (1986; 1990) and Lucas (1988) and also associated with the knowledge production function. 'The Solow model, based on exogenously given technology within a closed economy and mass production, leaves a great amount of variation of growth rates unexplained and leads to question where these unexplained growth rates come from, if not falling from heaven' (Acs et al., 2013, p. 762). The endogenous growth theory identified knowledge as a factor that leads to technological progress, which in turn became an endogenous determinant of economic growth. As opposed to the traditional production factors, capital and labour, knowledge has the unique property 'to spill over for use by third-party firms' (Acs et al., 2012, p. 289). Romer emphasized the role of research and development in creating new knowledge, which in turn can be used to develop new products and services and generate more value added. Lucas underlined the importance of human capital, and identified entrepreneurial knowledge as a particular form of human capital. The shortcomings of the endogenous growth theory are as follows: it attributes a high importance to knowledge spillovers in influencing economic performance, but assumes that these spill overs occur automatically. At the same time, the theory focuses on innovation (measured by research and development activity and patents) and human capital as explicit determinants of economic growth. The effect of entrepreneurship remains an implicit factor, meant to be read between the lines.

Leibenstein (1968; 1987) views entrepreneurs as agents who bridge gaps across market and firm imperfections ('gap filling'). The author differentiates between entrepreneurs who act within organizations (allocating resources, designing processes in new and more efficient ways) and entrepreneurs who act outside of those organizations

(starting business ventures that commercialize new ideas and address opportunities arisen due to market imperfections). Leibenstein acknowledges the deficiencies of the production function (not all inputs are used to create outputs) and views entrepreneurs as agents who address the difference between the potential and the observed efficiency of a firm (called X-efficiency) by mobilizing resources and introducing more efficient processes: 'There are great gaps of knowledge about the production function. Points on the production function refer to well-defined inputs. To the extent that they are not completely defined in actuality, the entrepreneur must in some way make up the deficiency' (Leibenstein, 1968, p. 73). Moreover, the entrepreneur is also an 'input completer', by ensuring that a firm possesses all needed inputs to create marketable product. As a result, 'entrepreneurship is frequently a scarce resource because entrepreneurs are gap-fillers and input-completers and these are scarce talents' (Leibenstein, 1968, p. 75). The author also takes an interesting angle on the glorification of the 'innovative entrepreneur', by giving credit to the 'mundane, routine' entrepreneurship, that doesn't necessarily imply innovation, but that enhances economic performance by improving the efficiency of business processes due to profit-seeking motives.

In the theoretical frameworks discussed up till now, the linkage between entrepreneurship and macro-level economic performance is elusive (the role of entrepreneurship is implicit, rather than explicit). This is one of the main problems that this thesis is trying to solve. As Leibenstein (1986) eloquently points out, even if Schumpeter's praise of the entrepreneur as an agent of change has fascinated many scholars, micro and macroeconomic theory evolved without the inclusion of entrepreneurship in economic modelling. This blind spot concerning entrepreneurship can seem puzzling nowadays, but in the economies of the 20th century, a greater role was assigned to large firms rather than small and medium enterprises. It is only later (late 20th, early 21st century) that new ventures and small enterprises earned their recognition as drivers of economic growth. This doesn't mean that an economy formed solely out of small entrepreneurial firms is the best performing kind. For example, Baumol et al. (2007) emphasise that sustainable economic growth is promoted through a combination of both new ventures and big firms, with laws and regulations that promote healthy competition and create a setting conductive of both types of enterprises.

Given the endogenous growth theory discussed earlier, does knowledge spill over automatically? The knowledge spillover theory of entrepreneurship strongly suggests that

the answer is no. The endogenous growth theory incentivised governments and firms to spend more on research and development, as well as on developing human capital (formal education, public and private training). This course of action failed to produce positive results, as economies didn't perform better in terms of growth rates. Acs et al. (2012) mention the 'European paradox': many European countries invested in research and development and education, but these investments resulted in modest growth rates. This is a turning point where entrepreneurship plays a key role. While knowledge has the tendency to spill over, it cannot do so without having the appropriate channels set in place. Entrepreneurs become agents who take existing knowledge within firms, universities, and other research institutions and bring it to the market in order to create new or improved products, services and business processes.

The knowledge spillover theory of entrepreneurship was developed in order to capture the central role of entrepreneurship in the process of 'exploitation of intra-temporal knowledge spillovers not appropriated by incumbent firms' (Acs et al., 2009, p. 28). Ghio et al. (2015) put together a comprehensive guide regarding the emergence and evolution of this theory. Acs et al. (2013) further assert that entrepreneurs serve as conduits for knowledge spillovers and innovation, enhancing economic performance by using 'ideas that evolved from an incumbent organization but [are] commercialized independent of this organization via the creation of a new firm' (p. 758). The knowledge spillover theory of entrepreneurship treats new business formation as a source of innovation and creativity in the markets, which is closer to the Schumpeterian approach to entrepreneurship. This is specifically valid for the technology start-up sector of today, where entrepreneurs extract knowledge generated in universities and incumbent firms to create new ventures that disrupt industries. A notable example in this sense is Google: founders Sergei Brin and Larry Page met at Stanford as PhD students and developed the search engine as a research project within the university. The company was incorporated two years later, transforming the knowledge generated through research into a concrete product, used today by billions of people[14]. Thus, the power of entrepreneurship as an enabler of knowledge spillovers should not be underestimated. The example of Google proves that knowledge spillovers don't happen automatically: an increase in economic output didn't occur due to the fact that Stanford University conducted research into the field of computer science; it occurred due to the ambition of two entrepreneurs to create

[14] For further details, see: http://www.google.com/about/company/history/

a new firm that would commercialise products based on that research[15]. In this context, Acs et al. (2013) affirm that it is 'the potential of taking advantage of knowledge spillovers [that] creates the entrepreneurial opportunity, which then drives knowledge spillover entrepreneurship' (p. 759). Technology firms such as Google, Facebook, Twitter and Apple are not the only examples that support the knowledge spillover theory of entrepreneurship. The UK government is actively encouraging entrepreneurship as a measure of recovery from the economic crisis, with a strong emphasis on the development of Tech City London[16], which is an area with a high concentration of digital and technology start-ups. Amongst those, Aire[17], a financial technology company based in Tech City London, aims to reinvent credit scoring by analysing customers' behavioural patterns and general background[18] and bases its scoring algorithm on research conducted by University College London and Harvard. This way, by using ideas generated through research to build innovative financial services, the company acts as a conduit of knowledge spillovers. On a more general scale, business start-ups access knowledge created elsewhere, recognize the value of it, derive business ideas out of it and transform it into commercially viable products. In this case, 'the process of new knowledge commercialization through knowledge spillover becomes a key determinant of innovation and growth in industries and regions' (Acs et al., 2013a, p. 819). By exploiting new or existing knowledge, entrepreneurial ventures accommodate consumer demand with increased efficiency and a greater variety of products, challenging incumbent firms to match their offerings and become more competitive. In the long run, this strive to innovate and expand existing markets can only result in an increased performance of the overall economy (Baumol et al., 2007). This way, the knowledge spillover theory of entrepreneurship is an important step in acknowledging the economic role of new business ventures.

Acs et al. (2013) also speak about the importance of the 'entrepreneurial absorptive capacity', which corresponds to the entrepreneur's ability to understand knowledge, to recognize its importance and be able to turn it into a viable commercial idea (p. 768). This is where one of the most recent theories of entrepreneurship stems from. The creativity theory of knowledge spillover entrepreneurship emphasises the

[15] Carlsson et al. (2007) also discuss the growing importance of 'entrepreneurial activities of alumni' (p. 36) in facilitating the impact of universities on different industries
[16] For further details, see: http://www.techcityuk.com/investors/#tcl
[17] For more information about the company, see: www.aire.io
[18] As opposed to current credit scoring methods, which are mainly based on credit history

importance of human capital in entrepreneurial activities. A smart, well-educated entrepreneur with good business skills will be able to grasp complex ideas, value them and turn them into new products or services. Moreover, the theory singles out creativity as a particular form of human capital which, according to Audretsch and Belitski (2013), 'can earn higher than normal rates of returns' (p. 819). Moreover, as László et al. (2013) point out, creative people are more inclined to economic independence, which determines them to start a business more often than people who are not creative. Thus, creativity theory of knowledge spillover entrepreneurship asserts that human capital, and in particular, creativity, plays a determining role in the success of an entrepreneurial venture. A successful venture increases, in turn, the general output of an economy, leading to higher levels of economic performance.

It is also important to acknowledge that entrepreneurial activities don't take place in a vacuum and that linkages between institutions, entrepreneurship and economic performance should be thoroughly explored. Baumol (1990; 2008) and Baumol et al. (2007) extensively discuss the role of institutions in providing incentives for entrepreneurial activities. The quality of institutions determines the distribution of entrepreneurship between the productive, unproductive (rent-seeking activities) and destructive types (parasitic activities[19]). Baumol (1990) asserts that 'the exercise of entrepreneurship can sometimes be unproductive or even destructive, and that whether it takes one of these directions or one that is more benign depends heavily on the structure of payoffs in the economy – the rules of the game' (p. 899). This proportional arrangement further influences macro-level economic performance. Baumol et al. (2007) enumerate the prerequisites for a successful entrepreneurial economy. These comprise easy procedures to form a business, a well-functioning financial sector, flexible labour markets, good property and contract rights and institutions that reward productive entrepreneurial activities, as opposed to parasitic activities, as discussed above. Changing the structure of incentives in an economy is essential in order to reallocate entrepreneurial activity from unproductive to productive sectors.

In this context, Desai and Acs (2007) claim that highly corrupt institutions negatively affect the quality of entrepreneurship, determining firms to engage in rent-seeking activities rather than in the creation of productive businesses, which ultimately

[19] Assuming that N is the total number of entrepreneurs, these can be either running productive firms (α) or engaging in parasitic activities (1-α) (which extort productive firms or provide protection in exchange for money)

prevents economies from achieving higher levels of performance. Corruption has a stronger negative impact on new firms, as opposed to incumbent firms (Aidis et al., 2008). New firms don't dispose of the resources, networks and contacts to mitigate the effects of corruption and until they acquire them, they operate from a disadvantaged position (Estrin et al., 2012). Moreover, an institutional environment characterised by corruption exerts a negative effect especially on high growth aspiration entrepreneurship (László et al., 2013). This argument is also strongly emphasised by Estrin et al. (2012), who view corruption as a 'progressive tax, falling more heavily on entrepreneurs of sufficient scale to attract the attention of rapacious officials' (p. 8) and find a negative coefficient for corruption, highly significant in explaining variations in growth aspirations of entrepreneurial firms. Thus, given that research by Stangler and Litan (2009) views business start-ups as prime contributors to net job creation, stifling high growth aspiration entrepreneurship negatively affects macro-level economic performance. In addition, the importance of strong property rights is readily stressed by the institutional theory as well. Strong property rights reduce the risk of expropriation and thus, stimulate entrepreneurial activity. Moreover, rapidly expanding businesses need a flexible access to finance, thus strong property rights become instrumental in attracting new investors (Estrin et al., 2012). Belitski and Korosteleva (2011a) find that the property rights system is a strong determinant of self-employment rates across European cities. Finally, government activity also influences the intensity of entrepreneurial activities in an economy. For example, an overly active government may absorb key resources otherwise meant for entrepreneurs. An excessive bureaucratisation may discourage new firm formation due to complicated regulations and procedures. A generous welfare system may also reduce expected returns from entrepreneurial activities, making employment, rather than self-employment, more attractive. In this context, Estrin et al. (2012) and Belitski and Korosteleva (2011a) show that high tax rates and high levels of welfare protection negatively impact entrepreneurial activity, by raising the opportunity cost and minimising the expected returns of new business ventures. Thus, it is clear that the effect of entrepreneurship on macro-level economic performance is conditional of the institutional context in which new businesses are created.

Audretsch and Belitski (2013) refer to the institutional environment as 'the knowledge filter', corresponding to 'the regulatory barriers to entrepreneurship, bureaucratic constraints, entrepreneurial opportunities and culture [that explain] why some creative individuals might decide against starting up a business, even when in

possession of creativity' (p. 821). Acs et al. (2013) also emphasize the importance of circumstances in both the creation of knowledge in an economy and the manifestation of entrepreneurship. The heterogeneity of context is identified as a determinant of new knowledge creation and of entrepreneurs' ability to evaluate ideas, and act on those ideas when other organizations fail to do so. Attitudes towards risk, education, possession of business acumen and cultural attitudes towards entrepreneurship are also important in determining whether a new venture will be started or not. This is where the theory of intuitionalism combines with the knowledge spillover theory of entrepreneurship: institutions incentivise entrepreneurial activities and create the context in which entrepreneurship ca become a conduit for knowledge spillovers.

Acs et al. (2014), Rodosevic and Yoruk (2013) take an augmented approach to the institutional theory by analysing the system-level determinants and outcomes of entrepreneurship. Building on the existing Systems of Innovation theory, Acs et al. (2014) develop a Systems of Entrepreneurship theory, which places entrepreneurs at the centre of innovation-based economic development. The theory analyses the interaction between individual agency - such as the search and pursuit of entrepreneurial opportunities, the mobilisation of resources, the active decision-making process that shapes entrepreneurial outcomes - and the complex economic, social, and institutional context in which entrepreneurs operate. László et al. (2013) view entrepreneurs as agents of change, challenging the status-quo in a system where established organizations and institutions are not incentivized to do so. Radosevic and Yoruk (2013) treat entrepreneurship as a characteristic embedded in the innovation system, 'dependent on structural features of the economic system and on social processes and mechanisms' (p. 1016). In this case, opportunities are actively shaped by entrepreneurs and become endogenous systemic features, further explored through entrepreneurial experimentation. Moreover, entrepreneurship thrives on complementarities that arise from the positive interaction of institutional, market and technological opportunities. Finally, Acs et al. (2014) define systems of entrepreneurship as 'the dynamic, institutionally embedded interaction between entrepreneurial attitudes, ability, and aspirations, by individuals, which drives the allocation of resources through the creation and operation of new ventures' (p. 479). This interaction ultimately enhances economic productivity through the allocation of resources to efficient uses (Acs et al., 2014).

Table 1 summarises the trajectory of the inclusion of entrepreneurship in main theories regarding the determinants of macro-level economic performance.

