ASSOCIAÇÃO DE POLITÉCNICOS DO NORTE **(APNOR)**

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Innovation on worldwide businesses in the period 2011- 2017: Panel data analysis on the impact of the business environmental factors

Kateryna Savosh

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Supervisor:

Alcina Maria de Almeida Rodrigues Nunes

***Bragança*, July, 2019**

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Abstract

On the modern stage of economic development, innovation policy is deemed to be a significant component of sustainable development by finding new solutions in response to problems, that ensue in the social and economic grounds. A key to a successful increase in innovation is to reveal and study what are the main business environment factors that determine innovation activity in companies. However, there are few works in the scientific literature that make such research. So, the objective of this research work is to identify and quantify which business environment elements impact on business innovation activity, in the last decade. With the purpose of accomplishing such goal the statistical analysis panel data methods (in particular, fixed and random effects models) were applied to a secondary dataset provided by the Global Entrepreneurship Monitor (GEM). The research work analyses the impact of the GEM's business environment factors, assessed by its experts, on the innovation activity worldwide as well as by the income level of 100 world economies. This study concludes that worldwide factors as financing, government support, lower taxes and bureaucracy, entrepreneurship education in primary and secondary levels of education and the country's economy openness present an important positive impact on innovation. Such results are obtained for a set of very heterogeneous world economies. None of the factors showed statistical evidence for low-income countries. Financing, basic school training and education, R&D transfer, and cultural and social norms have a positive impact on innovation activity in lower-middle-income countries. Financing, governmental support and policies, reduced taxes and bureaucracy, and basic school training and education revealed to influence innovation activity in upper-middle-income economies positively, whereas market dynamics and physical services and infrastructure influence negatively. In high-income economies, lower taxes and bureaucracy, commercial and professional infrastructure and market openness increase innovation activity, while market dynamics decrease it.

Keywords: innovation, business environment indicators, Global Entrepreneurship Monitor (GEM), panel data methods

Resumo

Atualmente, em termos de desenvolvimento económico, a política de inovação é considerada uma componente significativa do desenvolvimento sustentável ao encontrar novas soluções para responder aos problemas com origem social e/ou económica. Uma chave para um crescimento bem-sucedido da inovação passa por identificar e analisar quais são os principais fatores do ambiente de negócios que determinam a atividade de inovação nas empresas. No entanto, existem poucos trabalhos na literatura científica que realizam este tipo de análise. Assim, o objetivo deste trabalho de investigação é identificar e quantificar quais os elementos do ambiente de negócios com impacto na atividade de inovação empresarial, na última década. Para atingir tal objetivo, a análise econométrica de dados de painel (em particular, os modelos de efeitos fixos e aleatórios) foi aplicada a um conjunto de dados secundários fornecidos pelo Global Entrepreneurship Monitor (GEM). O trabalho de investigação analisa o impacto dos fatores do ambiente de negócios identificados pelo GEM, e avaliados por seus especialistas, na atividade de inovação em todo o planeta bem como pelo nível de rendimento de 100 das economias mundiais. Este estudo conclui que, em geral, fatores como o financiamento, o apoio governamental, a redução de impostos e burocracia, a educação para o empreendedorismo nos níveis primário e secundário de educação e a abertura da economia apresentam um impacto positivo importante na inovação. Tais resultados são obtidos para um conjunto de economias mundiais muito heterogéneas. Nenhum dos fatores apresentou evidência estatística para países de baixo rendimento. O financiamento, a formação e educação no ensino primário e secundário, a transferência de R&D e as normas culturais e sociais têm um impacto positivo na atividade de inovação em países de rendimento médio-baixo. O financiamento, o apoio e as políticas governamentais, a redução de impostos e da burocracia e a formação e educação revelaram influenciar positivamente a atividade de inovação em economias de médios e altos rendimentos, enquanto a dinâmica de mercado e a existência de serviços físicos e infraestrutura a influenciam negativamente. Em economias com rendimentos elevados, menores taxas e burocracia, com infraestruturas comerciais e profissionais e com maior abertura de mercado aumentam a atividade de inovação, enquanto a dinâmica do mercado a diminui.

Palavras-chave: inovação, indicadores de ambiente empresarial, Global Entrepreneurship Monitor (GEM), modelos de dados em painel

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Acronyms

AIR barriers - Active Innovation Resistance barriers

EIP - Economic Innovation Performance

FE - Fixed Effects

GEM - Global Entrepreneurship Monitor

GSME - Growing Small and Medium-Sized Enterprises

HI - Holistic Innovation

IP - Intellectual Property

NGO - Non-Governmental Organization

R&D - Research and Development

RE - Random Effects

RIS - Regional Innovation Systems

SIP - Sustainability Innovation Performance

SME - Small and Medium-Sized Enterprise

STS - Scientific and Technological Services

Table of Contents

List of Tables

Introduction

"There is only one thing stronger than all the armies of the world: and that is an idea whose time has come." - Victor Hugo

Many scientists consider changes vital for the organizations as well as the fundamental component of the economic progress (Drucker, 2006; Freeman & Soete, 2017). The level of innovation activity in an organization, either public or private, predicts the scope of its development, growth, improvement, and new experience, in other words, the wealth of such organization. Moreover, and in particular, companies benefit from successfully implemented innovations by the creation of new markets and needs, improvement of the product, process or organizational structure, and establishment of a new source of supply.

Examination of the innovation activity foresees observing the influencing environment of innovation which includes drivers and barriers. Therefore, there is a possibility to identify the key impacts for innovation activity in the companies, and later accordingly, strengthen or reduce them. Studying factors which influence innovation allows to promote innovation activity in organizations, in general, and business companies in particular.

The current research work is deemed to bring some contribution as well as increase value of the GEM-based publications regarding the topic of innovation activity as, according to Bergmann et al. (2014), there is a lack of GEM-based works covering the topic of innovation. The purpose of the study is to inspect the impact on innovation activity all around the world during the period of 2011-2017 (period for which comparable statistical information is available). The mission of the current work is to find out which business environmental factors - inside and outside of the companies - are presenting an effect on the innovation made and/or introduced by companies. Moreover, it is aimed to measure in which degree such factors influence the innovation made and/or introduced.

Based on the Global Entrepreneurship Monitor Consortium (1999), several variables, which describe business environment, were considered: (i) financing for entrepreneurs, (ii) governmental support and policies, (iii) taxes and bureaucracy, (iv) governmental programs, (v) basic school entrepreneurial education and training, (vi) post-school entrepreneurial education and training, (vii) Research and Development (R&D) transfer, (viii) commercial and professional infrastructure, (ix) internal market dynamics, (x) internal market openness,(xi) physical and services infrastructure, and (xii) cultural and social norms. The knowledge about which factors influence innovation and the degree of such influence allows the possibility to study better the environment of innovation activity. Therefore, more likely is the

possibility to improve the innovation activity. Furthermore, the analysis was concluded regarding the division of countries by income level as well as the world major regions, due to the financial and geographical differences that are well known.

Theoretical literature review of the study provides a background for developing a set of hypothesis, which encompass each of the business environmental factor. These business environmental factors are based on the Global Entrepreneurship Monitor Consortium (1999) and will serve as the independent (explanatory) variables of the study. Along with the study, the hypothesis are complemented with a theoretical framework, where the last one generates expected results.

Data about the innovation activity and business factors in the organizations all over the world during the period of time from 2011 to 2017 years, which will be used and applied in this work was exported from Global Entrepreneurship Monitor (GEM) GEM is international collaborative study on entrepreneurship, which provides a primary data based measurement and assessment tools regarding all forms of entrepreneurship as well as other socio-economic renewal derivatives (GEM, 2018a). GEM is a consortium of national teams which is building a unique data set and direct their social survey at individuals who are starting and doing the business, in order to measure entrepreneurial activity in different phases of the businesses existence (Bosma, Jones, Autio, & Levie, 2007). Descriptive analysis is implemented for the observation of the general trend of innovation activity around the world. Panel data method was selected for the current study since the study includes both individual and time dimensions. Individual dimension considers the different worldwide economies of 100 countries in the study. These economies will be further divided by income level which consist of low income, lower middle income, upper middle income and high income. The income level division of the economies was based on classification presented by World Bank (2018). The time dimension considers the 8 business years for which exists statistical international comparable information both for the innovation and the business environment factors abovementioned. The panel data models, for all the economies in the world, and for the economies by income and region, have the dependent variable – this is, the variable which variation which objective is to be explained - the innovation measured by economy and by year. The independent or explanatory variables will be the twelve business environment factors presented above. Note that with the purpose of estimating the results, both descriptive and panel data analysis will be implemented, using Stata econometric software, version 12.0.