Table 1. Theoretical frameworks linking entrepreneurship to measures of economic performance

Theory	Variables	Role of entrepreneurship
Solow	$Y^A = f(K^B, \mathbf{L}^C)$ + 'technical residual'	Minor: resource coordinator
Endogenous growth theory	$Y = f(K, L, \mathbf{A}^D)$	Implicit: contributor to accumulation of knowledge
Institutionalism	$Y = f(K, L, A, \mathbf{I}^E)$	Implicit: link between institutions and economic performance
Leibenstein	$Y = f(K, L, \mathbf{E_1}^F)$	Implicit: 'gap filling'
Knowledge spillover theory of entrepreneurship	$Y = f(K, L, A, I, \mathbf{E_2}^G)$	Explicit: 'mechanism that converts knowledge intro growth' (Acs et al., 2012)
Creativity theory of knowledge spillover entrepreneurship	$Y = f(K, L, A, I, \mathbf{E_3}^H)$	Explicit: with an emphasis on creativity and human capital
Systems of entrepreneurship	$Y = f(K, L, I, A, \mathbf{M}^I, \mathbf{T}^J, \mathbf{C}^K, \mathbf{E_4}^L)$	Explicit: entrepreneurship as endogenous systemic characteristic

[A] Output, [B] Capital; [C] Labour; [D] Knowledge; [E] Institutions; [F] Entrepreneurial activity, [G] Entrepreneurship; [H] Entrepreneurship, conditional of creativity; [I] Market opportunities; [J] Technologic opportunities; [K] Entrepreneurial culture and attitudes; [L] Systemic entrepreneurship

1.2 Review of Empirical Studies: Methodology, Results, Implications

Several empirical studies have been developed based on the theories discussed in the previous section of this chapter. This section will review the studies most influential for the research at hand, along with a description of data, variables, methodology used and a short presentation of main results.

Cumming et al. (2014) compare international datasets from which they extract different measures of entrepreneurship (The World Bank: new business density for 2004-2011; OECD: enterprise birth rates for 2004-2007; Compendia: business entry rates for

2004-2009). The authors regress four measures of economic performance, such as GDP per capita, unemployment, exports as share of GDP and patents per 1000 population, on entrepreneurship variables and control variables. The World Bank data and Compendia data show very strong support for the hypothesis that entrepreneurship positively influences the four measures of economic performance. While the OECD data is not consistent with these results, the authors point out that the OECD entrepreneurship variable is insignificant and can be overlooked in the light of such strong results from the other two datasets.

Acs et al. (2012) develop an empirical study based on the knowledge spillover theory of entrepreneurship. They extend the endogenous growth model to accommodate measures for entrepreneurship, using the function $G = f(A, R, E, \lambda)$. In this case, G represents GDP growth, A accounts for human capital (measured by the average years of schooling), R accounts for knowledge (measured by research and development expenditure), E incorporates the level of entrepreneurship (measured by the self-employment rate) and λ includes other variables that influence growth such as traditional production factors in the Solow model (capital and labour) and institutions (government expenditure as percentage of GDP). The impact of entrepreneurship on economic growth is tested using data from the OECD and World Bank databases, for a period from 1981 to 1998. The estimation results are consistent with theory: investments in human capital and research and development have a positive effect on economic growth. Moreover, growth relates positively to the extent of entrepreneurial activity in a country.

A similar methodology is employed by Audretsch and Keilbach (2004), who extend a traditional production function with measures accounting for knowledge creation and entrepreneurial capital. GDP levels of German regions are regressed on variables accounting for traditional production factors (capital, labour), knowledge creation (number of research and development employees) and entrepreneurship (new firm start-up rates) for a period between 1989 and 1992. The results indicate that entrepreneurship exerts a positive and significant effect on output levels across German regions. Mueller (2007) uses data for 72 West German regions between 1990 and 2002 to test the impact of entrepreneurship on GDP levels. The author extends the endogenous growth model beyond traditional production factors (capital, labour) and knowledge variables (research and development expenditure in the private and public sector) with entrepreneurship variables accounting for new firm creation in each region (number of start-ups). Both

knowledge creation and entrepreneurship are found to have a strong positive impact on economic performance. Galindo and Méndez (2014) employ a similar methodology using data from the World Bank and Global Entrepreneurship Monitor databases for 10 countries during the period 2001-2009. They regress GDP levels on variables accounting for entrepreneurship, innovation, human capital and private investment. The results strongly indicate that entrepreneurship increases economic performance by stimulating innovative activities.

The methodologies and results examined up till now are consistent with the endogenous growth theory, the knowledge spillover theory of entrepreneurship and the Schumpeterian view of entrepreneurship. So far, entrepreneurship has followed the self-fulfilling prophecy of having a positive impact on economic performance. Van Stel et al. (2005) examine entrepreneurship from a different perspective, by using the total early-stage entrepreneurial activity indicator from the Global Entrepreneurship Monitor[20] database. This indicator is different from the World Bank or OECD measurement of new firm rates and aims to capture the relative amount of nascent entrepreneurship in a number of different economies. The hypotheses tested are more daring than those in previous studies: the authors investigate whether entrepreneurship has the same effect in developed and developing countries, assuming that the latter category doesn't benefit as much from entrepreneurial activity. This paper is different from others reviewed up till now also because it uses the Growth Competitiveness Index as a proxy for the macro-level economic environment (thus not separate variables for capital, labour, institutions). This way, GDP growth is regressed on the total entrepreneurial activity indicator and the Growth Competitiveness Index, using data for 36 countries for 2002. The results point to a U-shaped relationship between entrepreneurship and economic development, indicating that there is a per-capita income threshold level beyond which entrepreneurship has a positive impact on economic growth. Moreover, entrepreneurship is found to have a significantly positive effect in rich countries and a significantly negative effect in poor countries.

[20] Further referred to in this section as GEM

Wong et al. (2005) also explore the GEM dataset, making a clear distinction between opportunity-driven[21] and necessity-driven[22] entrepreneurs and the way the two types impact macro-level economic performance. The empirical model uses GDP per capita growth as dependent variable and expands a traditional production function with measures for entrepreneurship and technological innovation. The entrepreneurship data is obtained from the 2002 dataset for a number of 37 countries. While the study doesn't find evidence that higher levels of total early-stage entrepreneurial activity lead to higher rates of economic growth, it does show, to some extent, that opportunity entrepreneurs have a positive effect and necessity entrepreneurs a negative effect on economic performance (although the coefficients are not significant, the direction of the relationship is according the description). A key conclusion is that high-potential entrepreneurship[23] exerts a significant, positive impact on economic growth, which is consistent with the hypothesis that start-ups with high growth aspirations are prime contributors to increased economic performance (Estrin et al., 2012).

Finally, Valliere and Peterson (2009) further explore the impact of different types of entrepreneurship on macro-level economic performance with a study based on the model developed by Wong et al. (2005). The authors examine data for 2004 and 2005, and run regressions separately for developed and developing countries. Explanatory variables correspond to the systems of innovation theory and the endogenous growth theory. These, along with variables accounting for entrepreneurship, are used to explain cross-country variations in GDP growth. The results indicate that in developed economies, high-potential entrepreneurship has a positive, significant impact on economic growth, while the effect of necessity-driven and opportunity-driven entrepreneurship is insignificant. The authors explain these results by stating that in developed economies, high-potential entrepreneurs have access to knowledge, a good regulatory environment and high quality human capital, which helps them impact economic performance in a more profound way than opportunity or necessity entrepreneurs. In emerging economies, economic performance is significantly affected by

[21] Entrepreneurs who 'claim to be driven by opportunity as opposed to finding no other option for work; and who indicate the main driver for being involved in this opportunity is being independent or increasing their income, rather than just maintaining their income' (GEM, 2015)
[22] Entrepreneurs who 'are involved in entrepreneurship because they had no other option for work' (GEM, 2015)
[23] Firms with high growth aspirations

the activity of necessity entrepreneurs, due to a contextual setting that isn't conductive of other types of entrepreneurship.

To conclude, the main goal of this literature and theory review was to gain a better understanding of the mechanisms through which entrepreneurship may impact economic performance. Moreover, this section aimed to provide an overview of methodologies employed by different scholars when modelling the effect of entrepreneurship on macro-level economic performance. The section also reviewed the variables used to measure different factors that affect economic performance, such as knowledge, entrepreneurship and innovation. This will be useful when developing the empirical study in Chapter 3. Next, it is important to place the theory and literature analysed in this chapter in the Central and East European context, it in order to understand how entrepreneurship has evolved in an area that was devoid of it for decades.

CHAPTER 2: ENTREPRENEURSHIP IN THE POST-COMMUNIST ECONOMIES OF CENTRAL AND EASTERN EUROPE

This chapter will argue that the manifestation of entrepreneurship in Central and Eastern Europe is different than in other regions of the world, due to the particularities of the area, and it is therefore imperative to be studied in depth, in order to derive useful policy recommendations. The communist regimes experienced by the Central and Eastern European countries influenced their economic development after 1990, and ultimately shaped the entrepreneurial opportunities and attitudes that arose once markets were liberalised. This chapter will also analyse entrepreneurship in Central and Eastern Europe through the lens of the theories discussed in Chapter 1. Transition economies can be regarded as real-life economic laboratories, where the impact of entrepreneurship on economic growth may be observed; before the experiment – the liberalization of the economy – entrepreneurship was little or non-existent; after the experiment was run, one can distinguish the manifestation of entrepreneurship in its different forms, along with its impact on economic performance.

2.1 The Initial Situation, Pre-experiment

The Soviet economic growth model was based on a massive mobilisation of labour (L) and capital (K), thus it can be associated with the Solow model of growth (Y= f (K, L) and exogenous technology, but absence of free market forces). The communist economies were biased towards the development of heavy industries, which particularly implied an orchestrated utilisation of capital, labour and technology. The defining characteristic of the Soviet system was, however, the abolition of the private sector and as a result, the elimination of the competitive structure of markets, which left entrepreneurship with little means for manifestation. As a result, one big firm dominated the economy: the state. Ageev et al. (1995) eloquently note that ‘the Party was the dominant depersonified entrepreneur, desperately balancing efficiency vs. power’ (p. 367). The Soviet doctrine advocated central planning as the recipe for economic and technological advancement. Hayek (2001) notes that central planning ‘contends, not that modern technique destroys competition, but that, on the contrary, it will be impossible to make use of many of the new technological possibilities unless protection against competition is granted’ (p. 53). As a result, the entrepreneur – defining element in

capitalist economies – was replaced by the glorified socialist worker, who applied herself through hard work to meet the established production quotas in a scheme 'where entrepreneurship was, to use computer terminology, not supported by the operating system' (Baumol et al., 2007, p. 65).

The inefficiency of the communist system lead to some reforms over the years regarding the expansion of the private sector. In Poland, for example, the communist authorities realised that a centralised system in agriculture was highly dysfunctional and allowed farmers to manage portions of land individually. In Hungary, the 1968 economic reform offered fairly extensive opportunities for private entrepreneurs. Moreover, a 'spontaneous privatization' process started in 1987, through which 150 companies restructured in order to maintain profitability due to the state's inability to help them financially. Yet these deviations from the central planning orthodoxy don't undermine the fact that entrepreneurs were personas non-grata in the communist economic system. Benáček and Michalíková (in press) argue that in hindsight the 'negation of entrepreneurship was among the primary causes of the demise of communism and its central command system' (p. 5). Can the validity of this affirmation be proved through the economic growth theories discussed in Chapter 1?

By suppressing entrepreneurship, central planning also deprived the economy of the creative forces that entrepreneurship normally supplies. It annulled the existence of the Schumpeterian entrepreneurs, whose job is to introduce innovations to the market through new or improved products and thus contribute to the creation of sustainable economic growth. This in turn led to a shortage of enterprises that could compete on innovation, as well as on service quality and product diversification. As a result, communist economies were defined by shortages and poor quality goods; their focus on heavy industries left an underdeveloped retail sector, which was unable to cater to consumer demand. In the early 90s, after the fall of the Berlin Wall, travelling from East to West meant a shift in paradigms: from constant shortages to fully stocked shelves; from poor quality and standardized consumer goods to a selection of brands that competed on quality, features and functionality. Thus, from a Schumpeterian point of view, the lack of entrepreneurship deprived communist countries of their competitive drive and their ability to diffuse innovation, leading to a dysfunctional economic system.

From the point of view of the endogenous growth theory, the communist countries in Central and Eastern Europe possessed the necessary stock of knowledge (A) in order to generate growth. The Soviet Union, for example, invested a lot in research and

development, and benefited from a large supply of human capital. The Soviet education system produced bright students, with a strong focus on mathematics and science, and universities were encouraged to pursue research activities. Thus, according to the endogenous growth theory (Y = (K, L, A)), knowledge should have spilled over in order to generate economic growth. This is where the knowledge spillover theory of entrepreneurship comes in useful. As Baumol et al. (2007) articulately explains, 'the countries belonging to the former Soviet Union and many of the Eastern European countries boasted some of the most successful primary, secondary and even higher-level educational systems in the world', yet these systems were 'embedded in a political and economic atmosphere that was the very antithesis of entrepreneurship' (p. 9). Even if the communist economies benefited from a generous supply of knowledge, there was no entrepreneurship to act as a knowledge spillover conduit. Since entrepreneurs are not inventors, but diffusers of innovation, they are able to recognize the commercial opportunity of an innovation and bring it to the market. The absence of entrepreneurship in the communist economies lead to the fact that many inventions were unable to traverse the gap between the research environment (science academies, universities) and the consumer market. Baumol (2008) also argues that the Soviet Union's 'superbly educated scientists and engineers contributed a surprising abundance of innovative technology, most of which was never put to use if it had no evident military purpose' (p. 7). Since military spending was a priority for the government, knowledge spilled over because the state acted as a conduit for it. Belitski and Korosteleva (2012) also argue that the Soviet education was extremely rigid and allowed 'limited opportunities for active learning' and 'discouraged critical thinking' (p. 12). This in turn affected human capital from an entrepreneurial point of view, producing students less able to create social networks and recognise market opportunities.

The fall of the communist system removed the previously existing restrictions regarding entrepreneurship. It also threw Central and Eastern European economies into a hectic transition process, for which they were scarcely equipped with the necessary capital, institutions, know-how or even realistic expectations. The way entrepreneurship manifested itself within this chaotic environment, and the way it evolved once the transition process was over, is what makes the subject so fascinating.

2.2 The Resulting Situation, Post-experiment

All Central and Eastern European economies experienced a boom in the number of new businesses after liberalisation (Aidis, 2005). Most of the new firms were established in the trade, services, manufacturing and construction sectors, mainly niche areas that were underdeveloped in the communist economies. Hashi and Krasniqi (2010) argue that small and medium enterprises were instrumental in the transition process due to their capacity to react rapidly to systemic shocks, as well as learn fast from the changing economic environment. They also provided employment opportunities at a time when state owned enterprises were undergoing privatization, thus absorbing a large proportion of the subsequent unemployment (due to a high proportion of workers in state owned enterprises being laid off). Small and medium enterprises also created competition for the state owned firms, ultimately ending their monopoly (McMillan and Woodruff, 2002) and creating competitive discipline within markets. Newly created private firms were also able to accommodate the unaddressed consumer demand with more flexibility. Moreover, they not only provided final consumption goods, but also inputs for existing firms, thus consistently covering gaps on the supply side (Winiecki, 2003). Benáček and Zemplinerovád (1995) also argue that micro, small and medium firms generated positive externalities for the rest of the society, thus they could be regarded as valuable public goods. Finally, they had the opportunity to import knowledge and technology from abroad in order to act as agents of change in the Schumpeterian sense (Musteen and Datta, 2011).

Two main types of entrepreneurs entered the market during the transition period. The first type of entrepreneurs covered short term opportunities that arose due to the specific economic conditions of transition. For example, they took advantage of problematic shortages in retail trade and supplied different kinds of goods and services to consumers. This type is associated with necessity-driven entrepreneurship, or replicative entrepreneurship, as defined by Baumol et al. (2007). It doesn't require a lot of creativity or knowledge yet it is key in bridging the gap between supply and demand at a time of uncertain economic conditions. While this type of entrepreneurship doesn't contribute to economic growth in a major way later on, it plays an important role at the beginning of the transition period. The second type of entrepreneurs refers to the Schumpeterian kind and is usually associated with later periods of transition. This type of entrepreneur goes beyond simple tradesmanship to include technological and organizational innovation in the process of building a business. It is also associated with opportunity-driven and

constructive entrepreneurship (Baumol, 1990; 2008). This kind of entrepreneurship plays an increasing role in the economic performance of Central and Eastern European countries as they move on to later stages of transition, by facilitating the diffusion of knowledge and technology within the economy. It also requires a different set of skills than the first type of entrepreneurship (more business acumen, better leadership skills, and ability to spot innovative business opportunities). These sets of skills were absent amongst the people educated in the communist system, thus the liberalization of the economy facilitated knowledge transfers from abroad and development of business-oriented training programmes, which encouraged opportunity-driven entrepreneurship. While many scholars in the field favour the role of the innovative entrepreneur over the redistributive entrepreneur, this author considers that both types played an important role in Central and Eastern European economies, helping them achieve macroeconomic stabilisation during the early stages of transition, as well as an increased economic performance later on. Hashi and Krasniqi (2010) also point out that many of the self-employed people during the early transition period were well educated. Thus, even if they became entrepreneurs due to necessity reasons, they could have easily turned into opportunity driven entrepreneurs at later periods of transition[24] (Aidis, 2005).

From the point of view of the endogenous growth theory, the legacy of well-educated human capital (in terms of tertiary education) and research centres continued in Central and Eastern Europe after the fall of communism (Aidis et al., 2008). Evidence regarding this is provided by Radosevic et al. (2008), who analyse entrepreneurial firms in Hungary, Czech Republic, Croatia, Poland and Romania, with data referring to 2006. The study shows that CEOs in these countries tend to be highly educated (a high proportion of tertiary education degrees), for example: 44% have PhDs in Hungary and 85% have Master's degrees in the Czech Republic. The paper also indicates that a high percentage of entrepreneurs originated from the business sector (68%) and the science and technology sector (25%). As Belitski and Korosteleva (2012) assert, the liberalisation process also made the Central and Eastern European education system more flexible, incorporating entrepreneurial education within traditional learning programs. In this case, there is potential for entrepreneurship to act as a mechanism of knowledge spillovers. Moreover, most of the entrepreneurs surveyed by Radosevic et al. (2008) were motivated by market opportunity when starting a business, which associates them with the

[24] Unfortunately, data regarding such conversion rates is not available, but it can represent scope for future research.

innovative type of entrepreneurship discussed earlier. Some entrepreneurs stated other reasons for starting a business, such as opportunities risen from the privatization process; this is a particular feature of post-communist economies. When asked to identify factors that lead to their success, small and medium enterprises pointed towards links with scientific organizations or the use of unique technologies, patents and licences. This way, entrepreneurship manifests itself in accord with the knowledge spillover theory of entrepreneurship, thus becoming a vital link between knowledge and economic performance in Central and Eastern Europe.

It is also important to understand the institutional context in Central and Eastern European countries, as it represents a particular problem in the area (this approach is consistent with institutionalism). As McMillan and Woodruff (2002) note, when policy makers envisioned the creation of the private sector, they focused mainly on privatizing stated owned enterprises, and not on the creation of new firms: 'little attention was given to what reform policies would foster entry' (p. 153). Thus, government support for small and medium enterprises varied across the Central and Eastern European countries. Some scholars, such as Boycko, Shleifer and Vishny (1995) cited in Berkowitz and DeJong, (2005), argue that rapid privatization had a positive impact on new business formation, since politicians didn't have incentives to 'harass new small businesses in an effort to protect state enterprises' (p. 32). In case of a longer process of privatization, workers, managers and politicians would 'collude in an effort to gain privatization rents' (Berkowitz and DeJong, 2005, p. 32). This incentivized politicians to discourage the entrepreneurial activities of emerging small firms, so they won't create competition for the larger privatized firms. As Benáček and Michalíková (2010) indicate, authentic small-scale businesses 'were often squeezed out of the space for rapid development by surviving, former state-owned enterprises (SOEs) that were converted to corporations owned formally by thousands of petty stock-owners and a thin class of insiders with dominant stakes' (p. 2).

The early transition period was characterised by the collapse of the old regulatory system, as well as by macroeconomic instability. This lead to an uncertain institutional environment. As Central and Eastern European countries faced problems with inflation and adopted a prudential monetary policy, small and medium enterprises encountered high costs of borrowing, along with a harsh fiscal policy aimed at stabilising national budgets through increased tax rates. These institutional aspects were hardly conductive of new business formation. Furthermore, new businesses faced complicated licencing

procedures (high fees, complex paperwork, and a long waiting period), frequent changes in laws and regulations, and a problematic access to finance, due to lack of credit history and collateral. Table 2 shows how the situation improved as countries moved to later stages of transition (data selected for Central and Eastern European countries that are currently in the European Union; earliest available year is 2003). While all countries have significantly different starting points, they follow a similar trend of decreasing the cost of business start-up. Bulgaria and Slovenia have showed the largest improvement, yet Czech Republic and Poland have improved the least (the cost of start-up procedures is the furthest away from the mean towards the highest values for these two countries and Hungary in 2013). Poland has the highest start-up costs in 2013, with a 5.9 standard deviation from the mean. Belitski and Korosteleva (2012) also find some empirical support for more flexible (and less costly) business regulations stimulating an increase in the number of small and medium enterprises in the CIS[25] area (using 1995-2008 data).

Table 2. Cost of business start-up procedures (% of GNI per capita)

Country	2003	2013	Percentage change
Bulgaria	10.4	0.8	-92
Croatia	16.3	3.5	-79
Czech Republic	10	8	-20
Estonia	8	1.4	-83
Hungary	40.4	8.3	-79
Latvia	10.1	3.6	-64
Lithuania	4	0.7	-83
Poland	21.3	12.9	-39
Romania	10.9	2.1	-81
Slovakia	9.4	1.5	-69
Slovenia	14.8	0	-92
Mean	**14.6**	**4.6**	**-79**

Data source: World Development Indicators, World Bank Database, 2015

As functioning market institutions were clearly scarce during the early years of transition, entrepreneurs resorted to developing and maintaining very good relationships with their trade partners in order to make up for non-existing contract enforcement laws. László et al. (2013) and Estrin et al. (2012) speak of the importance of such social

[25] Commonwealth of Independent States

networks. Unable to access a well-functioning finance sector, entrepreneurs also relied on credit received from their trade partners (e.g. deterred payment dates for the merchandise bought). In this case, ex-post moral hazard was mitigated through the high opportunity cost of breaking ties with business partners (most small and medium firms were conducting business in the same city or region, thus breaking ties with suppliers would have made them unable to find other ones). This way, the early period of transition is characterized by the informal nature of contract enforcement procedures, as well as an increased cost of shirking due to the limitations of the business environment.

At the same time, issues with weak property rights and weak contract enforcement laws lead to a rising share of unproductive and destructive entrepreneurship (see Baumol's unproductive vs. productive entrepreneurship reviewed in Chapter 1). This uncertain legal environment increased barriers of entry for new firms and the cost of doing business legally, and provided incentives of parasitic entrepreneurial activities. Corruption was also a serious issue during the transition period. New firms were required to make 'extra' payments to government officials in order to obtain business licences, or to avoid the expropriation of their profits (Aidis et al., 2008). According to statistics provided by McMillan and Woodruff (2002)[26], 90% of Russian managers vs. 20% of Polish managers had to make 'extra' payments to the government. Moreover, while 90% of Russian managers vs. 8% of Polish managers made payments to parasitic entrepreneurs (mafia) for protection.

Nonetheless, entrepreneurship managed to thrive in this hectic environment, which had none of the characteristics that Baumol et al. (2007) identified as conductive of an entrepreneurial economy, such as easy procedures to form a business, a well-functioning financial sector, well protected property rights, absence of rent-seeking behaviour, and incentives for innovation. On the contrary, as Berkowitz and DeJong note, 'entrepreneurs have thrived although […] their contracts have been poorly enforced; their taxes have been high and the regulations they faced have been burdensome; they have routinely been forced to make extra-legal payments to local mafias and government organs for protection; and they have had limited sources of external finance' (p. 26). Entrepreneurs were attracted by high profit opportunities and thus motivated to overcome any institutional difficulties. As Belitski and Korosteleva (2011b) indicate, 'institutional loopholes have created opportunities not only for destructive or unproductive

[26] The authors consider Poland as most successful in encouraging entrepreneurship, while Russia as least successful in encouraging entrepreneurship

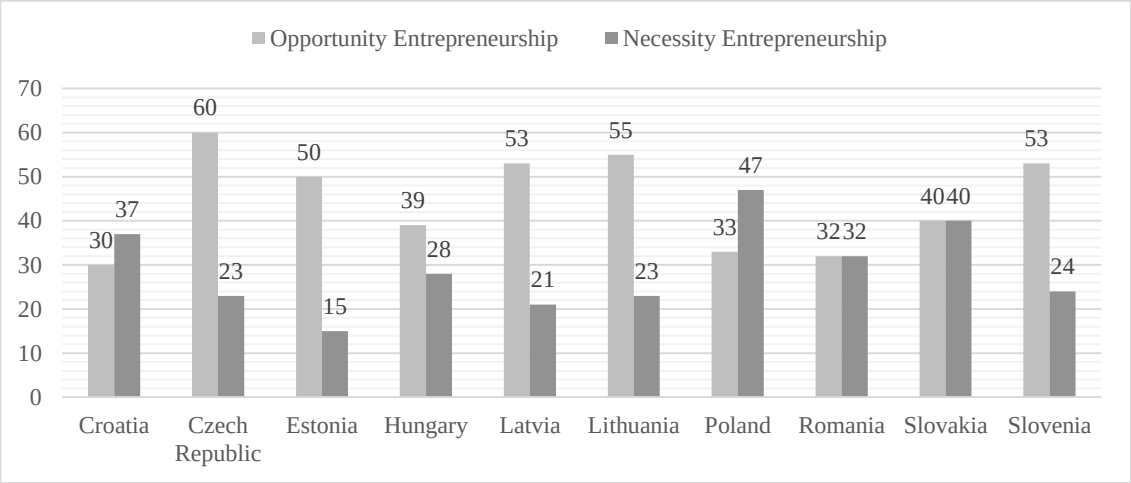
entrepreneurship to flourish, but they have also led to a surge in productive entrepreneurship' (p. 3). As a result, new businesses and small firms became instrumental engines of increased economic performance in the newly liberalised economies. Still, as the transition process continued, the complicated regulatory environment gradually lead to lower start-up rates, which was empirically demonstrated by Aidis et al. (2008). This leads to the conclusion that the development of new ventures and small businesses in Central and Eastern Europe resembled a serpentine, rather than a smooth road. This is what makes entrepreneurship in the post-communist economies of the area a special case.

As previously mentioned, at the beginning of the transition process, necessity entrepreneurship prevailed. Even if this kind of entrepreneurship is replicative (and not innovative), it has a key value in transition economies, as it becomes a means of diffusing market elements within previously command economic systems. Baumol et al. (2007) calls this 'rewarding imitation' (p. 111), a process than can affect macro-level economic performance in positive ways, even if it doesn't introduce first-time innovations. As countries moved towards later periods of transition (and out of transition all together), the amount of opportunity entrepreneurship increased as well. Let us round up this chapter by looking at the current entrepreneurship trends in Central and Eastern Europe. Figure 1 shows the proportion of necessity-driven entrepreneurs and opportunity driven entrepreneurs[27] for 10 Central and Eastern European economies in 2011[28].

[27] As a reminder, necessity entrepreneurship is defined as the percentage of nascent entrepreneurs who had no other option for work, while opportunity entrepreneurship is defined as the percentage of nascent entrepreneurs who seek being independent and increasing their income (GEM, 2015).

[28] The Global Entrepreneurship Monitor collected data for entrepreneurship in Central Eastern Europe at different times in different countries; e.g. Croatia, Hungary, Latvia and Slovenia have full time series available since 2005, Estonia has data available only for 2012, 2013, Czech Republic has data available only for 2006, 2011, 2013; Poland has data available only for 2011, 2012, 2013; a result, full dynamic analysis with this data is very hard to perform.

Figure 1: Opportunity vs. necessity entrepreneurship, % (2011)



Data Source: Global Entrepreneurship Monitor, 2015

The data reveals some interesting patterns. Czech Republic, Estonia, Latvia, Lithuania and Slovenia seem to be the countries with a strong discrepancy between the two kinds of entrepreneurship and most inclined to fostering opportunity-based entrepreneurship above the necessity type. In 2 countries, Romania and Slovakia, the shares of the two types of entrepreneurship are equal. Finally, in the next 2 countries, Croatia and Poland, necessity entrepreneurship prevails. This last observation doesn't seem to makes sense. Poland has been praised by scholars as a country conductive of entrepreneurship: its effective establishment of a well-functioning stock market in the early stages of transition enabled new businesses' access to equity and thus accelerated their growth; its government policies encouraged the activities of small and medium enterprises through tax incentives (McMillan and Woodruff, 2002). Yet if we look at Table 2, Poland has the highest cost of business start-up procedures as percentage of GNI per capita, which could be considered as an impediment for opportunity entrepreneurs to pursue their business ideas (necessity entrepreneurs don't have a choice, as they need to earn an income). The data presented here gives a static view of entrepreneurship (only for 2011), so perhaps a dynamic view would be more comprehensive. Appendix 1 contains all data available from GEM for opportunity and necessity entrepreneurship since 2005 in Central and Eastern Europe. Poland has very few entries unfortunately (2011-2013) and for all 3 years necessity entrepreneurship prevails. Perhaps this is a situation that resulted due to the financial crisis and the European sovereign debt crisis, and policy makers should direct their attention towards encouraging opportunity entrepreneurship. To make inferences regarding the validity of this statement, let us look at Croatia, which

displays similar patterns as Poland (more necessity entrepreneurs than opportunity ones in 2011-2013). Croatia's share of opportunity entrepreneurs has indeed plummeted considerably after 2010 (it was exceeding the share of necessity entrepreneurs before 2010). Given the fact that Poland doesn't have available data for those years, one can only infer that entrepreneurship in Poland followed a similar trend. The conclusion is, however, that for 2011 Central and Eastern European countries display contradicting patterns regarding the distribution of necessity and opportunity entrepreneurship. As a result, this data should be more closely investigated through a regression analysis, if possible (this will be further discussed in Chapter 3).