The research study comprises the following parts. The next section is a theoretical part that includes the state of the art regarding the literature on the topic under study. It involves acquaintance with the conception of innovation, the classification of innovation, the innovation activity in organizations and business, the barriers identified on the innovation activity and the factors that influence innovation. Another important part of the research include the section of methodology, in particular, description of the research methodology as well as the database. The following section is the main part of this research work – the empirical part that will add some knowledge to the one reviewed in the previous section. The

empirical part aimed at reaching the final outcome of the research, by applying descriptive analysis and panel data method as described before. The section of conclusions, limitations and further research work will finish the research. It sums up the findings of the study as well as compare them to the previous researches within the same field of study.

1. Innovation on business: general overview

This literature review is aimed at observing the sizeable body of the conception of innovation and its classification as well as it slightly touches upon the overview of the historical development of innovation. The main part of the literature review is dedicated to the contribution of factors influencing innovation activity in the companies, focusing mostly on small and medium-sized enterprises (SME). The range of introduced factors is supported by the literature review and are based on the Global Entrepreneurship Monitor determinants.

1.1. The innovation concept

Regarding Freeman and Soete (2017), innovation is assumed to be important not only for creating wealth in a narrow field of increased prosperity, but also enables humanity of creating something that was never done before. Rogers (2003eu), defined innovation as a communication process about something newer or better. Later on, Brown and Ulijn (2004) and Osburg and Schmidpeter (2013) argued that innovation is similar to a communication process as they both are not a one-way linear event, but are relational and dynamic. Also, in the past, Grossman and Helpman (1993) mentioned that innovation was seen as a process during which using the combination of knowledge and resources, it was possible to receive new knowledge as a result. After that, this chain may continue when the knowledge gets to the research community stimulating, in that way, even more knowledge. Nowadays, Kahn (2018) offers the idea of understanding innovation in the sense of outcome, process, and mindset. He suggests that those organizations that are focusing strictly on the outcome will minimize process, which leads to inefficiencies such as duplication of effort and resource overconsumption. What is more, firms that focused strictly on the process are turning out innovation into tangled bureaucratic movements which complicate outcome.

Rogers (1995, as cited in Howard Partners, 2008), much earlier, introduced another definition of innovation. According to his definition, innovation was an idea, practice or an object that was perceived as new by an individual or organization. It does not especially matters, whether or not an idea is new as measured by the lapse of time since its first discovery. Hence, to consider an idea as innovation it has to be recognized as a new one. Further on, more attention will be paid to the conception of innovation in the business field. The definition of technological innovation was pointed on the capacity of producing new knowledge or combining existing knowledge in new ways and then transforms it into economically significant products and processes (Edquist, 1997). Before, Schumpeter defined innovation in an extremely broad concept which was called as new combinations. The notion of Schumpeterian's "new combinations" postulation is being broadly cited in several publications on this scientific area (Edler & Fagerberg, 2017; Edquist, 1997; Lundvall, 2016; Osburg & Schmidpeter, 2013; Pikkemaat, Peters, & Chan, 2018).

Another definition of innovation to present is the one that identifies it as "a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)" (OECD/Eurostat, 2018, p. 20). The minimum requirement for innovation is to present some remarkable improvements or create some novelty in the product, process, marketing or organisational method. Furthermore, it is worth to touch upon the concept of business innovation as well as innovation activity. "Innovation activities include all developmental, financial and commercial activities undertaken by a firm that is intended to result in innovation for the firm. A business innovation is a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm" (OECD/Eurostat, 2018, p. 20). The World Bank work called "Agricultural Innovation Systems" provided a definition of innovation and innovation system. According to it "innovation is the process by which individuals or organizations master and implement the design and production of goods and services that are new to them, irrespective of whether they are new to their competitors, their country, or the world. An innovation system is a network of organizations, enterprises, and individuals focused on bringing new products, new processes, and new forms of organization into economic use, together with the institutions and policies that affect their behaviour and performance" (World Bank, 2012, p. 2).

To Lundvall (2016) innovation is a combination of technical opportunity and user needs. The author argued about the process of innovative activities in which outcome includes both technical changes and upraises in technical opportunities. For the author, the process of innovation is seen as cumulative. Being more specific, even the simplest innovation commenced with accumulating knowledge and experience. According to Drucker (2006), innovation has been presented as a tool of entrepreneurs with which they exploit change as an opportunity for a certain business. Innovation has been considered as an idea converted into business in order to create value as well as increases the satisfaction of the customers. Besides, innovation helps enterprises by challenging opportunities resulting in a sustainable profit. The

previously mentioned author also gave the image of the entrepreneur touching on the concept of innovation. “Entrepreneurs consider change as the healthy norm. Usually, they do not bring about the change themselves. But — and this defines entrepreneur and entrepreneurship — the entrepreneur always searches for change, responds to it, and exploits it as an opportunity” (Drucker, 2006, pp. 27-28). When talking about stakeholders of the innovation process it is significant to bring up the next definition. Regarding the World Bank (2012), innovation network signified a diverse collaborative group of actors that voluntarily contribute knowledge and other resources like money, equipment, and land in order to develop or improve a social or economic process or product. These networks may also be called as innovation platforms. Lundvall (2016) highlighted the importance of the idea of exchanging and sharing the information, experience and knowledge during the process of innovation activity.

It may be observed (without straying too far afield from the primary focus of this research work) that Joseph Schumpeter is viewed as the greatest “innovation” economist and his seminal work includes change-oriented and innovation-based economics direction (Schumpeter, 1934). Therefore, it is significant to implicate the overview of the scientific legacy of Schumpeter regarding the subject of innovation. Due to this fact, it would be possible to accomplish the literature overview of innovation in a more profound and abundant way. In the theory of Economic development, Schumpeter perceived structural changes as a part of the historical development. In addition, he argued that innovation is one of the key drivers of economic evolution. The central role in the Schumpeterian conception belongs to the entrepreneur (Albu, 2017; Brown & Ulijn, 2004; Freeman & Soete, 2017; Howell, 2016; Law, Lee & Singh, 2018; Śledzik, 2015). According to Schumpeter (2017), the strategic inciting motive of economic development is innovation. Innovation was defined as the commercial or industrial application of the new product, process, or method of production, new market or source of supply, a new form of commercial, business, or financial organization. A relevant point to consider when discussing Schumpeterian contribution is a notion of “creative destruction” (Albu, 2017; Drucker, 2006; World Bank, 2012). The process of “creative destruction” implies the interminable revolution of the economic structure from within, interminable destruction of the old one and an interminable creation of a new one (Śledzik, 2015). In “The Theory of Economic Development” of Schumpeter, the author revealed the role of innovation in economic development. According to him “economic growth emerges from and as a consequence of cyclical development. Discontinuous bursts of innovative investment are the basic, underlying cause of cyclical fluctuations. The qualitative changes arising from within the system which comprises innovations are associated with innovative investment and are the fundamental source of economic development” (2017, p. xxvii).

1.1.1. Classification of innovation: different perspectives

Several researchers (for example, Albu, 2017; Anzola-Román, Bayona-Sáez & García-Marco, 2018; Distanont & Khongmalai, 2018; Osburg, 2013; Osburg & Schmidpeter, 2013) took into account the

meaningful classification of innovation proposed by Joseph Schumpeter. According to Schumpeter, there could be distinguish five types of innovation: (i) the introduction of a new product (or improvement of the existing one), (ii) innovation in process, (iii) creation of a new market, (iv) discovery of new source of supply and, (v) innovation in organization. Another valuable contribution of Joseph Schumpeter was the distinction between the concepts of innovation and invention. Schumpeter argued that invention is seen as a new idea or novelty, while innovation is seen to be the idea applying in practice. This issue is being discussed in the scientific literature (Edler & Fagerberg, 2017; Freeman & Soete, 2017)

Regarding the theoretical framework of Damanpour (1991), it should be taken into account that administrative and technical, product and process, and radical and incremental types of innovation attain more consideration through scholars. Garcia and Calantone (2002), describe three types of innovation. Firstly, radical innovation, that embodies a new technology that results in a new market. Secondly, a really new innovation in the process of which a discontinuity must occur on either a marketing or technological macro basis in combination with a micro level discontinuity. Thirdly, incremental innovation considered to be a product which provides new features or improvement to existing technology in the existing market. As mentioned by Albu (2017), citing several other authors, there were identified five generations of innovation models which are: (i) technology-push, (ii) market-pull, coupling, (iii) functional integrated innovation, (iv) integrated, interconnected, and (v) parallel and flexible innovation process models. This definition of five generations was considered significant in the scientific sense as it represents the evolution of innovation. Another classification, mentioned by the same author, introduced six generations of innovative models. In general, such divisions build a structure which describes innovation simultaneously in macro and micro levels.