Finally, a report from the European Commission (Gagliardi et al., 2013) analyses the contribution of small and medium enterprises to measures of economic performance in the EU. Two aspects of economic performance are particularly investigated: employment and value added. For example, the report finds that small and medium firms have accounted for 66.5% of the employment in the private sector (financial sector excluded) and for 57% of the value added in 2012 (the service sector brought most of the contribution). The number of small and medium enterprises in the knowledge intensive services followed an ascendant trend in 2008-2012 (up by 6%), which reinforces the idea that entrepreneurship should be analysed through the perspective of the knowledge spillover theory of entrepreneurship. The report reveals, however, that there are contradicting trends within the economic performance of small and medium enterprises in Central and Eastern Europe (especially in the years following the financial crisis of 2008). For example, in 2012, in countries like Estonia and Latvia, small and medium firms experienced growth in both value added and employment, while in states such as Lithuania and Slovakia they registered growth in value added but a decline in employment. In a third group of countries, like Czech Republic, Hungary and Slovenia, small and medium enterprises experienced growth in employment and decline in value added, while in Bulgaria and Romania, both economic performance indicators were in decline. As the report indicates, 'the performance dynamics of SMEs at country-level have been variable since the beginning of the recession' (Gagliardi et al., 2013). Moreover, the performance of small and medium enterprises in countries such as Bulgaria, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania and Slovakia has been negatively affected by conditions related to the business environment, transparency of government and public administrations procedures during 2008 and 2009, and the recovery has been slow up to date. These aspects clearly indicate that there is a

large scope for further investigation of the relationship between entrepreneurship and economic performance in Central and Eastern Europe. As a result, research is further carried through a statistical analysis in Chapter 3, where an empirical model using multivariate cross-sectional regression is estimated, with data for 2010 and 2011. While the heterogeneity in the entrepreneurship data for Central and Eastern Europe poses some issues (as seen in this section as well), the empirical analysis derives valuable conclusions nonetheless.

CHAPTER 3: EMPIRICAL STUDY

Even if Central and Eastern European countries display certain similarities due to their communist past – mostly manifested through political and cultural paradigms – there are also significant outliers within the group, in terms of economic performance, such as GDP and unemployment levels, as well as institutional characteristics, such as quality of government and corruption (see Appendix 2). Moreover, as Chapter 2 eloquently shows, Central and Eastern European countries also differ in terms of business start-up costs and entrepreneurship levels. Due to these circumstances, providing evidence regarding the impact of entrepreneurship on economic performance in Central and Eastern Europe is a challenging task. The heterogeneity displayed by the countries in terms of economic performance indicators and business environment, as well as the restriction of the data sample to a specific area, lead to complications in the empirical analysis. Nonetheless, the empirical inquiry of this thesis has unearthed valuable conclusions, which expand existing academic views on the economic mechanisms that drive entrepreneurship and economic development in Central and Eastern Europe.

Conclusion 1: At the country level[29], entrepreneurship resembles a zero-sum game in the Central and Eastern Europe. When examining such a limited and specific set of countries, entrepreneurship is hard to observe at that level of aggregation. The differences between countries, complemented by the variances in entrepreneurial activities within the same country, lead to difficulties in deriving meaningful conclusions about the impact of entrepreneurship on economic performance[30]. Thus, understanding the economic role of entrepreneurship requires the decomposition of the phenomenon from national level to regional level[31].

Conclusion 2: At the regional level, the effect of entrepreneurship is observed more clearly[32] and the regression results yield a positive, significant impact on economic performance. Thus, regional policies encouraging new business formation should be

[29] This level of aggregation is considered higher than the regional level (regions within countries), which is followed by the metropolitan level (cities).
[30] At a country level, with data from Central and Eastern Europe only
[31] Regions in a certain country may have more in common with regions in another country, rather than with the rest of the regions in the initial country.
[32] László et al. (2013) argue that 'entrepreneurship is a regional process because the effect of determinants of entrepreneurship including access to resources for production, access to finance, and embeddedness in regional networks attenuate quickly with distance' (p. 13)

developed alongside those focusing on traditional factors of economic performance (such as capital investments).

To present the reasoning behind these conclusions, the analysis starts with (and focuses on) a cross-sectional regression analysis using data from Central and Eastern European regions at the NUTS-2 level[33], aiming to show that entrepreneurial activity exerts a positive impact on a region's economic output. On this regard, the first sub-chapter will include the derivation of the empirical model, the estimation methodology, assumption checks and finally, the economic interpretation of results. The second sub-chapter presents the experience from conducting a country-level panel data analysis and the reasoning regarding why an analysis with regional data is better.

This empirical study aims to contribute to economic research by expanding existing knowledge of entrepreneurship with regional data for Central and Eastern Europe. The research focuses only on this area and investigates the role of entrepreneurship in a habitat that metamorphosed from chronic denial of entrepreneurship to eager embracement of free market economic behaviour. Finally, the study accomplishes this task at a more discrete level of aggregation and explores statistics provided by the Eurostat regional database, which is a first, among previous studies.

3.1 Regional Level Analysis

Chapter 1 offers an extensive overview of the main economic growth models and their gradual inclusion of entrepreneurship as an additional factor influencing economic performance. Chapter 1 also acts as a prequel to the empirical analysis developed in this section of the thesis, by constructing a solid theoretical background. As a result, the empirical model studies the impact of new business formation on economic performance from the perspective of the knowledge spillover theory of entrepreneurship and follows the methodology employed by Acs et al. (2012), Audretsch and Keilbach (2004) and Wong et al. (2005), also reviewed in Chapter 1.

[33] The EU classifies the regions within a country at 3 levels: NUTS-1, NUTS-2, and NUTS-3. The NUTS-2 level was considered appropriate for this study because these are 'basic regions for the application of regional policies (Eurostat, 2015a) and Eurostat provides the most amount of data at this level. For more information, see: http://ec.europa.eu/eurostat/web/nuts/overview

The theoretical development of the model starts with a production function of the Cobb-Douglass specification form:

$$\mathbf{Y = A \times K^{\alpha} \times L^{\beta}\ (1)}$$

The production function is further augmented with measures for entrepreneurship and knowledge. In equation (1), output (Y) is determined by the available physical capital (K), labour (L) and total factor productivity (A). Next, the equation is transformed using natural logarithm on both sides:

$$\mathbf{\ln(Y) = \ln(A) + \alpha \ln(K) + \beta \ln(L)\ (2)}$$

Through the lens of the knowledge spillover theory of entrepreneurship, the total factor productivity is influenced by an economy's ability to create knowledge (thus generate new ideas and prototypes), its existing stock of knowledge (human capital) and its inclination towards entrepreneurial activity, which possesses the ability to commercialize the knowledge and innovations generated through research in a flexible and agile way. This can be expressed through the following equation[34]:

$$\mathbf{\ln(A) = B + \lambda\ ENT + \rho\ KNOW\ (3)}$$

In equation (3) B is the constant, KNOW stands for measures of knowledge (both knowledge creation and human capital) and ENT represents the entrepreneurial activity. By substituting (3) into (2), the following is obtained:

$$\mathbf{\ln\ (Y) = B + \lambda\ ENT + \rho\ KNOW + \alpha\ ln\ (K) + \beta\ ln\ (\ L)\ (4)}$$

This equation views entrepreneurship and knowledge as endogenous determinants of economic performance, which is consistent with the endogenous growth theory and the knowledge spillover theory of entrepreneurship. In equation (4), consider that Y represents the economic performance of a region, ENT includes a measure for entrepreneurship in that region, KNOW incorporates the two knowledge measures discussed before (knowledge creation activities and human capital), K stands for measures of capital stock, and L stands for measures of labour.

[34] The net outcome of entrepreneurial trial-and-error activities is 'the gradual allocation of resources towards increasingly productive uses, which will eventually drive up total factor productivity' (László et al., 2013, p. 12).

As a result, the empirical model used in this thesis has the following general form:

$$\textbf{Economic Performance}_i = \beta_0 + \beta_1(\textbf{Entrepreneurship measure})_i + \beta_2(\textbf{Knowledge measures})_i + \beta_3(\textbf{Capital measure})_i + \beta_4(\textbf{Labour measure})_i + \varepsilon_i \quad \textbf{(5)}$$

In equation (5), *i* refers to the EU NUTS-2 level regions within Central and Eastern European countries.

While the model is based on sound theoretical reasoning, what empirical implications will it have? The main hypothesis explored by this empirical study articulates that entrepreneurship should have a significant, positive impact on regional economic performance in Central and Eastern Europe. This hypothesis is investigated by conducting a cross-sectional regression analysis with OLS estimates at the regional level. The next sections of this sub-chapter gives a more detailed account of the chosen variables, of the estimation procedure, and a thorough interpretation of the results.

3.1.1 Description of variables

All data used in this study comes from the Eurostat database, which contains regional statistics for 56 NUTS-2 level regions of Central and Eastern European countries that have joined the European Union up to date. Table 3 gives an overview of the variables used, followed by a more detailed description.

Table 3: Overview of variables used in the regression model

Variable	Measure of	Unit	Further referred to as
GDP	Economic performance	Million Euros	GDP
Number of new businesses	Entrepreneurship	Single units	New businesses
R&D expenditure	Knowledge (creation)	% (of GDP)	R&D
Participation rate in education and training	Knowledge (human capital)	% (of total population)	Education
Gross fixed capital formation	Physical capital	Million Euros	Capital
Total employment	Labour	Thousand people	Employment

Economic performance is measured by the level of GDP in millions of euros. Given that the GDP is representative of the total economic activity in a certain region, it was considered to be a good measure of economic performance (approach consistent with Audretsch and Keilbach (2004)).

Measuring entrepreneurship is slightly more intricate. Entrepreneurship is a multifaceted phenomenon, thus there is no ultimate, perfect measure for it. As Audretsch and Keilbach (2004) note, 'measurement of entrepreneurship capital is no less complicated than is measuring the traditional factors of production [… and] invokes numerous assumptions and simplifications' (p. 953). Eurostat provides data on the number of new businesses at the NUTS-2 level, combined for the industry, construction and services sectors (except insurance activities of holding companies)[35]. This is a good measure of the level of nascent entrepreneurship, since it captures a region's inclination to create new firms. Data accounting for the number of new businesses is available for three years only: 2008, 2009 and 2010. Year 2010 is the best suited for extracting entrepreneurship data, since 2008 and 2009 contain a lot of missing observations, which would seriously reduce the size of the sample. The coefficient for the entrepreneurship variable is expected to be positive.

Two variables are used to quantify knowledge (as mentioned before, one accounting for knowledge creation and one accounting for human capital). The first variable is research and development expenditure (as % of GDP), which measures R&D intensity in a region and is consistent with the measure for knowledge used by Acs et al. (2012). R&D intensity is considered by Eurostat as the main driver of innovation, defined as 'creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this knowledge to devise new applications' (Eurostat, 2015b). This definition clearly places R&D among the key determinants of a region's capacity to create knowledge, which makes R&D expenditure a good measure for knowledge creation in this empirical model as well. The second knowledge variable is the participation rate in education and training. This variable is considered by Eurostat to be a measure of life-long learning activities and it stands for human capital in this empirical model. This measure has an advantage over the simple rate of tertiary education enrolment, since it encapsulates the way the quality of human capital is enhanced even

[35] In this category Eurostat comprises the total number of new firms created within a region

after leaving formal education, capturing a society's propensity for life-long education. The signs of the coefficients for both R&D and education are expected to be positive.

Capital is measured by gross fixed capital formation in millions of euros and represents investments in fixed assets made by producers who reside in a certain region. This measure for capital is used by Wong et al. (2005) and Acs et al. (2012). Labour is measured by the total employment in a region in thousands of people and is defined by Eurostat as 'the number of people engaged in productive activities in an economy' (Eurostat, 2015c).

Finally, Audretsch and Keilbach (2004) suggest that using lagged values for entrepreneurship helps avoid, to a certain extent, the simultaneity[36] between entrepreneurship and output. Taking into account this suggestion, two sets of models were designed: Models 1-2 are estimated using data for 2010 for all variables (no lagged values), while Models 3-4 are estimated using 2010 data for entrepreneurship and 2011 data for the rest of the variables[37] (thus the values for new business formation are lagged). This arrangement helps to control for simultaneity and also check the robustness of the results by using data for two different years.

Model 1: $\text{GDP}\ (2010)_i = \beta_0 + \beta_1 \text{New businesses}\ (2010)_i + \beta_2 \text{Capital}\ (2010)_i + \beta_3 \text{Employment}\ (2010)_i + \beta_4\ \text{R\&D}\ (2010)_i + \varepsilon_i$

Model 2: $\text{GDP}\ (2010)_i = \beta_0 + \beta_1 \text{New businesses}\ (2010)_i + \beta_2 \text{Capital}\ (2010)_i + \beta_3 \text{Employment}\ (2010)_i + \beta_4 \text{R\&D}\ (2010)_i + \beta_5 \text{Education}\ (2010)_i + \varepsilon_i$

Model 3: $\text{GDP}\ (2011)_i = \beta_0 + \beta_1 \text{New businesses}\ (2010)_i + \beta_2 \text{Capital}\ (2011)_i + \beta_3 \text{Employment}\ (2011)_i + \beta_4 \text{R\&D}\ (2011)_i + \varepsilon_i$

Model 4: $\text{GDP}\ (2011)_i = \beta_0 + \beta_1 \text{New businesses}\ (2010)_i + \beta_2 \text{Capital}\ (2011)_i + \beta_3 \text{Employment}\ (2011)_i + \beta_4 \text{R\&D}\ (2011)_i + \beta_5 \text{Education}\ (2011)_i + \varepsilon_i$

[36] Simultaneity appears in the case when not only entrepreneurship influences output, but also output influences the amount of new businesses in a certain region: 'the argument would imply that entrepreneurs move to locations where economic performance is high' (Audretsch and Keilbach, 2004, p. 954).

[37] Simply using data for entrepreneurship for 2009 and keep the rest of the data for 2010 is not a feasible approach because 2009 entrepreneurship data is of bad quality (contains a lot of mission variables)

3.1.2 Descriptive statistics and preliminary analysis

Comprehensive analyses start with a good understanding of the data, thus it is essential to inquire into the characteristics and the quality of the dataset at hand. Table 4 reports summary statistics for the data used in the model.

Table 4: Summary statistics

Variable	Obs.	Mean	Standard deviation	Min	Max
2010					
GDP (million EUR)	56	17266.27	12838.75	2586	79053
New businesses	52	12724.62	9421.737	2533	50322
R&D (% GDP)	56	.7171429	.5451963	.13	2.65
Education (%)	52	4.303846	3.429684	.7	18
Capital (million EUR)	49	3811.814	2701.491	402.2	14193.8
Employment (thousands)	56	845.1589	427.34	336.6	2473.8
2011					
GDP (million EUR)	56	18071.2	13486.9	2732	82930
R&D (% GDP)	56	.8001786	.6438506	.11	3.1
Education (%)	52	4.775	4.157058	.8	18
Capital (million EUR)	48	4087.756	2872.711	415.1	14292.1
Employment (thousands)	56	839.9446	438.6	326.3	2566.7

As seen above, data for the number of new businesses is available for 52 regions (thus not all 56 NUTS-2 regions). Capital is most underrepresented is this dataset, with only 49 observations available in 2010 and 48 observations available in 2011. Education is also recorded only for 52 regions. As a result, the number of observations used in the regression analysis is limited to 43-45 in Models 1-4. It is important to acknowledge and keep in mind this deficiency of the dataset at hand. Missing variables decrease the quality of the data and exclude observations that could have impacted the final estimates.

Examining the minimum (2533) and maximum (50322) values for the number of new businesses, it can be noticed that there is a great amount of variation within the data (some regions have very low levels of entrepreneurship, others have a very high level of entrepreneurship, with a standard deviation of 9421.737). To inspect the number of new businesses by regions, Appendix 3 includes a table with regions ordered by their level of entrepreneurship. Appendix 3 reveals that Polish and Czech regions are most entrepreneurial, while Romanian and Bulgarian ones are the least entrepreneurial. Furthermore, regions within the same country differ drastically by the level of new

business formation, while they display similarities with regions in other countries. For example, CZ01 and HU10 regions are similar, while HU10 and HU33 differ significantly by the level of new business formation. This provides further support for the idea that an analysis by regions, rather than countries, is more effective, because the manifestation of entrepreneurship can be observed at a more discrete level, thus more meaningful inferences can be made.

Next, it is important to inspect the relationships between the dependent variable (regional GDP) and the independent variables (new businesses, R&D, education, capital and employment). A correlation matrix of these variables, which gives an overview of the nature of the relationship among them, can be found in Appendix 4. There is a positive correlation between all explanatory variables and the dependent variable, which is in accord with the initial intuition and hypotheses, and should yield positive coefficients for the variables in the regression analysis. It is also important to ensure that the independent and dependent variables display at least a generally linear relationship. In order to do so, the variables for GDP, capital and employment have been transformed using natural logarithm. The linearity of relationship is graphically represented through scatterplots of GDP and explanatory variables (GDP on the y-axis and new businesses, R&D, education, capital and employment on the x-axis). Appendices 5a and 5b contain the respective graphs. The graphical representation of the relationship between the dependent and independent variables indicate that there is a linear, positive relationship in all cases. In both 2010 and 2011, there is a strong positive relationship between the number of new businesses and GDP, which is again in accord with the initial intuition, presented in the previous section.

3.1.3 Testing the OLS assumptions

In order to make sure that the regression results are interpretable, and can be used to draw economic conclusions, it is important to test the underlying OLS assumptions. Table 5 contains an overview of the main tests performed and their associated results, which will be further discussed in the following text. The full snapshots of the test results performed in *Stata* are to be found in Appendix 6.

Table 5: Tests for OLS assumptions

#	Test	Model 1	Model 2	Model 3	Model 4
1	Breusch-Pagan / Cook-Weisberg test for heteroskedasticity (Prob > Chi^2)	0.9234	0.2586	0.8527	0.9469
2	Pr(Skewness) and Pr(Kurtosis) of residuals	0.3730	0.7846	0.3496	0.3972
3	VIF for multicollinearity	2.42	2.86	1.86	2.80
4	Ramsey RESET test for omitted variables (Prob > F)	0.0744	0.3270	0.1717	0.1682

First, it is essential to investigate whether heteroskedasticity is present or not. Heteroskedasticity is a problem when the variance of errors is not homogenous. This is a violation of the OLS assumption concerning homoscedastic residuals. To detect whether heteroskedasticity is present or not, the Breusch-Pagan / Cook-Weisberg test is performed in Stata using the command *hettest*. The test inspects if the null hypothesis *H0: constant variance in errors* can be rejected or not. The statistical results of the test are found in first row of Table 5. In all for cases, Prob > Chi^2 is higher than 0.05, which leads to the conclusion that the null hypothesis can't be rejected and that the variance of errors is homogenous (thus heteroskedasticity is not a problem).

The results of the Breusch-Pagan / Cook-Weisberg test are reinforced through the visual inspection of residual plots. Evidence of these graphs can be found in Appendix 7. The plotted residuals appear to have a slight conic shape towards the end of the graphs on the right side, but this does not show a strong case of heteroskedasticity. After visually analysing the variance of errors, and taking in consideration the results of the previous test, the conclusion is that correcting for heteroskedasticity is not necessary.

Another important assumption is that the residuals are normally distributed. This implies that the dependent variable (GDP) should fall, on average, on the regression line for the models to be applied correctly. In order to inspect the normal distribution of errors, the *sktest* for skewness and kurtosis was performed in Stata, which tests whether the null hypothesis *H0: Residuals are normally distributed* can be rejected or not. The statistical results of the test are shown in the second row of Table 5. These clearly indicate that the joint probability of Pr(Skewness) and Pr(Kurtosis) is higher than 0.05 for all four models and lead to the conclusion that the null hypothesis can't be rejected, thus the residuals are normally distributed in all four cases. Again, to provide further support to this claim, a

visual examination of the distribution of errors is required. Appendix 8 contains the histograms for the residuals of each model. In all four graphs, the shape of normal distribution is unmistakably observed, which leads to the conclusion that indeed, the errors are normally distributed and this OLS assumption is successfully met by the models developed in this analysis.

To inspect potential issues with multicollinearity, the variance inflation factors (VIF) have been computed for each variable included in the models (as well as a combined value for each model as a whole). The VIF figures are shown the third row of Table 5. All of the values are lower than 10, which is a generally accepted cut-off point. This leads to the conclusion that multicollinearity is not an issue in all four models.

Finally, to check the models for specification errors, the command *ovtest* in Stata performs the Ramsey (RESET) test for omitted variable bias and tests whether the null hypothesis *H0: No omitted variable bias* can be rejected or not. Evidence regarding the results of this test are shown in the fourth row of Table 5. All models indicate the absence of omitted variable bias, due to the fact that Prob>F is higher than 0.05 in all four cases. This means that the null hypotheses cannot be rejected and that the models are specified correctly.

All the tests and visual inspections performed in this section indicate that Models 1-4 satisfy the OLS assumptions and the regression estimates are theoretically unbiased. It is, therefore, safe to move on to the next section, in order to present and economically interpret the results of the regression.

3.1.4 Regression results and economic interpretation

What does the empirical study reveal about the relationship between entrepreneurship and economic performance in Central and Eastern Europe? According to the original intuition, entrepreneurial activity is expected to exert a positive and significant effect on economic performance, especially due to entrepreneurs' ability to diffuse knowledge, to recognize business opportunities, to create start-ups that foster competition and thus explore yet untapped consumer demand. How do the regression results relate to these expectations, given the dataset restricted to Central and Eastern Europe? The answers to these questions are found in Table 6, which reports the sets of estimates for each of the four models.

Table 6: Cross-sectional regression results

Dependent variable: GDP (ln)	**Model 1**	**Model 2**	**Model 3**	**Model 4**
	Current entrepreneurship data		Lagged entrepreneurship data	
Constant	2.234*** (.377)	2.112*** (.4046)	3.140*** (.4001)	3.047*** (.4764)
New businesses[38]	**.8629***** **(.3087)**	**.8219**** **(.3054)**	**1.4374***** **(.3375)**	**1.4142***** **(.3531)**
Capital (ln)	.6436*** (.0522)	.6095*** (.0532)	.7382*** (.0530)	.7462*** (.0589)
Employment (ln)	.2998*** (.0643)	.3559*** (.0675)	.0413 (.0535)	.0457 (.0572)
R&D (% GDP)	.1224** (.0457)	.0283 (.059)	.0430 (.0406)	.0321 (.0730)
Education (%)		.0214** (.0093)		.0017 (.0106)
N (number of regions)	45	43	44	43
Prob > F	0.0000	0.0000	0.0000	0.0000
Adj R-squared	0.9607	0.9601	0.9504	0.9405

*** denotes significance at 5% level; **** denotes significance at 1% level; coefficients are reported as the first figure, standard errors are reported as the second figure in parentheses*

For all 4 Models, the F-test has a very small associated p-value (0.0000 < 0.05). An insignificant F-test rejects the null hypothesis *H0: Coefficients are jointly equal to 0*. This indicates that the independent variables (new businesses, R&D, capital, employment and education) can be jointly used to reliably explain the regional levels of GDP in Central and East European regions. The models are therefore significant overall and the choice of explanatory variables is justified statistically as well, not only theoretically.

The adjusted R^2 statistic for each model is also reported by Table 6. All the R^2 values are high, over 90%, which indicates that the models have a good explanatory power (the independent variables explain at least 90% of the variation in the dependent variable).

[38] Variable divided by 100.000

The adjusted R^2 was chosen over the simple R^2, because it provides a more honest statistic, removing the increase in R^2 that occurs simply by adding more variables to the model (which is the case in Model 2 and Model 4).

Models 1-4 successfully manage to explore the intuitive relationship between the dependent and independent variables and investigate the validity of that intuition. So far, the signs and significance of the coefficients are consistent with intuition and in conformity with the initial hypothesis of this study. The estimation results point to some interesting observations. In Model 2, education crowds out the effect of research and development, which indicates at that a regional level, in Central and Eastern Europe, increments in human capital have a more significant impact on economic performance than research and development activities. In Model 3 and 4, employment, R&D and education become insignificant, while the lagged values of entrepreneurship take over their significance and explanatory power in the model.

In all four models, entrepreneurship (represented by the number of new businesses registered in a region, both current and lagged values) plays an important role as an economic factor leading to higher levels of GDP within the NUTS-2 regions in Central and Eastern Europe. The coefficient for new businesses is significant at 1% level in Models 1, 3 and 4 and at 5% level in Model 2. This is in accord with the endogenous growth theory and the knowledge spillover theory of entrepreneurship, which postulates that new business formation facilitates knowledge spillovers within the economy. As a result, entrepreneurs contribute to increased economic performance by recognizing the commercial value of ideas generated through research and bringing them to the market through the form of new (or improved) products and services. The strongly significant and positive coefficients for entrepreneurship in all four models demonstrate that entrepreneurship is indeed a valuable contributor to economic performance in Central and Eastern Europe. EU policies also exert a strong focus on entrepreneurship, considering new businesses along with small and medium enterprises key factors leading to economic recovery and growth[39]. This approach in policy is justified by the results from this cross-sectional regression analysis, which suggest that improving a region's inclination towards new business formation leads to an increased economic performance of that region. Using lagged values for the variable 'new businesses' in Models 3 and 4 reinforces the conclusion that entrepreneurship is a salient contributor to economic performance in

[39] The Small Business Act (2008) views small and medium enterprises as 'providers of employment opportunities and key players for the wellbeing of local and regional communities' (p. 2)

Central and Eastern Europe. The coefficients for the entrepreneurship variable remain positive and statistically significant, which is an indication that the results are robust. Moreover, the increased value of the coefficients for new businesses in Models 3 and 4 lead to the conclusion that lagged rates of entrepreneurship have a stronger impact on the levels of GDP. Businesses that were formed in the previous time period already had the opportunity to conduct activities that generate an added economic value, thus the larger coefficients in Models 3 and 4 are entirely justified. The positive sign and strong significance of the coefficients for the 'new businesses' variable in all four models indicate that entrepreneurship is a key factor in explaining variations in output across NUTS-2 level regions in Central and Eastern Europe, a result which is consistent with conclusions drawn by Audretsch and Keilbach (2004) and Acs et al. (2012) (only these authors conducted an analysis of German regions and OECD countries, respectively).

The coefficient for R&D is positive in all four models, which indicates that the intuitive direction of the relationship between R&D activities and economic performance is confirmed through the current study. This is also in accord with the endogenous growth theory, which suggests that knowledge creation activities, such as R&D, relate positively to economic performance. How significant is this relationship in the models developed in the current paper? The coefficient for R&D is significant only in Model 1, while in Models 2, 3 and 4 it is crowded out by the effect of human capital, as well as by the effect of lagged values for new businesses. Does that indicate that investments in R&D activities are not justified? Surely, no. One explanation of the insignificant coefficients would be that research alone can't lead to higher levels of economic performance, unless it is filtered through the commercial lens of entrepreneurship, which transforms it into products that satisfy consumer demand in new (and improved) ways. As seen from Table 6, the strong significance of the 'new businesses' variable indicates that entrepreneurship can take on the special role of filtering knowledge and linking it to higher levels of GDP. Another explanation would be that, given the fact that this analysis is conducted at regional level, it is safe to assume that not every region in Central and Eastern Europe has the capacity to invest in extensive R&D activities. Thus the insignificance of the coefficients may be due to the fact that in such close quarters, like neighbouring regions within a country or between countries, knowledge may spill over from one region to another. As a result, research generated strictly in one region may not have a significant impact the associated level of GDP, since the positive spillover effect of research comes from another region. Again, the significant coefficient of entrepreneurship indicates that

new businesses may act as knowledge spillover conduits between regions, and not necessarily within the same region[40].