Chesbrough (2006), distinguished the ideas of open and closed innovation. Open innovation is examined as a paradigm that assumes the ability of a firm in using simultaneously external and internal ideas; internal and external paths to market, as firms wish to advance their technology. The author pointed out that in open innovation involves cooperation with smart people from inside and outside a particular company, while in closed innovation just the employees make contributions. Generally, the principles from open innovation are based on both external and internal environments, including building a better business model aimed at passing a new idea first to the market. When in closed innovation the company needs to discover, develop and ship the ideas by itself. While considering open innovation, Oliveira, Echeveste, Cortimiglia and Gonçalves (2017) made research in Regional Innovation Systems (RIS) in the Paraná state, Brazil, and they indicated determinant factors which facilitate the implementation of open innovation in RIS. These factors foresee relationships with higher education institutions, the assistance of public support, governance system which bridges the relationships with other stakeholders of knowledge outside the regional area, the policy of relationship network and the absorptive capacity by the institutions which belong to the RIS.

Innovation activities could be classified into three kinds, according to a given period. Firstly, successful, that resulted in the implementation of new innovation. However, this innovation activity does not need to be commercially successful. Secondly, ongoing, that is considered being work in progress, talking in general, not yet resulted in the implementation of an innovation. Thirdly, abandoned, starts before the process of implementation of an innovation (OECD & Statistical Office of the European Communities, 2005). Edquist (1997) discussed organizations that are not governed and motivated by profit-seeking aspects and profit-oriented organizations engaged in innovation activity. Hence, both non-profit organizations and profit-oriented ones are interacting between each other proceeding learning and innovation.

1.1.2. Leadership and creativity: their relation to innovation

Leadership and creativity are deemed to play a significant role in the innovation process. Xie et al. (2018) point out the positive correlation between leadership and innovation. The authors believe that leaders with transformational leadership style aimed at establishing a clear vision, paying great attention to innovation values and increasing the degrees of cognitive innovation. Howard Partners (2008) cited John Bailye, who claims that innovation is all about understanding a current problem and then finding a new solution to overcome it. He understands innovative leadership as finding out a new way of solving the problem that is different from the traditional one (Howard Partners, 2008). Based on the critical review of Hughes et al. (2018), it may be assumed that leadership is an important variable in determining creativity and innovation. Moreover, Dodge et al. (2017) make remarks about the importance of leadership in innovation. Particularly, their survey-based research suggests tree most valuable leadership dimensions for innovation that depend on the company's culture: (i) organizational encouragement, (ii) challenging work, and (iii) work group support.

Regarding the idea of creativity, it is worth to invoke the following citation of Weisberg (2006, p. 1). According to the author, "creative thinking brings about new things — innovations — ranging from solutions to simple puzzles and riddles to ideas and inventions that have radically altered our world. Creative people are those who produce such innovations, and the creative process consists of the psychological processes involved in bringing about innovations". Also to Goldenberg and Mazursky (2002), a creative idea is an idea which will definitely change the way of thinking about the problem which helps to innovate more. According to the recent empirical study of Hughes et al. (2018), creativity and innovation are deemed to be drivers for organizational success. It should be bared in mind that the inputs of innovation are creativity and productivity (Dodge et al., 2017).

1.2. Linking innovation to business

There exists a considerable number of studies (Albu, 2017; Baldwin & Gellatly, 2003; Brown & Ulijn, 2004; Crossan & Apaydin, 2010; Delmas & Pekovic, 2018; European Union & Eurostat, 2017; Freeman & Soete, 2017; Howard Partners, 2008; Jiao, Koo, & Cui, 2015; Law et al., 2018; Mihaela & Ţiţan, 2014; Schumpeter, 2017; Śledzik, 2015; Xie et al., 2018) which hint at the importance of the innovation in creating wealth, increasing development of economy, creating new employment, efficient use of recourses and evolution of the society. In work of Brown and Ulijn (2004) the authors stress that both innovation and entrepreneurship are playing a significant role in the economic growth of a country and assume that innovation and entrepreneurship might be the most important components that drive the process of economic development.

Freeman and Soete (2017) present a more profound overview of the innovation process in history. They point out that, in the general sense, economists perceived the central importance of technological innovation for economic development. Primary, Adam Smith took notice at the issue of improvement of the machinery as well as the idea of promoting inventions by the division of labours. Further on, Karl Marx introduced a model of capitalist economy which attributes a major role to technical innovation in capital goods. Alfred Marshall described knowledge as the main driver of progress in the economy.

Touching on the historical development of the innovation it is important to mention the following observation of the innovation theory transformation during the last decades. According to Osburg and Schmidpeter (2013), during the 1950s, innovation activity was focused on the concept of newness. Later on in the 1960s, innovation was concentrated in the field of Management theory. Then in the 1970s, studies of innovation were mainly centralized on the meaning for the demand side. During the 1980s and 1990s, the scientists were taking into consideration, generally, the process Innovation and service innovations. Ultimately, over the last decade, open Innovation and social Innovation provoke a significant debate. Osburg and Schmidpeter (2013) discuss about the relatively modern paradigm of social innovation involving social entrepreneur and other related social innovation aspects. Scholars are citing the definition from Corporate Social Responsibility (CSR) of European Commission, that say social innovation refers to new ideas, business models, products and services, which resolve existing sustainability challenges and create new social collaborations between business sectors and stakeholders. Social innovation is increasingly seen as a sound business strategy to solve some of society's most difficult problems at local, regional, national and global level (Osburg & Schmidpeter, 2013, p. 77).

A study by Howard Partners (2008) analyzed the process of purposeful innovation. First of all, the purposeful innovation starts from the detailed analysis of the opportunities while taking into account a majority of levers which are defined by areas, times and sources. Besides, Howard Partners (2008) hint at the importance of knowledge as well as focused simple idea as a basis. What is more, every organization has to estimate its opportunity for entering new markets.

Later, Afuah (2009) discussed the issue of strategic innovation, which foresees a game-changing innovation in products/services, business models, business processes in order to improve performance. His book opens a different horizon of new game strategy which is deemed in creating values in another ways. For instance, new games theory aimed at facilitating opportunity in the company to create benefits for a valuable set of customers as well as the position of the company with respect to competitors to appropriate created value.

Recently, Chen, Yin and Mei (2018) take notice of another type of innovation holistic innovation (HI), which is being implemented in the eastern culture, particularly in China. According to the researches, HI is considered to be a collaborative innovation powered by a strategic vision in an era of strategic innovation. HI strives for sustainable and competitive benefits and is it based upon four key dimensions: (1) strategic, (2) total, (3) open, and (4) collaborative. Chen, Yin, and Mei (2018) describe HI as the one which corresponds to the issues of open innovation, global peace, and sustainable development.

Nowadays, the question of green innovation is being considered vital in terms of future development. Wakeford et al. (2017) confirmed that green innovation assists in meeting the environmental regulations as well as minimizing the negative effect on the environment. The same authors made research in manufacturing companies in Ethiopia and confirmed that there is the need in supporting green innovation by providing special training for the manufacturing companies. The authors conclude that the establishment of environmental enforcement and responsible units will help the advance of green innovation.

1.2.1. Role of research and development in companies

It is no longer a secret that the innovation activity in a company mainly commences from the research and development (R&D) department of the organization (Hippel, 1988). Moreover, to R&D, company is able to bring technology and know-how in a number of forms and from several sources in connection with the development and implementation of innovations (OECD and Statistical Office of the European Communities, 2005). Freeman and Soete (2017) present industrial R&D statistics which aimed at measuring professionalization which is in turn based on three main changes. The first one introduces the scientific character of technology, which applies often to mechanical processes. The second change, which is designated as complex systems, foresees growing complexity of technology and the partial replacement which means physical separation of experimental development work into specialized institutions. Finally, the third change ensures the general trend in labour, which give some advantages to the R&D, due to the highly qualified employees.