The second measure of knowledge, human capital (represented here through the participation rate in education and training), also has a positive impact on economic performance. The direction of this relationship is in accord with intuition and consistent with the endogenous growth theory, indicating that an educated population, actively engaged in learning, leads to higher levels of GDP. The coefficient for education is significant in Model 2 at a 5% level, yet this significance is crowded out in Model 4 by the effect of lagged entrepreneurship values. Nonetheless, these results point to the clear role of education in fostering increased regional economic performance in Central and Eastern Europe. As mentioned in Chapter 2, countries in Central and Eastern Europe are have a strong human capital potential, due to a strong tradition of tertiary education established during their communist past and actively shaped during the post-communist period. Supporting the development of this human capital after leaving formal education is also very important. This conclusion is certainly supported by the positive, significant coefficient for education in Model 2. At a regional level, increasing the participation rate in education and training implies creating and investing in training centres, supported by agents in both public and private sectors. Educating the labour force in their chosen career and informing employees about changes and improvements that happen in their field leads to increased performance at work, which in turn leads to higher turnover at the firm level and as a result, to higher economic performance at the regional level. This observation has special implications for Central and Eastern Europe: due to the strong tradition of tertiary education, life-long learning somehow acquired less importance. Moreover, the tertiary education system is criticized for not being able to adequately prepare students for their future careers. Thus, the results in Model 2 suggest that an emphasis on promoting life-long learning may be a solution to this problem. Life-long learning increases the quality of human capital engaged in the labour force, enabling people to pursue careers in fields that are not necessarily related to their degree, thus facilitating knowledge spillovers between economic sectors. Radosevic et al. (2008) reviewed in Chapter 2 also indicate that most of the entrepreneurs in Central and Eastern Europe come from the business sector (68%). From this perspective, increasing life-long learning may lead to more successful new businesses. How? A simple explanation is that

[40] The intuition in this case is that spillovers between regions can occur more frequently than spillovers between countries, due to the more discrete level of aggregation

training and education opportunities for employees in the business sectors lead to an increased quality of human capital. As Acs et al. (2013) and Belitski and Korosteleva (2011b) reviewed in Chapter 1 indicate, people who possess more business acumen are more likely to start and sustain a successful business (which will then further lead to increased economic performance at the macro-level). Investing in education and training for the labour force in the business sector in Central and Eastern Europe leads, therefore, to an increased business acumen of future entrepreneurs. This, in turn, facilitates more successful business ventures and finally, higher levels of regional GDP. In this case, entrepreneurship acts again as a conduit for knowledge spillovers and as a link between investments in education and higher levels of economic performance. As seen in Model 2, education crowds out the effect of research and development. This behaviour is entirely justified, pointing to the conclusion that in Central and Eastern Europe, at a regional level, increasing the quality of human capital can have a more potent impact on economic performance than investing in research, since human capital is more closely related to entrepreneurship capital; educating a business mind-set among the labour force leads to more successful new businesses, which in turn leads to higher levels of GDP.

Capital, traditional economic growth factor in the Solow model, displays a positive impact on GDP, which is consistent with economic intuition and theory. Moreover, the variable is strongly significant (at 1 % level) in all four models, remaining significant in Models 3 and 4 as well, where the significance of other variables is overtaken by the impact of the lagged values for entrepreneurship. Capital has a higher impact on the level of GDP than labour (employment), which is a characteristic of post-communist economies, where new capital is more efficient. Given that post-communist economies are still developing, capital has a potent impact on economic performance, as new fixed assets increase production capacities and offer development facilities for businesses (that were not in place before). The coefficient for capital remains generally stable across all four models, which means that a 1 % increase in capital will lead to at least a 0.6 % increase in GDP. Labour, second factor in the Solow model, is represented here by the level of employment and has a positive impact on GDP. This result is also in accord with theory and intuition. Employment has a significant coefficient (at 1% level) in models 1 and 2 only, while in models 3 and 4 it becomes insignificant. Nonetheless, by looking at the first two models, it is safe to conclude that increasing the level of employment by 1% will lead to at least a 0.2 % increase in GDP. Capital and labour

(employment) have higher coefficients than other predictor variables, which makes them the dominant factors in the production function (which is in accord with theory).

Overall, the models developed through the empirical study yield results that support the knowledge spillover theory of entrepreneurship. The strongly significant and positive coefficients for entrepreneurship (both current and lagged values) point to the conclusion that entrepreneurship acts as a conduit of knowledge spillovers in Central and Eastern Europe. New businesses are able to appreciate the commercial value of knowledge created through research and transform it into products and services that can be used by end consumers. Moreover, entrepreneurship makes use of high quality human capital to build successful business processes, which ensure the economic sustainability of new firms. In these ways entrepreneurship ultimately enhances economic performance in Central and Eastern Europe. The study also reveals the importance of encouraging the development of high quality human capital, in addition to research and development activities, in order to increase regional economic competitiveness.

3.1.5 Limitations

The models developed in this study have both strengths and weaknesses. They are based on a sound theoretical background and analyse a yet unexplored dataset to derive conclusions about the impact of entrepreneurship on economic performance in Central and Eastern Europe. All four models have a good explanatory power, as demonstrated at the beginning of the previous section through an analysis of the p-value associated with the F-test and the adjusted R^2 value. Moreover, the coefficient of the variable accounting for the level of new businesses formation in each NUTS-2 region is significant across all four models, and the results remain robust even when lagged values for entrepreneurship are used. The impact of R&D and human capital is consistent with the endogenous growth theory, as discussed at length in the previous section.

Nonetheless, there are limitations to the empirical analysis performed in this sub-chapter. The first important limitation is that the models don't include any institutional variables. The importance of the institutional environment in promoting productive entrepreneurship – and thus contributing to economic performance – was discussed at length in the first chapter. Baumol (1990; 2007; 2008), Acs et al (2013a), Estrin et al. (2012) underline the importance of the economic context in encouraging entrepreneurship and creating the necessary conditions for a firm's success. Institutions play a significant

role in Central and Eastern European economies as well, as it was shown through an analysis of the transition period in the Chapter 2, as well as the current start-up rates across countries in the area. Thus, including institutional variables in the empirical models would have provided useful information about the impact of corruption, quality of government as well as start-up costs on economic performance, combined with their interaction with entrepreneurship. The literature review in the first chapter provides a useful overview of the institutional variables traditionally employed by previous studies, such as the Global Competitiveness Index, government final consumption expenditure (% GDP), strength of creditor protection, and cost of business start-up procedures. The database at hand, however, doesn't permit the inclusion of these variables in the current regression analysis. Eurostat doesn't contain information about the quality of institutions at a regional level, which became a constraint for the modelling procedure employed in this sub-chapter. This remains an area to be improved through the contribution of future research.

A possible way to improve this empirical study is to extend it through a panel data analysis. A cross-sectional regression analysis, rather than a panel data one, was preferred in this study due to the unavailability of entrepreneurship data for an extensive period of time. This is again a limitation of the dataset at hand. As more statistics become available over the next few years, a panel data exercise with the Eurostat regional database would improve the quality of research regarding entrepreneurship in the NUTS-2 regions of Central and Eastern Europe, and provide useful insights about the validity of the results obtained through the current study (along with a dynamic view of the impact of entrepreneurship on economic performance in the area).

Considering the limitations, the models developed in this chapter can't offer detailed conclusions regarding the dynamic role of entrepreneurship in Central and Easter Europe, or regarding the interactions between entrepreneurship and institutional variables, and their impact on economic performance. The models do, however, yield a very firm conclusion that entrepreneurship should be encouraged through regional policies, as it clearly has a significant, positive impact on regional output. Policy makers should thus divert their attention from traditional production factors and invest more in promoting entrepreneurial capital and human capital at the NUTS-2 regional level in Central and Eastern Europe.

3.2 Country Level Analysis

As mentioned in the introduction of this chapter, the empirical study first made an attempt to inquire into the relationship between entrepreneurship and economic performance in Central and Eastern Europe, with the assumption that a country level aggregation is appropriate for the regression analysis. Due to the high volatility and heterogeneity displayed by the data at this level of aggregation, an analysis with regional data was preferred instead. The exercise performed with country-level data should not, however, go unnoticed. As a result, the main methodology and conclusions will be presented in this sub-chapter.

Regression analysis using panel data was considered appropriate at this level of aggregation due to the following reasons: first of all, it gives a dynamic view of the relationship between entrepreneurship and economic performance; second of all, given the small number of countries in the Central and East European region, a static cross-sectional analysis would not have been possible (too few data points to obtain statistically accurate results).

Next, an important decision had to be made about which entrepreneurship measure to use. At the country level, entrepreneurship can be measured in many interesting ways, but not all these can be used in the study of Central and Eastern European countries. The most basic measure is the self-employment rate, available from databases such as the World Development Indicators (World Bank) and Euromonitor. The self-employment rate, however, fails to capture the inclination of an economy towards the formation of new businesses. Self-employment incorporates people who own both innovative firms and simple corner shops, or who are pursuing a profession such as consulting, accounting or law and declare themselves self-employed (but are not entrepreneurial in the true sense), thus this is the least preferred measure of entrepreneurship.

Databases from the Global Entrepreneurship Monitor and the Global Entrepreneurship and Development Institute offer more complex measures of entrepreneurship. The Global Entrepreneurship Monitor, for example, reports country-level statistics regarding Total Early-stage Entrepreneurial Activity, Improvement-Driven Opportunity Entrepreneurial Activity and Necessity-driven Entrepreneurial Activity (these were revised in the second section of Chapter 1 as well). The database includes entrepreneurship measures for 15 Central and Eastern European countries, but the data is

not homogenous. From 2005 to 2013, data is available at different points in time for different countries: Czech Republic has data available only for 2006, 2011 and 2013; Estonia only for 2012-2013; Macedonia only for 2008, 2010, 2011 and 2013; Poland and Slovakia only for 2011-2013; Serbia only for 2007-2009. Thus pooling together data for a regression analysis is not possible, due to the large amount of missing variables (this will leave too few data points to run the regression on). The same problem arises with the GEDI (Global Entrepreneurship and Development Index)[41]. The index 'collects data on the entrepreneurial attitudes, abilities and aspirations of the local population and then weights these against the prevailing social and economic 'infrastructure'' (GEDI, 2015), combining multiple sources to provide the most comprehensive measure of entrepreneurship up-to-date. The GEDI is, however, a fairly new index and data is publicly available for 2013 and 2014 only, making it impossible to use in a panel-data analysis.

Finally, the World Development Indicators database from the World Bank offers statistics regarding the number of new businesses and new business density in a country. A drawback of this measure is that it doesn't distinguish between necessity and opportunity entrepreneurship. An advantage for this entrepreneurship measure is that it captures the level of nascent entrepreneurship in a country, solving the deficiencies showed by the self-employment rate. The measure is available since 2004 for 16 Central and Eastern European countries: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Moldova, Poland, Romania, Serbia, Slovakia, Slovenia, Ukraine and Russia. Problems arose when the entrepreneurship data wasn't evenly available for all countries, but the situation was much better than in case of the Global Entrepreneurship Monitor database (Estonia has figures missing for 2008, 2010 and 2011; Lithuania for 2010 and 2011; Macedonia for 2004 and 2005; Moldova for 2010 and 2011; Poland for 2004, 2010 and 2011; Ukraine and Serbia for 2004). Missing variables were tackled either by using a trend function or by assuming constant change between years (this method is employed in Acs et al. (2012) as well). As a result, this measure of entrepreneurship was used in the panel data regression analysis.

The estimation model represented an extension of the knowledge production function (as presented in Chapter 1), following a similar methodology employed by Audretsch and Keilbach (2004), Acs and al. (2012), and Wong et al. (2005), who extend

[41] Offered by the Global Entrepreneurship and Development Institute

a traditional production function with measures for knowledge and entrepreneurship. The model was developed in accordance with the theories discussed in Chapter 1 (endogenous growth theory, knowledge spillover theory of entrepreneurship and institutionalism) and with the empirical studies reviewed in the same chapter:

$$\textbf{Economic Performance}_{it} = \beta_0 + \beta_1(\textbf{Entrepreneurship measure})_{it} + \beta_2(\textbf{Knowledge measures})_{it} + \beta_3(\textbf{Capital measure})_{it} + \beta_4(\textbf{Labour measure})_{it} + \beta_5(\textbf{Institutional measures})_{it} + \varepsilon_{it} \quad \textbf{(6)}$$

Economic performance was measured as the level of GDP. Entrepreneurship was measured as the number of new businesses and new business density. Knowledge was quantified by two variables: research and development expenditure (% of GDP) and the percentage of population enrolled in tertiary education (human capital). Physical capital was measured as gross fixed capital formation (% of GDP) and labour as total labour force available. Institutional variables were represented by government final consumption expenditure (% of GDP), Distance to Frontier score for the regulatory environment and cost of business start-up procedures. Data was extracted for 16 Central and Eastern European Countries for the period of 2004-2011 (8 years).

The model was estimated using the fixed effects and random effects technique, accompanied by the Haussmann test, which showed that there was no hidden heterogeneity in the data correlated with the independent variables and thus an entity (country) fixed effects estimation procedure is appropriate. Cluster-robust standard errors were used to account for the correlation of observations within the same group (country) and correct for heteroskedasticity.

The results, however, weren't robust and statistically (or even intuitively) accurate. The data showed too much heterogeneity in its behaviour both by countries and by years. The signs of the coefficients for variables such as labour, research and development expenditure, government expenditure and distance to frontier score were far from intuitive (negative signs for the first two variables and positive signs for the last two variables, when it should be the other way around). The sings of the coefficients and their significance changed when introducing a variable or excluding a variable from the model. This extremely volatile behaviour indicates results that aren't robust. To investigate issues with multicollinearity, the variance inflation factors were measured (VIF), which yielded extremely high values, in the range of 200-300. These high figures indicate severe

problems with multicollinearity; after investigating the correlation matrix, and excluding potentially correlated variables, the problem with multicollinearity persisted, which indicated an inherent issue within the data that is not compatible with the modelling procedure. When performing checks for omitted variable bias, the results showed that the models had omitted variables (again, these results could change simply by taking out or putting in a variable, which indicates serious issues with volatility within the data). Moreover, the Pesaran test for serial correlation across entities didn't reject the null hypothesis that residuals are correlated.

This extremely unstable behaviour, combined with the poor results from the tests performed to check for the validity of the underlying model assumptions, led to the conclusion that the panel dataset at hand should not be used to investigate the impact of entrepreneurship on the economic performance of Central and Eastern European countries. There is one main reason for such poor results: the countries in the region are not compatible and too heterogeneous in their associated data to produce statistically robust results at this level of aggregation. The selection of the countries is too restrictive due to the particularities of the area, thus inducing sample selection bias. Studies that have used the panel data approach at a country level of aggregation, such as Cumming et al. (2014), Acs et al. (2012), Valliere and Peterson (2009), include a diverse set of countries in their analysis (from all areas of the world, not restricted to one area only). Clearly, this approach doesn't work in the case of just Central and Eastern European countries. This ultimately lead to the conclusion that a more discrete level of aggregation should be used for an analysis of the Central and Eastern European area, such as regional-level aggregation (of regions within countries).

CONCLUSION

This thesis sets out investigate the relationship between entrepreneurship and economic performance in Central and Eastern Europe, an area where entrepreneurial activity has been a missing ingredient from the 'economic mix' up until 25 years ago. The introduction of the thesis and the second chapter establish that this particular aspect is what makes the study of entrepreneurship in the area so fascinating. The research presented in this thesis follows a logical sequence: the starting point is marked by an in-depth look at the theoretical links between entrepreneurship and measures of economic performance; the second part applies the theoretical frameworks developed at the start of the thesis to the Central and Eastern Europe to provide a contextual view of the area; finally, an empirical study is developed based on the rich contextual understanding of entrepreneurship developed through the analyses carried out in the first two parts of the thesis.

Chapter 1 represents a starting point for the inquiry into the economic implications of entrepreneurship. From a myriad of scholarly approaches towards the study of entrepreneurship, Chapter 1 pinpoints the major theories that investigate the way entrepreneurial activity may impact measures of economic performance, such as levels of GDP and growth of GDP. This theoretical inquiry crystalizes the central view of this thesis towards entrepreneurship, later to be investigated through the empirical study: entrepreneurial activity enhances regional or national performance by fluidizing the process of knowledge spillovers in an economy and by acting as stimuli and conduits for them. Moreover, entrepreneurship doesn't stand alone as a factor contributing to increased performance, but it is part of an integrated ecosystem, where innovation, research and development activities, human capital, institutions and even individual attitudes determine an entrepreneur's ability to grasp business opportunities and develop sustainable start-ups.

In order to better understand the manifestation of entrepreneurship in Central and Eastern Europe, the second chapter of this thesis is dedicated entirely to a contextual analysis of entrepreneurial activity in the area, through the lens of the theories discussed in the first chapter. Several conclusions are derived from this analysis. First, it is established that the sluggish economic growth experienced by the Soviet Union the last two decades of its existence was caused by the absence of entrepreneurship to act as a conduit of knowledge spillovers. Even if the Soviet economy invested heavily in research

and development activities, the lack of entrepreneurship lead to an under-commercialisation of ideas generated through research. Entrepreneurship wasn't present to generate 'creative combinations' in the Schumpeterian sense, and transpose research into products and services that could reach the end consumer. Second, it is shown that entrepreneurship in the early transition period in Central and Eastern Europe relates to economic performance in opposite ways than those reasoned through the theories discussed in Chapter 1. Necessity entrepreneurship in the early transition period is the main contributor to economic performance, actively filling gaps between supply and demand, absorbing unemployment shocks and replicating innovations from abroad. Moreover, entrepreneurship thrived in the early transition period, even if the institutional environment wasn't conductive of new business formation, with high start-up costs, high opportunity costs of doing business legally and complicated licencing procedures. Finally, it is demonstrated that towards the later stages of transition, opportunity entrepreneurship prevails, providing a fertile ground for new businesses to act as knowledge spillover conduits in Central and Eastern European economies. It is also shown that the costs of business start-up procedures have decreased consistently in the area, but small and medium enterprises have strikingly different performances (both in value added and employment) across different Central and Eastern European countries.

So far, the thesis has presented entrepreneurship as a creative factor in the economy, which contributes to economic performance by challenging incumbent firms, enhancing competition and systemically diffusing knowledge and innovation. Moreover, the thesis has established entrepreneurship as an important, yet changing economic factor in Central and Eastern Europe. These findings are further investigated through a statistical analysis performed in Chapter 3. This part of the thesis focuses mainly on developing a cross-sectional regression analysis using regional data provided by the Eurostat database, showing that entrepreneurship has a positive and significant impact on regional GDP in Central and Eastern Europe. The general form of the model is derived by expanding a traditional production function with measures for knowledge (this corresponds to the endogenous growth theory) and measures for entrepreneurship (this corresponds to the knowledge spillover theory of entrepreneurship). After analysing the data at hand, four different empirical models are used in the regression analysis. Moreover, both current and lagged values for entrepreneurship are employed, to control for simultaneity and check the robustness of the results. All four models yield high overall significance (demonstrated by the low p-value of the F-statistic) and have a strong explanatory power

(confirmed by the high adjusted R^2 value, which is over 90%). The underlying OLS assumptions are met in all four cases, which was demonstrated through a series of graphs and tests (these are available both in the body of the thesis and in the corresponding appendices). Furthermore, the regression estimates do not disprove the validity of the initial hypotheses. The statistical significance of the coefficient for entrepreneurship is very pronounced. The coefficient also has a positive sign, indicating that the direction of the relationship between entrepreneurship and GDP is in accord with both intuition and theory. These results place entrepreneurship among key determinants of regional economic performance in Central and Eastern Europe, but also demonstrate that the effect of entrepreneurship is strongly enhanced by the available quality of human capital, and partially enhanced by research and development activities. The empirical study demonstrates that life-long learning activities have a positive, significant impact on GDP, augmenting entrepreneurs' ability to build sustainable businesses that act as conduits of knowledge spillovers in the economy. Finally, the empirical study reveals that entrepreneurship is a valuable part of the economic ecosystem, connecting available labour, physical capital, knowledge stock and human capital in a nimble and creative manner, and thus driving the economy towards increased performance levels.

This way, through the multidimensional approach that it employs, this thesis successfully investigates the role of entrepreneurship in a habitat that suffered tremendous transformations in the past two decades and that metamorphosed from 'entrepreneurial vacuum' to an environment conductive of new business formation. The research clearly demonstrates that, given the recent economic conditions, entrepreneurship should be regarded by policy makers an important tool for boosting economic performance in Central and Eastern Europe.

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LIST OF APPENDICES

Appendix 1: Opportunity vs. necessity entrepreneurship, GEM data

	Croatia	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovakia	Slovenia
Opportunity entrepreneurship										
2005	35	-	-	43	47	-	-	-	-	64
2006	38	61	-	51	58	-	-	-	-	66
2007	40	-	-	46	41	-	-	38	-	76
2008	57	-	-	49	54	-	-	34	-	68
2009	39	-	-	45	54	-	-	31	-	69
2010	49	-	-	43	51	-	-	47	-	54
2011	31	57	-	29	46	47	32	34	34	51
2012	36	-	49	35	46	51	30	38	43	64
2013	30	60	50	39	53	55	33	32	40	53
Necessity entrepreneurship										
2005	50	-	-	39	16	-	-	-	-	11
2006	44	31	-	22	16	-	-	-	-	10
2007	40	-	-	23	15	-	-	14	-	10
2008	28	-	-	28	21	-	-	34	-	12
2009	37	-	-	24	32	-	-	34	-	10
2010	32	-	-	20	27	-	-	31	-	16
2011	35	27	-	31	26	28	48	41	28	12
2012	34	-	18	31	25	25	41	24	36	7
2013	37	23	15	28	21	23	47	32	40	24

Appendix 2: Economic performance indicators, Euromonitor database, 2011

Corruption Perceptions Index[42]	
Estonia	6.40
Slovenia	5.90
Poland	5.50
Lithuania	4.80
Hungary	4.60
Czech Republic	4.40
Latvia	4.20
Croatia	4.00
Montenegro	4.00
Slovakia	4.00
Macedonia	3.90
Romania	3.60
Bulgaria	3.30
Serbia	3.30
Bosnia-Herzegovina	3.20
Albania	3.10
Moldova	2.90
Belarus	2.40
Russia	2.40
Ukraine	2.30

GDP, million international dollars, PPP	
Russia	3,226,599.00
Poland	838,048.00
Ukraine	379,140.00
Romania	345,176.00
Czech Republic	283,888.00
Hungary	223,497.00
Belarus	157,284.00
Slovakia	135,653.00
Bulgaria	114,070.00
Croatia	86,461.00
Serbia	86,050.00
Lithuania	68,197.00
Slovenia	58,948.00
Latvia	41,131.00
Bosnia-Herzegovina	35,584.00
Estonia	31,301.00
Albania	28,144.00
Macedonia	24,614.00
Moldova	14,878.00
Montenegro	8,768.00

Unemployment Rate	
Macedonia	31.40
Bosnia-Herzegovina	27.50
Serbia	23.00
Montenegro	19.70
Latvia	16.20
Lithuania	15.40
Albania	14.00
Croatia	13.70
Slovakia	13.70
Estonia	12.40
Bulgaria	11.30
Hungary	11.10
Poland	9.60
Slovenia	8.20
Ukraine	7.90
Romania	7.20
Czech Republic	6.70
Moldova	6.70
Russia	6.60
Belarus	0.70

[42] A score of 0 indicates that a country is perceived as highly corrupt

Appendix 3: NUTS-2 regions ordered by the number of new firms, 2010

Region	Code	New firms	Region	Code	New firms
Mazowieckie	PL12	50322	Warminsko-Mazurskie	PL62	10558
Slaskie	PL22	36402	Zahodna Slovenija	SI02	8816
Wielkopolskie	PL41	30653	Swietokrzyskie	PL33	8784
Praha	CZ01	27565	Lubuskie	PL43	8659
Közép-Magyarország	HU10	27288	Podlaskie	PL34	7824
Malopolskie	PL21	26550	Észak-Alföld	HU32	7713
Dolnoslaskie	PL51	25218	Eesti	EE00	7355
Pomorskie	PL63	21472	Dél-Alföld	HU33	7241
Lódzkie	PL11	19575	Közép-Dunántúl	HU21	6887
Jihovýchod	CZ06	17866	Yuzhen tsentralen	BG42	6857
Yugozapaden	BG41	17217	Opolskie	PL52	6667
Zachodniopomorskie	PL42	16206	Vzhodna Slovenija	SI01	6509
Západné Slovensko	SK02	16033	Severoiztochen	BG33	6384
Severovýchod	CZ05	15627	Nyugat-Dunántúl	HU22	6295
Kujawsko-Pomorskie	PL61	15506	Dél-Dunántúl	HU23	5742
Lubelskie	PL31	15069	Észak-Magyarország	HU31	5698
Strední Cechy	CZ02	14573	Yugoiztochen	BG34	5671
Jihozápad	CZ03	14092	Nord-Vest	RO11	5472
Podkarpackie	PL32	12842	Sud-Est	RO22	4932
Bratislavský kraj	SK01	12789	Sud - Muntenia	RO31	4606
Východné Slovensko	SK04	12410	Centru	RO12	4224
Stredné Slovensko	SK03	11845	Nord-Est	RO21	4191
Bucuresti - Ilfov	RO32	11499	Vest	RO42	3810
Strední Morava	CZ07	11122	Severen tsentralen	BG32	3458
Severozápad	CZ04	11115	Sud-Vest Oltenia	RO41	3011
Moravskoslezsko	CZ08	10927	Severozapaden	BG31	2533

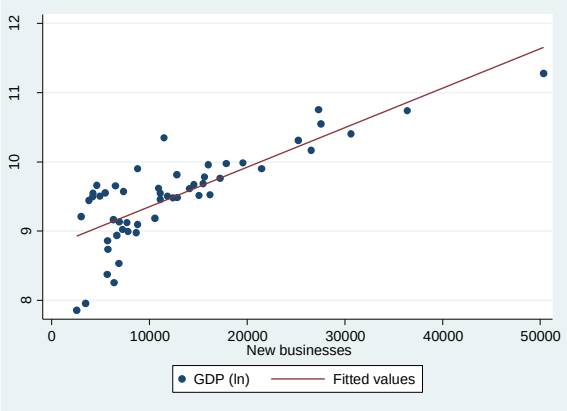
Appendix 4: Correlation matrices

2010	GDP (ln)	Capital (ln)	Employment (ln)	New businesses	R&D	Education
GDP (ln)	1.0000					
Capital (ln)	0.9583	1.0000				
Employment (ln)	0.6926	0.5913	1.0000			
New businesses	0.7847	0.7162	0.5643	1.0000		
R&D	0.5208	0.5371	0.0095	0.3667	1.0000	
Education	0.4039	0.4082	-0.1720	0.3045	0.7797	1.0000

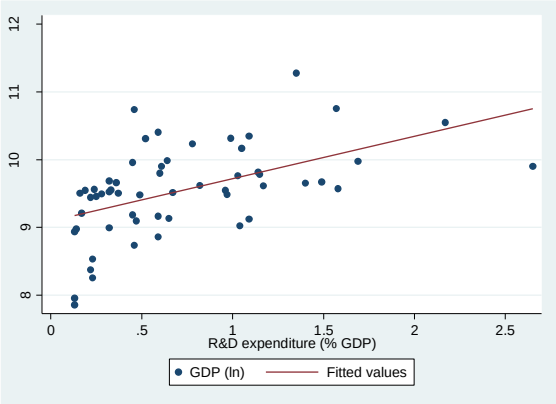
2011	GDP (ln)	Capital (ln)	Employment (ln)	New businesses	R&D	Education
GDP (ln)	1.0000					
Capital (ln)	0.9612	1.0000				
Employment (ln)	0.3026	0.3059	1.0000			
New businesses	0.7862	0.7100	0.1578	1.0000		
R&D	0.4855	0.4807	-0.0209	0.3173	1.0000	
Education	0.3488	0.3417	-0.1768	0.2244	0.8460	1.0000

Appendix 5a: Scatterplots of dependent vs. independent variables, 2010

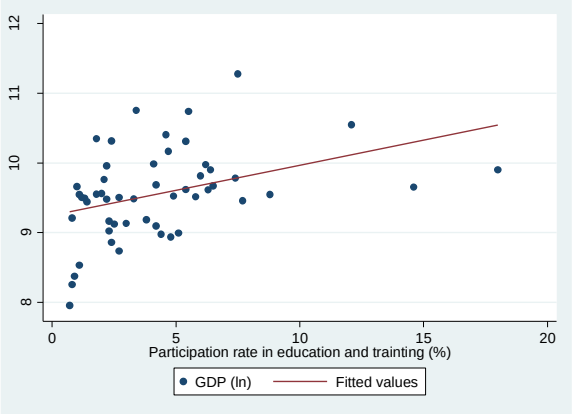
GDP (ln) and New businesses



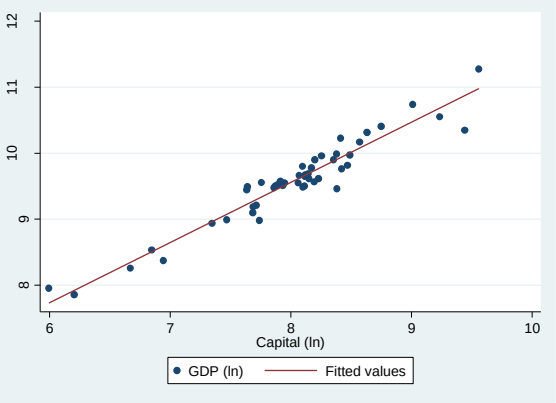
GDP (ln) and R&D Expenditure (% GDP)