The Frascati Manual (OECD, 2015, p.44) indicates that “research and experimental development (R&D) comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new

applications". According to the Frascati Manual (OECD, 2015), R&D activities have to response to following five characteristics: (i) novelty, (ii) creativity, (iii) uncertainty, (iv) systematic, (v) transferable and/or reproducible. The research of Paula and Silva (2018) was observing how internal and external R&D both influence innovation performance. This study shows that internal and external R&D strategies are supplementary in companies with more technologically intense industries, and in the enterprises with low intense technology, both strategies alone are effective when it comes to improving innovation activity. OECD and the Statistical Office of the European Communities (2005), examine a category that consists of the acquisition of capital goods for innovation that is not included in R&D activities. There is a need to take into account the issue of acquisition of external knowledge. For instance, capital formation includes the acquisition of land and buildings, machinery, instruments and equipment or computer software. Besides, OECD and the Statistical Office of the European Communities (2005) indicate that the stages of development and implementation for the adoption of new products are important in innovation activity. There is a need to take into consideration that segmentation of other development activities is necessary for innovation performance. For example, design, testing and evaluation, setup and engineering, market preparation for product innovations and training.

It is important to mention that scientific and technological services (STS) connect the R&D system with production and routine technical activities. STS includes a list of activities as design, quality control, information services, survey, and feasibility studies. All the above-mentioned activities are essential for efficient innovation and may have a significant impact of spreading technical change in industry (Freeman & Soete, 2017).

Howard Partners (2008, p. 23) indicate that the main objective of innovation policy is "to build economic strength and international and national competitiveness by generating and harnessing the latest developments in science, technology, creativity and design and applying these to real-world applications — that is, products, services and processes that people and organisations (private or public) are prepared to purchase and pay for". Regarding Hametner et al. (2018), the next significant improvement of the innovation could be identified. Innovative products and services are assumed to make a great contribution to the strategy of smart growth as well as goals of sustainability. By introducing new ideas to the market industrial competitiveness may increase. Innovating also promotes job creation and labour growth of productivity. Furthermore, R&D and innovation play a key role in providing scientific and technical solutions in order to solve global problems like climate change, renewable energy, security, active and healthy ageing.

1.3. Management practices of innovation

Implementation of innovation in the companies obviously brings significant changes (Baldwin & Gellatly, 2003; Bessant & Tidd, 2011; European Union & Eurostat, 2017; Howard Partners, 2008; Schumpeter, 2017). Regarding the study of Xie et al. (2018), the most important task of every organization is to create

a favourable environment for the employees with a culture of company values and high level of motivation and creativity. Leaders have to lead their teams and, in this way, build that innovative atmosphere. Specifically, leaders should give proper guidance for the employees and establish a clear vision and a focus for a team

Brown and Ulijn (2004) believe that, basically, innovation is all about the ability to manage knowledge creatively in response to market demand as well as other social needs. The same authors, develop the issue of trends which may help to change the condition for successful innovation. They argue that firstly, innovation depends on effective interaction between the science and the business sector. Secondly, some factors like competitive markets and technological change may force firms to innovate more rapidly. They hint at the importance of networking and collaboration. Globalization of economies nowadays is capable of promoting countries' innovation interdependence (Brown & Ulijn, 2004).

The way in which human capital is managed plays a significant role in the ability of organizations to motivate important behaviours and attitudes from their employees. Effective human resource management can contribute to gain trust among employees involved in innovation activities as well as reduce the level of turnover (Allen, Adomdza & Meyer, 2015). First of all, by innovating, the organization is able to improve the overall performance as well as increasing demand or reducing costs. Product differentiation could be increased through demand, by targeting new markets and by influencing demand for already existing products. In addition, new organisational practices can help to improve the firm's ability to gain and create new knowledge that can be used in the elaboration of other innovations. Organization need to evaluate the communication between stakeholders, knowledge flows and other aspects of the innovation process in order to develop policies that support innovation (OECD & Statistical Office of the European Communities, 2005).

Brown and Ulijn (2004) share a notion about the two stages of implementation innovation on practice. During the first stage, the organization is preparing for innovativeness involving actions with knowledge-sharing culture, interpersonal trust, and motivation. Authors believe that these steps may increase the creativeness of the employees. The second stage of management culture is aimed at selection and implementation of organizational resources, which aims to supplement agenda to enterprise level with connections, information, infrastructure and technology. This stage is believed to facilitate a socially constructed base which helps to successfully implement innovation. Regarding Hall et al. (2004), one of the components of innovation is an interactive learning process which includes a variety of scientific and economic agents. Furthermore, innovation consists of interaction and knowledge flow between research and entrepreneurial organizations in the public and private sectors. Thus, they assume that learning caused much iteration and evolution in the innovation processes.

Based on a work of Adler and Shenbar (1990), it has not escaped from this research that any organization without considerable technological base is not able to reach the strategic and operational targets. The previous authors suggested that the purpose of evaluating the technological base of the company is

about the capability of innovating. Technological capability of the company is aimed at developing products that meet market needs, using suitable process technologies, responding to new technology novelties. Furthermore, other significant objective for the company is to estimate whether it is capable of creating new opportunities as well as responding to them. Therefore, the essentials to promote the development of technological capability of the organization are the following: technological, organizational and external assets, and projects. Technological assets are the most visible element since includes the technological base or the set of reproducible capabilities. Organizational assets are the resources which include the profile of employees, management of the company, organizational structure and culture of values. External assets represent the relations of the company with other stakeholders like suppliers, customers or the local communities. Project dimension is considered as a combination and the transformation of technological, organizational and external assets. World Bank (2012, p. 16) understands innovation, as the "the skills to build and integrate internal and external resources to address problems or take advantage of opportunities".

Frishammar, Richtnér, Brattström, Magnusson and Björk (2018) examine the importance of innovation audit in the climate of challenges. They are convinced that innovation audits help managers with the identification of strengths and weaknesses in innovation as well as developing future plans. Companies also benefit from an innovation audit which is assumed to be future oriented. To Lundvall (2016), one of the most important points while talking about innovation system perspective is how an innovation system generalizes and distributes knowledge through learning. The last author believes that network formation, social capital as well as the knowledge-intensive business services are the factors that need to be taken into account regarding innovation and economic growth.

Recently, Rauter, Globocnik, Perl-Vorbach and Baumgartner (2018) show evidence that involving stakeholders such as universities, customers and non-governmental organization (NGO) into the process of open innovation activity could be beneficial for the companies. Furthermore, the same authors determined results with the managerial appliance, which confirm that sustainability innovation performance (SIP), as well as economic innovation performance (EIP), has a positive correlation, thus could be reached simultaneously.

1.4. Problems and barriers for the innovation activity

Organizations engaged in innovation activity are often facing many problems and barriers. The obstacles which hamper the implementation of innovation could originate from both external and internal environments.

According to the research of Joachim, Spieth and Heidenreich (2018), researchers took a look into 17 active innovation resistance barriers. It was assumed that active innovation resistance has commonly comprised the next barrier types: (1) value, (2) communicability, (3) trialability, (4) amenability, (5)

compatibility, (6) complexity, (7) visibility, (8) realization and (9) co-dependence (functional barriers), and (10) norm, (11) usage, (12) image and (13) information (psychological barriers) as well as risk barriers. Besides, risk barriers should be divided into more concrete barriers of risk, for instance: (14) economic, (15) functional, (16) personal or (17) social. The study reveals that all the mentioned 17 active innovation resistance (AIR) barriers contribute to the customers' decision making process of rejecting the innovation.

According to Pikkemaat et al. (2018), and regarding the literature framework, they mentioned a long list of problems and barriers causing the failure of innovation: (1) the unprofessionalism of entrepreneurs, (2) the attitude of locals toward innovation, (3) policies, (4) bureaucracy, (5) environmental issues and natural protection, (6) the lack of willingness to cooperate, (7) complication of project application procedures, among others. Moreover, even employees could become a barrier without effective engagement and motivation. Study of Pikkemaat et al. (2018) suggested that the biggest barrier of innovation is in the management of human resources. The previous authors highlighted the fundamental barriers in small and medium-sized enterprises (SMEs) which are lack of knowledge, willingness to cooperate and human resource management and project management.

In the work of Baldwin and Gellatly (2003), regarding the small and medium-sized enterprises (SMEs), authors analysed the macroeconomic environment that determines success and failure of the innovation activity in the companies. The levers of influence that have to be mentioned are the following: (1) lack of financing, (2) use of outmoded technology and (3) maintaining the favourable personnel. Besides, the success of small-sized firms relies upon their ability to deliver high-quality output to the special markets. The accomplishments of the small-sized firms are oftentimes referring to simple administrative structures and flexible reaction.

Generally speaking, it is considered more significant to review scrupulously factors that influence innovation activity rather than problems, owing to the fact that problems that may arise are based on the impact factors.

1.5. Factors influencing innovation activity

In order to obtain a more comprehensive overview of innovation in the business field, it is significant to determine which business environmental factors affect innovation activity. Accurately, the question should be next one. Which of the influencing factors promote or hamper innovation activity in the companies?

Regarding Katila and Shane (2005), the following environmental factors deemed to have an effect on the innovation activity: (i) degree of competition, (ii) availability of financial resources, (iii) manufacturing intensity of the production process, and (iv) size of the market. Other authors (D'Este, Iammarino, Savona, & von Tunzelmann, 2012; Bayarçelik, Taşel, & Apak, 2014) consider, as well, financial obstacles

important regarding the innovation activity of the companies. Furthermore, Law et al. (2018) observe the value of the financing issue in supporting innovating. The same authors pointed on that efficient financial allocation facilitates in funding research and development. Brown and Ulijn (2004), took into account the factors that influence organizations. These factors are related to a country specificity such as its; (i) financial system and corporate governance, (ii) legal and regulatory frameworks, (iii) level of education and skills, (iv) degree of personal mobility, (v) labour relations, and (vi) dominant management practices. Howell (2016) supported the idea of financing innovation in arguing that investments in intangible assets like R&D are quite vulnerable to financing as there is usually a strong need for purchasing high-tech equipment. Law et al. (2018) generated an analysis for 75 developed and developing countries and identified that the relationships between innovation and financing may vary according to institutional quality. Law et al. (2018) proved that a higher level of institutional quality could be beneficial for a company's innovation activity as it creates a background for financial development.

The role of governmental policies and support should not be underestimated while considering innovation. Discussing more obstacles of innovation there is a need to mention that high level of taxes may reduce firms' innovation as it decreases firms' internal cash flows, which assumed to be a major source of innovation financing (Howell, 2016). Relying on the literature review made by Francis and Bessant (2005) it is worth to mention that the relationships between innovation and bureaucracy are assumed to be negative. Moreover, the research of Jiao et al. (2015), dedicated to the observation of governance factors in the innovation activities of Chinese firms, shows that government ownership may negatively shape the relationship between government effectiveness and management innovation. Jiao et al. (2015) also conclude that government effectiveness has a positive influence on a firm's product innovation, technological innovation, process innovation and management innovation. According to Baldwin and Gellatly (2003), that took into consideration the growing small and medium-sized enterprises (GSME) survey with the purpose of completing a more robust and profound report about the strategies and characteristics of SMEs. Small and medium-sized companies acknowledge the importance of government programs which include training, industrial support and procurement.

Based on the innovation system capability investment framework, secondary level education was mentioned as one of the considerable components of it (Howard Partners, 2008). More recently, Lundvall (2016) confirmed the great role of education of labour. To his mind, employees are the most considerable and dynamic resource in the innovation system. Hence, the improvement of education and training is one of the key components which contribute to promoting interaction between users and producers. Another aspect of this is the scientific evidence of Mihaela and Ţiţan (2014), who believe that education greatly contributes to development and innovation. Regarding a previous research work made by Baldwin and Gellatly (2003) the contribution of skilled workers is glorified by innovators. There are findings emerged from the Local Innovation Agents (LIA) programme for small business entrepreneurs in a small region in Brazil. According to the results, companies considered knowledge, experience and need for survival as significant determinants of innovation (Lima & da Silva Müller, 2017). Bessant and

Tidd (2011) mentioned the contribution of knowledge to innovation. They are convinced that innovation, likewise entrepreneurship, is targeted at creating new possibilities by virtue of combining knowledge sets.

Presently, some experiences are being developed to support the importance of R&D transfer. Recently, Hametner et al. (2018) admitted that public investment in R&D help to generate knowledge and talent. This may increase educational organizations and innovative companies need. Besides, higher public investment in R&D supports private investment in research and innovation, providing new jobs in business, raising demand for scientists and researchers in the labour market. Baldwin and Gellatly (2003) had before argued that R&D capability, as well as the intensity of investment in R&D, tend to be greater in successful organizations.

A theoretical review made by Adams, Bessant and Phelps (2006) indicated that commercialization has a great share in the successful implementation of innovation. Commercialization focuses on obtaining a commercial success during the innovation process while involving facilities like marketing, sales, distribution and joint ventures. During studying the components of business environment which may influence innovation, it is necessary to bring up the framework of determinants of innovation which are: (i) innovation leadership, (ii) managerial levers, and (iii) business processes (Crossan & Apaydin, 2010). The late authors emphasize the fact that managerial levers play direct and indirect roles in innovation activity.

Surprisingly, a recent study of Schmidt, Balestrin, Engelman, and Bohnenberger (2016) concludes that services and infrastructure are necessary, but not sufficient, in order to facilitate R&D processes. A valuable and extensive study of Frenz and Lambert (2012) regarding the innovation system of United Kindom, analysed the relationships between the organizations' performance with innovation environmental in respect to standards, design, accreditation, metrology and intellectual property (IP). Findings confirmed a great role of the infrastructures as a resource in the efficient performance of the company as well as innovation activity.

When mentioning the notion of market openness, Baldwin and Gellatly (2003) debated the importance of entry of new firms to the market relying on the scope of small size companies. They conclude that entry brings new ideas to the market and facilitate innovation and product development. Levers like intense completion trends could also enable the company to innovate more. In addition, consumer preferences, as well as the market orientation, are indicated as important indicators for innovation (Bayarçelik et al., 2014). A study of D'Este et al. (2012) provides evidence that market barriers reflect the degree of difficulty on innovation. Based on the research of Anzola-Román et al. (2018) it can be assumed that the size and sector of the market are playing a specific role, relying on the type of technological innovation. The research of Distanont and Khongmalai (2018), applied for SMEs located in central Thailand, demonstrated that factors which do promote innovation on the micro level are market

orientation and include customers, suppliers and industry. Along with factors on the macro level that influence innovation activities are regulations and national support.

Rao and Weintraub (2013) provide a cherished interpretation which embraces six building blocks of an innovative culture. These blocks are: (1) resources, (2) processes, (3) success, (4) values, (5) behaviours, and (6) climate. Moreover, they are connected between each other as one may impact another. Authors claim that the factors which involve peoples' values and behaviours are more demanding and problematic to cope with. Debating on about the cultural issues, it is necessary to have in mind that the development of creative ideas is a process which requires collaboration and interaction between the business stakeholders. Therefore, employees who support social interactions in the companies are more likely to propose new ideas. Besides, social interaction is believed to facilitate in boosting knowledge and information exchange (Delmas & Pekovic, 2018). The research of Damanpour (1991) evidenced that there does exist a correlation between innovation and specialization, functional differentiation, professionalism, managerial attitude toward change, technical knowledge resources, administrative intensity and external and internal communication.

Table 1 was elaborated for a quick guide regarding factors that influence innovation activity. This table presents the literature framework for the factors influencing innovation which contains literature support for each of the innovation influencing factors.