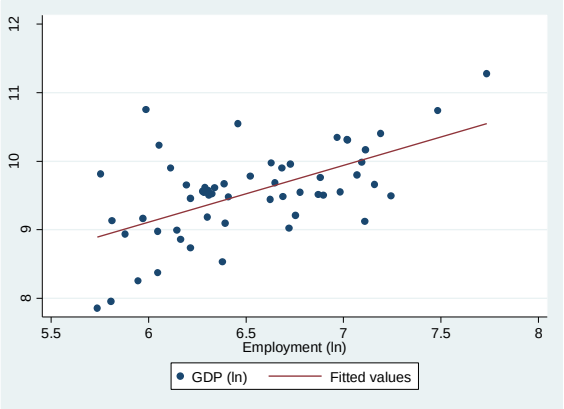
GDP (ln) and Education (%)



GDP (ln) and Capital (ln)

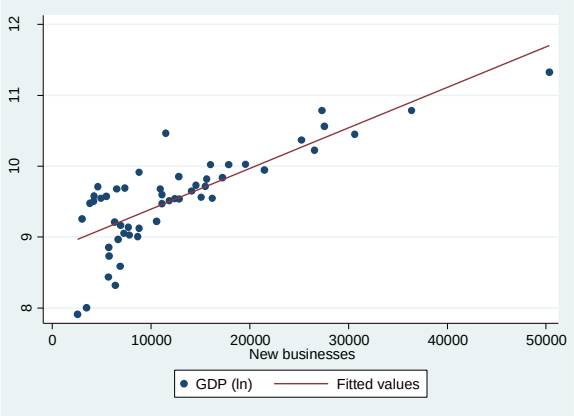


GDP (ln) and Employment (ln)

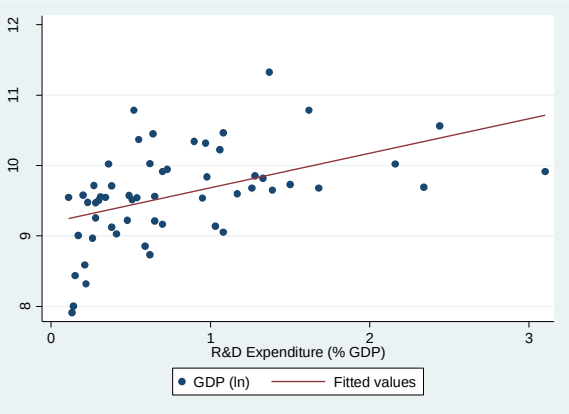


Appendix 5b: Scatterplots of dependent vs. independent variables, 2011

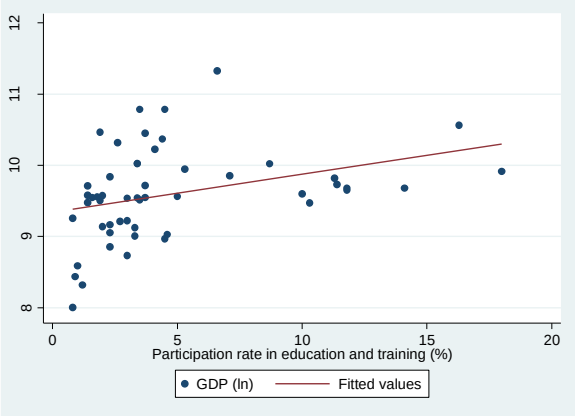
GDP (ln) and New businesses



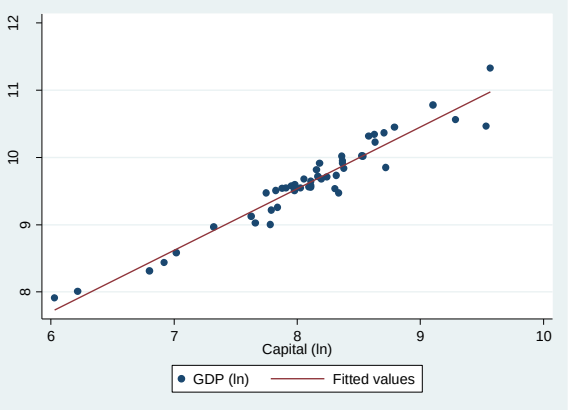
GDP (ln) and R&D Expenditure (% GDP)



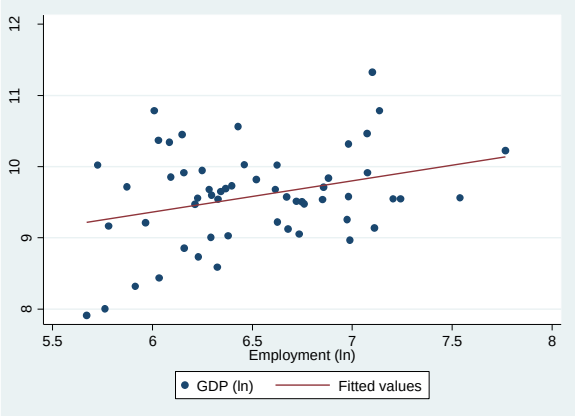
GDP (ln) and Education (%)



GDP (ln) and Capital (ln)



GDP (ln) and Employment (ln)



Appendix 6: Outputs for OLS assumptions tests performed in *Stata*

Hettest command: Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Model 1

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of lngdp

         chi2(1)      =     0.01
         Prob > chi2  =   0.9234
```

Model 2

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of lngdp

         chi2(1)      =     1.28
         Prob > chi2  =   0.2586
```

Model 3

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of lngdp

         chi2(1)      =     0.03
         Prob > chi2  =   0.8527
```

Model 4

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of lngdp

         chi2(1)      =     0.00
         Prob > chi2  =   0.9469
```

Appendix 6: Outputs for OLS assumptions tests performed in *Stata* (continued)

Sktest command: Skewness and Kurtosis of residuals

Model 1

Skewness/Kurtosis tests for Normality

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	joint adj chi2(2)	joint Prob>chi2
resid	45	0.4501	0.2553	1.97	0.3730

Model 2

Skewness/Kurtosis tests for Normality

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	joint adj chi2(2)	joint Prob>chi2
resid	43	0.7113	0.5621	0.49	0.7846

Model 3

Skewness/Kurtosis tests for Normality

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	joint adj chi2(2)	joint Prob>chi2
resid	44	0.6188	0.1878	2.10	0.3496

Model 4

Skewness/Kurtosis tests for Normality

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	joint adj chi2(2)	joint Prob>chi2
resid	43	0.6363	0.2176	1.85	0.3972

Appendix 6: Outputs for OLS assumptions tests performed in *Stata* (continued)

VIF command: Test for multicollinearity

Model 1

Variable	VIF	1/VIF
lncapital	3.49	0.286223
lnemployment	2.24	0.446837
newbusiness	2.20	0.454572
rd	1.77	0.566140
Mean VIF	2.42	

Model 2

Variable	VIF	1/VIF
lncapital	3.41	0.293442
education	3.08	0.324630
rd	3.01	0.331991
lnemployment	2.50	0.399512
newbusiness	2.28	0.437694
Mean VIF	2.86	

Model 3

Variable	VIF	1/VIF
lncapital	2.79	0.358935
newbusiness	2.02	0.495659
rd	1.38	0.723519
lnemployment	1.25	0.801036
Mean VIF	1.86	

Model 4

Variable	VIF	1/VIF
rd	4.17	0.239693
education	3.87	0.258553
lncapital	2.66	0.375990
newbusiness	2.04	0.490112
lnemployment	1.25	0.798723
Mean VIF	2.80	

Appendix 6: Outputs for OLS assumptions tests performed in *Stata* (continued)

Ovtest command: Ramsey RESET test for omitted variables

Model 1

```
Ramsey RESET test using powers of the fitted values of lngdp
       Ho:  model has no omitted variables
                   F(3, 37) =      2.50
                   Prob > F =      0.0744
```

Model 2

```
Ramsey RESET test using powers of the fitted values of lngdp
       Ho:  model has no omitted variables
                   F(3, 34) =      1.19
                   Prob > F =      0.3270
```

Model 3

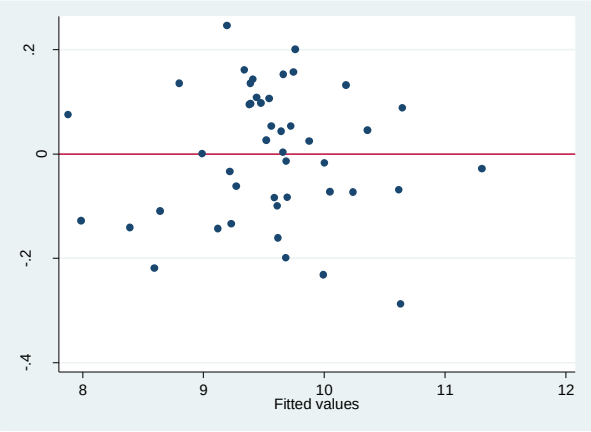
```
Ramsey RESET test using powers of the fitted values of lngdp
       Ho:  model has no omitted variables
                   F(3, 36) =      1.76
                   Prob > F =      0.1717
```

Model 4

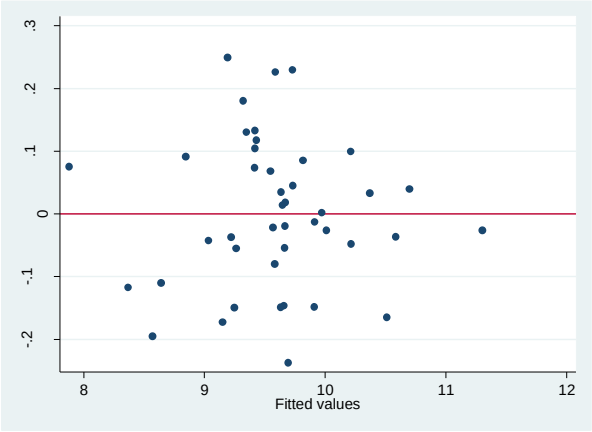
```
Ramsey RESET test using powers of the fitted values of lngdp
       Ho:  model has no omitted variables
                   F(3, 34) =      1.79
                   Prob > F =      0.1682
```

Appendix 7: Residual plots

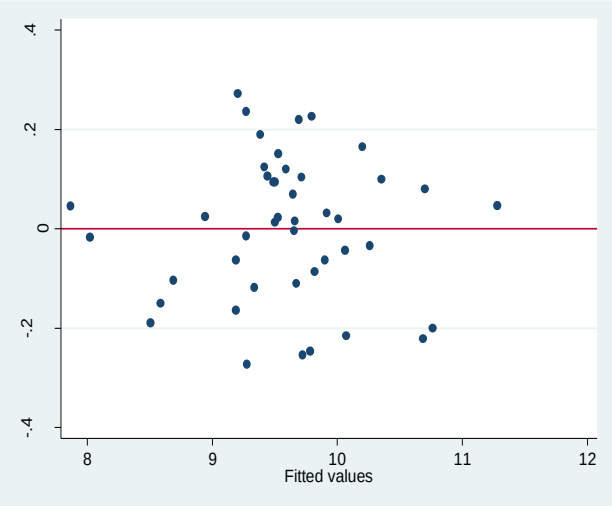
Model 1



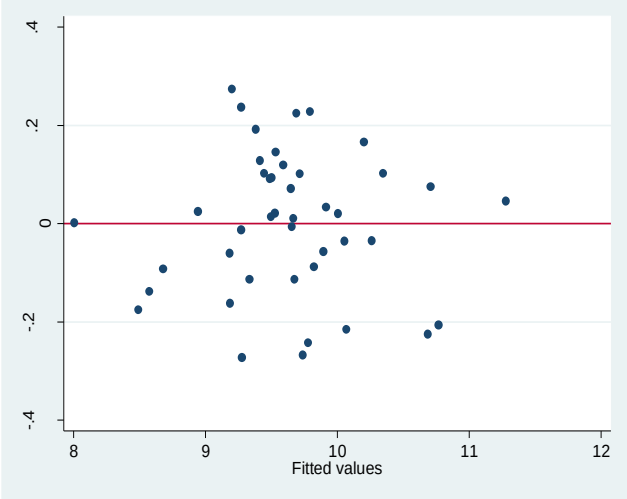
Model 2



Model 3

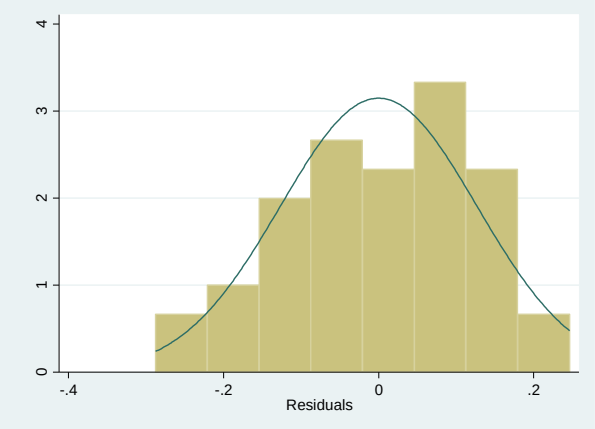


Model 4

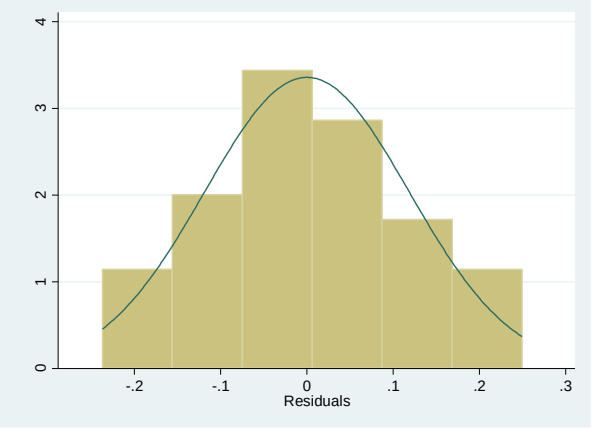


Appendix 7: Distribution of residuals

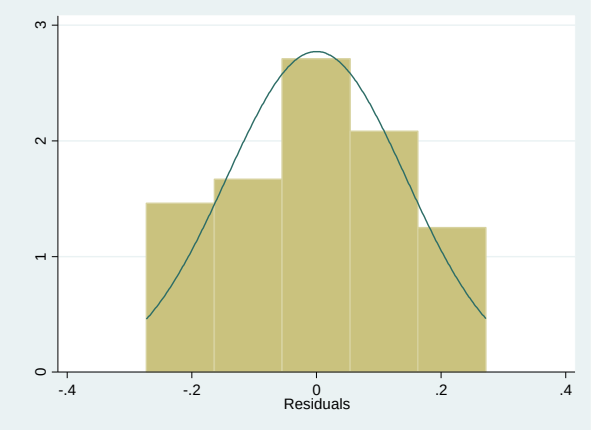
Model 1



Model 2



Model 3



Model 4