Table 1. Literature framework for the factors influencing innovation

Factors influencing innovation	Bibliographic References
Financing for entrepreneurs	Katila and Shane (2005); D'Este, Iammarino, Savona, and von Tunzelmann (2012); Bayarçelik, Taşel, and Apak (2014); Law, Lee and Singh, (2018); Brown and Ulijn (2004); Howell (2016)
Governmental support and policies	Jiao, Koo, and Cui (2015)
Taxes and bureaucracy	Howell (2016); Francis and Bessant (2005)
Governmental programs	Baldwin and Gellatly (2003)
Basic and post school school entrepreneurial education and training	Howard Partners (2008); Lundvall (2016); Mihaela and Ţiţan (2014); Baldwin and Gellatly (2003); Lima and da Silva Müller (2017); Bessant and Tidd (2011)
R&D transfer	Hametner, et al. (2018); Baldwin and Gellatly (2003)
Commercial and professional infrastructure	Adams, Bessant and Phelps (2006); Crossan and Apaydin (2010)
Internal market openness	Baldwin and Gellatly (2003)
Internal market dynamics	Bayarçelik, Taşel, and Apak (2014); D'Este, Iammarino, Savona, and von Tunzelmann (2012); Anzola-Román, Bayona-Sáez, and García-Marco (2018); Distanont and Khongmalai (2018)
Physical and services infrastructure	Schmidt, Balestrin, Engelman, and Bohnenberger (2016); Frenz and Lambert (2012)
Cultural and social norms	Rao and Weintraub (2013); Delmas and Pekovic (2018); Damanpour (1991)

Source: Author's own elaboration

2. Research Methodology

2.1. Objective of the study and research hypotheses

The objective of the study is to reveal the business environment factors which influence the innovation activity in business in economies all over the world during the period of 2011-2017. In addition, it is significant to research in which degree each factor has an impact on innovation, this is to estimate the dimension of their impact. To reach this main purpose it is important to perform the outlook of the overall performance of companies, among countries around the world and over time, which are engaged in innovation activity. It is also important to notice, that the analysis of the business environment conditions for innovation activity in the companies worldwide requires taking into consideration the level of the income of the countries. Nowadays, scientific publications based on GEM data reckon a great number of the ones which study specific issues of entrepreneurship phenomenon. Current work is considered being valuable as it contributes to the expansion of knowledge in the area of study of GEM-based scientific researches.

During the present research work, it will be identified and quantified which business environment factors have a stronger influence on the innovation activity of new companies. By applying, simultaneously, space and time dimensions the research work will try to establish causal relations between the business environment variables and the innovation activity of the companies. The main purpose of this research work will be to detect which problems and/or solutions in the business environment are influencing business innovation activity, all over the world and in the last decade. It is believed that the identification and measurement of the business environment influencing factors for the innovation activity will help to detect, examine and discuss sources of problems and incentives which retard or boost, respectively, the innovation activity. Based on theoretical developments about innovation, several hypotheses regarding the business environmental factors that may influence business innovation will be formed and tested.

Table 2 identifies the research study hypothesis. The set of the hypothesis presented is based on the literature framework reviewed and presented in the theoretical part (Section 1). In the table is possible to verify the hypothesis postulated about each of the individual variables as well as the expected results, according to the literature review.

Table 2. Research study hypothesis and expected relationship among variables

Environmental factor	Hypothesis	Expected relationship
Financing for entrepreneurs	H1: Availability of financial resources increases innovation activity	+
Governmental support and policies	H2: The extent of government support and policies has a positive relationship with innovation activity in the company	+/-
Taxes and bureaucracy	H3: Taxes or regulations either size-neutral or that encourage new and SMEs increases innovation activity.	+
Governmental programs	H4: The presence and quality of governmental programs directly assisting companies, promote innovation activity.	+
Basic school entrepreneurial education and training	H5: The extent in basic school entrepreneurial education and training may facilitate the improvement the level of innovation activity.	+
Post school entrepreneurial education and training	H6: The extent in post school entrepreneurial education and training may facilitate the level of innovation activity.	+
R&D transfer	H7: The extent of R&D transfer contributes to the success of innovation activity.	+
Commercial and professional infrastructure	H8: The presence of commercial and professional infrastructure has a positive influence on innovation activity.	+
Internal market openness	H9: The extent of internal market openness supports innovation.	+
Internal market dynamics	H10: The level of internal market dynamic has a strong influence on innovation.	+
Physical and services infrastructure	H11: Ease of access to physical and services infrastructure positively influences innovation activity.	+/-
Cultural and social norms	H12: The extent of cultural and social norms has a positive impact on innovation activity.	+

Source: Author's own elaboration

Statistical data, that has been collected and applied in order to facilitate the results of this work, have two specific sources: (1) Global Entrepreneurship Monitor (GEM) and (2) The World Bank. The statistical data used is public and is available on the webpages of the GEM and the World Bank.

While evaluating the environment of innovation activity in the companies, we will involve the data of Gross National Income (GNI) *per capita* Atlas method of the countries around the world based on the data set of World Bank from the period of 2011-2017 years. According to World Bank (2018), the variable GNI per capita[1] is the gross national income, which is converted to U.S. dollars using the World Bank Atlas method, divided by the midyear population. The classification presented by the World Bank (2018) indicates four groups of income: low-income (995 American dollars *per capita/per* year or less), lower-middle-income (between 996 and 3,895 American dollars *per capita/per* year), upper-middle-income (between 3,896 and 12,055 American dollars *per capita/per* year), and high-income economies (12,056 American dollars *per capita/per* year or more). Besides, this classification distinguishes the following world regions: East Asia and Pacific, Europe and Central Asia, Latin America & the Caribbean, Middle East and North Africa, North America, South Asia, and Sub-Saharan Africa. Table 5 presents the division of the economies under study by income and world region. The analysis will be done just by income level however it is important to understand where countries, divided by income, are located worldwide.

[1] Known before as Gross National Product (GNP) *per capita*.

Table 3. Distribution of countries by income and region

Region	Income level				
	Low-income	Lower-middle-income	Upper-middle-income	High-income	
East Asia and Pacific		Indonesia Philippines Vietnam	China Malaysia Thailand Hong Kong	Australia Japan South Korea Singapoore	
Europe and Central Asia		Georgia Kosovo	Bosnia and Herzegovina Bulgaria Kazakhstan Macedonia Romania Russian Federation Turkey	Austria Belgium Croatia Cyprus Czech Republic Denmark Estonia Finland France Germany Greece Hungary Ireland Italy	Latvia Lithuania Luxembourg Netherlands Norway Poland Portugal Slovak Republic Slovenia Spain Sweden Switzerland United Kingdom
Latin America & the Caribbean		El Salvador	Bezile Brazil Colombia Costa Rica Ecuador Guatemala Guyana	Guyana Jamaica Mexico Peru Suriname Venezuela	Argentina Barbados Chilie Panama Puerto Rico Trinidad and Tobago Ururguay
Middle East and North Africa		Egypt Morocco Tunisia Palestine		Algeria Iran Jordan Lebanon Libya	United Arab Emirates Israel Quatar Saudi Arabia
North America					Canada United States
South Asia	Nepal	Bangladesh India Pakistan			
Sub-Saharan Africa	Burkina Faso Ethiopia Madagascar Malawi Uganda	Angola Cameroon Ghana Nigeria Zambia		Botswana South Africa	

Source: Author's own elaboration using information from the World Bank (2018)

It has to be noted, that the World Bank classification of countries according to the income level as well as the region, was used specifically with only one purpose – the identification of the level of income and region of the economies. Therefore, there is no detail explanation is provided about the World Bank database.

2.2. Global Entrepreneurship Monitor: database and variables

Global Entrepreneurship Monitor (GEM) is a platform that supplies academic research and publications with a primary data based measurement and assessment tools regarding all forms of entrepreneurship activity as well as socio-economic renewal derivatives about approximately 100 countries (GEM, 2018a). GEM research program is focused on studying differences in the entrepreneurship on the international level. GEM project has many benefits due to the public use availability, annual release of the global report on the entrepreneurial activity as well as the unique organizational structure of the projects, which includes the national experts in participating countries, who systematically provide the assessment of national entrepreneurship conditions and political characteristics (Reynolds, 2017). It includes survey-based measures of activities in start-ups and entrepreneurs who are starting a new business. Moreover, GEM provides clear and direct data collection based on the fundamentals of entrepreneurship. Regarding the website of the Global Entrepreneurship Monitor (2018), GEM promotes academic researches as well as scientific publications by offering a profound data collection in respect with such important issues such as entrepreneurship, economic growth, and innovation.

Bosma (2013) described three main objects of the GEM. These objectives are: (i) measuring the level of entrepreneurial activity between countries, (ii) disclosing factors that determine national levels of entrepreneurial activity, and (iii) detecting policies that may enhance national levels of entrepreneurial activity. Furthermore, GEM data guarantees high-quality control due to the thoroughly reviewed surveys. Bergmann, Mueller and Schrettle (2014), viewed GEM as a unique database due to a set of advantages. Firstly, GEM is the only source of comparable data on entrepreneurship which encompasses a great number of countries around the world. Secondly, GEM benefits from other data sources by comprising all kinds of entrepreneurial activities as well as start-ups, early-stage entrepreneurship, and new and established businesses.

Returning to the study of Bosma (2013), the author considered that even on that time was important to bear in mind that the number of publications based on the GEM data had a trend to gradually increase forcing GEM-based publication to reach a higher level of quality. Nevertheless, the Global Entrepreneurship Monitor data project has limitations, which enables future challenges as well as improvements. Bergmann et al. (2014) shared the idea that research works based on GEM data which cover topics such as innovation and internationalization, had not captivated many scholars. A brief analysis of the published researches on this topic stresses the opinion of these last authors, nowadays.

In this study, it is investigated the business environment for innovation activity in SMEs during the period of 2011-2017 in a group of countries from all over the world. A related point to consider is that data is based on the Global Entrepreneurship Monitor and the actual group of 100 countries includes: Algeria, Angola, Argentina, Australia, Austria, Bangladesh, Barbados, Belgium, Belize, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chile, China, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Finland, France, Georgia, Germany, Ghana, Greece, Guatemala, Hong Kong, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kosovo, Latvia, Lebanon, Libya, Lithuania, Luxembourg, Macedonia, Madagascar, Malawi, Malaysia, Mexico, Morocco, Namibia, Netherlands, Nigeria, Norway, Pakistan, Palestine, Panama, Peru, Philippines, Poland, Portugal, Puerto Rico, Qatar, Romania, Russia, Saudi Arabia, Senegal, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Suriname, Taiwan, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Arab Emirates, United Kingdom, United States, Uruguay, Venezuela, Vietnam, and Zambia.

The variable that will be explained (Table 4), measures the percentage of the companies involved in total early-stage entrepreneurial activity (TEA) which consider that their product or service is new to at least some customers and that few/no businesses offer the same product (GEM, 2018c). This will be used as a *proxy* variable for innovation in the present work.

Table 4. Identification and description of the dependent variable

Variable	Description	Measurement unit
Innovation	Percentage of those involved in TEA who indicate that their product or service is new to at least some customers AND that few/no businesses offer the same product	percent, %

Source: Author's own elaboration based on the GEM (2018a)

The variables that will be used to explain the innovation activity in the companies are the twelve ones that, according to experts[2] (GEM, 2018d), define the business environment of economies. These variables, presented and described in Table 5, include: (1) financing for entrepreneurs, (2) governmental

[2] A representative National sample of at least 36 experts stratified on the following nine critical framework conditions (four experts related to the each of them): entrepreneurial financing system, governmental public policies for entrepreneurs, governmental public policies for entrepreneurs, entrepreneurial education and training, R&D transfer, commercial and professional infrastructure, internal market openness, physical infrastructure and services, cultural and social norms. Experts are selected based on their experience and specialization in the framework conditions. All geographic regions of the country should be covered, including urban and rural areas; experts must be residents in the target country or region.

support and policies, (3) taxes and bureaucracy, (4) governmental programs, (5) basic school entrepreneurial education and training, (6) post-school entrepreneurial education and training, (7) R&D transfer, (8) commercial and professional infrastructure, (9) internal market dynamics, (10) internal market openness, (11) physical and services infrastructure, (12) cultural and social norms (Global Entrepreneurship Monitor Consortium, 1999).

Table 5. Identification and description of the independent variables

Variables	Description	Measurement unit
Financing	Availability of financial resources such as equity and debt for small and medium enterprises (SMEs) including grants and subsidies.	5 points Likert scale, where 1 means the statement is completely false, according to the experts, and 5 means the statement is completely true
Governmental support and policies	The extent to which public policies support entrepreneurship - entrepreneurship as a relevant economic issue.	
Taxes and bureaucracy	The extent to which taxes or regulations are either size-neutral or encourage new and SMEs.	
Governmental programs	The presence and quality of programs directly assisting SMEs at national, regional, and municipal levels of government.	
Basic school entrepreneurial education and training	The extent to which training in creating or managing SMEs is incorporated within the education and training system at primary and secondary levels.	
Post school entrepreneurial education and training	The extent to which training in creating or managing SMEs is incorporated within the education and training system in higher education such as vocational, college, business schools, etc.	
R&D transfer	The extent to which national research and development will lead to new commercial opportunities and is available to SMEs.	
Commercial and professional infrastructure	The presence of property rights, commercial, accounting and other legal and assessment services and institutions that support or promote SMEs.	
Internal market openness	Extent to which new firms are free to enter existing markets.	
Internal market dynamics	Level of change in markets from year to year.	
Physical and services infrastructure	Ease of access to physical resources such as communication, utilities, transportation, land or space at a price that does not discriminate against SMEs.	
Cultural and social norms	Extent to which social and cultural norms encourage or allow actions leading to new business methods or activities that can potentially increase personal wealth and income.	

Source: Author's own elaboration based on the GEM (2018a; 2018b)

It is worth to note, that regarding time and economies, some observations in the dataset of GEM might be absent – the panel composed of years and economies is an unbalanced panel. However, that will not affect the econometric model that foresees the problems and presents solutions to solve it, as explained in a future subsection.

2.3. Methods of Data Analysis

2.3.1. Descriptive Analysis

Before presenting the results of the estimations based on the panel data econometric method, it will be presented some specific descriptive analysis for each variable in the analysis within a panel of observations and time. According to Holcomb (2016), descriptive statistics are used in order to summarize and organize, when a big set of data are needed to be interpreted. Descriptive statistics is one of the statistical methods, which help us to summarize the data set as well as help us to describe the main features of the data regarding our research, using mean and standard deviation (Mishra et al., 2019). The descriptive analysis will contain the main indicator of a distribution centrality, the mean, and three indicators for the variability in distribution: the standard deviation, the maximum and the minimum values for the overall, between and within observations. The overall observations include the variation observed among countries (the individual observations in this research) during the period of time and concerning the information about countries. The between values include the variation of values across countries within a period of time. And the within values include the variation of values for a specific economy. The mean indicator is considered the standard measure of the centre of the distribution of the data.

2.3.2. Panel Data Analysis

In order to achieve the objective of the study, while concluding the analysis, panel data analysis is going to be implemented. Panel data method implicates two dimensions: individual observations and time. Regarding the current issue, the individual dimension represents a set of countries, while the time dimension embodies the period of time from 2011 to 2017.

There exist many benefits of opting for a panel data method instead of other econometric regression methods, namely the traditional well-known Ordinary Least Squares (OLS) regression analysis. According to Hsiao (2007) the following strong points of panel data are: (i) high level of sample variability, which ensures precise results of the model parameters, (ii) ability to consider the complexity of human behaviour, (iii) having control over the effect of omitted variables, (iv) detecting dynamic relationships among individuals and over time. Regarding Longhi and Nandi (2015), longitudinal data has an advantage over cross-section data, as the first one is able to analyse the transitions or changes over time. According to the same author, it is possible to apply such econometric techniques as fixed and

random effects, even in case of repeated observations for the same individual, since longitudinal data analysis, as the panel data methods, enables to study dynamics as well as to measure changes.

Panel data analysis is being widely used for the purpose of finding results in scientific articles with a similar background - innovation activity. In particular, some of the following authors investigate innovation activity on the scale of small and medium enterprises. For instance, the study of Ren, Eisingerich and Tsai (2015) aimed at exploring the relationships, in particular, the influence of business factors on the performance of innovation in China's SMEs. By implementing panel data analysis, the authors concluded that internationalization positively affects the innovation performance of the company, when the R&D capability or marketing capability is high and affects innovation performance negatively. More recently, Liu, Mu, Hu, Wang and Wang (2018), using panel data analysis identified the existence of a U-shape relationship between intellectual property (IP), protection and technological innovation, regarding advanced manufactured SMEs in China. Before, Horbach (2008), had taken into account environmental innovation issues, using two German panel databases. The author concluded the development of technological capabilities by R&D or further education measures generates environmental innovations. He also confirmed the hypothesis "innovation initiates innovation" by implementing the analysis of Mannheim Innovation Panel (MIP) data.

Panel data is multi-dimensional data that consists of measurement over a period of time. Equation [1] for panel model regression explains the relationship between the dependent variable (Y) at time t and observation i and the independent variable (X) at the same time and individual dimensions. In the equation, α is an intercept, β is a parameter which quantifies how much the independent variable (X) influences (explains) the dependent variable (Y) and e is an error (Pillai, 2016).

$$Y_{it} = \alpha_{it} + \beta X_{it} + e_{it} \quad [1]$$

According to Longhi and Nandi (2015), panel data allows to take into consideration the individual unobserved heterogeneity. In the particular case of this research work, panel data gives the possibility to examine the differences between the economies in analysis, over time.

Panel data may allow to identify individual (group) effects, time effects (or even both effects). For that, panel data are analysed using the fixed effect panel data and the random effects panel data, respectively. The fixed effects (FE) model observes if intercepts vary across groups (countries) or time period. The random effects (RE) model examines differences in the error variance components across countries or time period (Park, 2011). These differences are indicated as individual-specific heterogeneity or time specific heterogeneity and they will be represented by the fixed parameters, thus the models are deemed to have fixed effect (Biørn, 2016).

According to (Park, 2011) the equations for the FE model (equation [2]) and the RE model (equation [3]) are the following:

$$Y_{it} = \alpha_i + \beta X'_{it} + e_{it} \quad [2]$$

$$Y_{it} = \alpha + \beta X'_{it} + (u_i + e_{it}) \quad [3]$$

Note, that u_i is a fixed or random effect specific to individual (country) or time period that is not included in the regression, and is assumed that errors are independent and identically distributed.

In order to choose between the FE or the RE models, the Hausman test have to be conducted. Hausman test takes into account the existence of a statistically significant p-value that results from the test to accept (or not accept). Hausman test (which hypothesis are presented in equation [4]) assumes as the null hypothesis the RE estimates are efficient and consistent. The alternative hypothesis claims that RE estimates are inefficient and the results of the FE are the ones to be considered (Pillai, 2016).

$$\begin{cases} H_0: Random\ effects\ (RE)\ estimates\ are\ consistent\ and\ efficient \\ H_A: Random\ effects\ (RE)\ estimates\ are\ inefficient \end{cases}, \quad [4]$$

3. Presentation and Analysis of Empirical Results

With a purpose of estimating the innovation activity all over the world based on GEM data, statistical analysis is going to be made. The purpose of analysis is to designate the correlation between the innovation activity in countries all around the world from the period of time from 2011 to 2017 and the influencing factors which may predict the business environment. The following statistical analysis aimed at establishing relationships between dependent variable innovation, which signifies the percentage of the companies involved in total early-stage entrepreneurial activity (TEA) which consider that their product or service is new to at least some customers and that few/no businesses offer the same product and independent variables which foresee the business environment and are estimated from 1 to 5 points.

The adequate and profound statistical analysis will be impossible to reach without considering the level of income of different economies. It is worth noting, that the innovation activity regarding the level of income of different economies may differ. Therefore, analyzing innovation activity of economies with income levels will be advisable. To start the analysis a descriptive statistical analysis is made.

3.1. Descriptive statistics of the variables under study[3]

The statistical descriptive analysis is based on indicators as mean, standard deviation (Std. Dev.) and maximum (Max) and minimum (Min) values for the overall, between and within observations. The overall observations include all the countries analysed during the period of time in study, this is, the overall sample (433 observations considering countries and periods of time). The results for the between observations are the descriptive statistics obtained regarding each group of countries (100 groups referred to the 100 countries). The within observations correspond to the observations for each economy.

[3] All the results have been obtained using the Stata statistical, 12.0 version.

Since the panel is an unbalanced one (not all the countries have data for all the years) the number of countries is, in average, 4,33 economies.

Table 6 presents the above mentioned descriptive analysis for the dependent variable – innovation - and all the twelve independent variables.

Table 6. Descriptive panel analysis of dependent and independent variables

Variables	Statistics	Mean	Std. Dev.	Min	Max	Observations
Dependent variable						
Innovation	overall	25,73	10,38	0,76	58,70	N = 433
	between		9,27	6,78	55,17	n =100
	within		5,16	8,21	50,85	T-bar =4,33
Independent variables						
Financing	overall	2,53	0,42	1,62	3,71	N =433
	between		0,37	1,83	3,38	n =100
	within		0,19	2,02	3,17	T-bar =4,33
Governmental support and policies	overall	2,57	0,48	1,56	3,96	N =433
	between		0,43	1,77	3,54	n =100
	within		0,24	1,50	3,87	T-bar =4,33
Taxes and bureaucracy	overall	2,40	0,55	1,28	4,18	N =433
	between		0,53	1,53	4,18	n =100
	within		0,20	1,68	3,78	T-bar =4,33
Governmental programmes	overall	2,61	0,48	1,34	3,75	N =433
	between		0,45	1,50	3,62	n =100
	within		0,17	1,99	3,29	T-bar =4,33
Basic school entrepreneurial education and training	overall	2,02	0,41	1,15	3,43	N =433
	between		0,39	1,22	3,07	n =100
	within		0,18	1,34	3,24	T-bar =4,33
Post school entrepreneurial education and training	overall	2,83	0,36	1,82	3,86	N =433
	between		0,33	1,85	3,54	n =100
	within		0,17	2,35	3,26	T-bar =4,33
R&D transfer	overall	2,35	0,39	1,43	3,73	N =433
	between		0,36	1,55	3,53	n =100
	within		0,15	1,70	2,81	T-bar =4,33
Commercial and professional infrastructure	overall	2,99	0,35	1,26	3,90	N =433
	between		0,29	2,09	3,66	n =100
	within		0,17	2,17	3,81	T-bar =4,33
Internal marker dynamics	overall	3,02	0,51	1,78	4,35	N =433
	between		0,45	2,01	4,16	n =100
	within		0,22	2,26	3,85	T-bar =4,33
Internal market openess	overall	2,56	0,36	1,29	3,73	N =433
	between		0,30	1,71	3,53	n =100
	within		0,17	2,00	3,32	T-bar =4,33
Physical and services infrastructure	overall	3,76	0,48	2,10	4,82	N =433
	between		0,47	2,31	4,80	n =100
	within		0,19	1,95	4,29	T-bar =4,33
Cultural and social norms	overall	2,83	0,48	1,62	4,40	N =433
	between		0,43	1,93	4,21	n =100
	within		0,18	2,23	3,53	T-bar =4,33

Source: Author's own elaboration

The analysis includes the sample size N, which indicates the number of all observations included (economies multiplied by the years for which exist statistical data), the number of countries, n, and the average number of countries, T-bar, which gives the information about the average number of economies under observation (T=N/n). Indeed, the results presented in Table 6 provide a quick way to understand not only the overall central tendency and the variability of values for all the observations but, also, the between and within variance for the variables under study. The minimum and the maximum values can help understand the range for each country but are less helpful for the within data (specifically because it is an unbalanced panel). Still, the between and within standard deviations should be examined closely.

Results of the table indicate that, in average, 25,7% of all 433 observations worldwide indicated that companies involved in early-stage entrepreneurial activities (TEA) indicate that their product or service is new to at least some customers and few or no businesses (at all) offer the same product. The standard deviation of innovation activity within a period of time is bigger than across countries. However, the standard deviation between observation reaches a relative value of around 40% of the average value (10,38% out of 25,7%), which indicates that a big variability can be observed for the 433 observations. The minimum percentage of companies around the world with an early stage entrepreneurial activity that consider are offering an innovative product is just 0,76%[4]. The maximum value reaches 58,7%[5].

Regarding the results for the between and within observations, Table 6 shows that the variability of innovation among countries is bigger than the variability verified for each economy over time (the standard deviation (9,27%) between the groups of economies is bigger than the standard deviation (5,16%) within each economy over time). Moreover, the range between minimum and maximum values among groups of countries is much bigger than the range between these values within the economies over time. This indicates the importance of undertake an analysis that may divide countries in homogenous groups, like the division of countries by level of income.

When talking in account the factors that determine business environment, results provide evidence that the indicators related to physical and services infrastructure and the internal market dynamics present the highest overall assessment average values – 3,76% and 3,02%, respectively (in a scale from 1 to 5, as should be remembered). The indicators that present the lowest overall assessment average values are the indicators related with the basic school entrepreneurial education and training (2,02%), the R&D transfer (2,35%) and the taxes and bureaucracy (2,40%). It is also important to notice that the average overall expert's assessment is for most indicators below 3 point values – only the 2 indicators abovementioned indicators with a higher assessment present an average overall assessment higher than 3 point values. However, the average hides the existence of big differences in the expert's assessment. Overall there are economies, in specific years, with a very low assessment. For instance, the indicator that measures the basic school entrepreneurial education and training reaches the minimum

[4] The value was found for Brazil in 2013.
[5] The value was found for Lebanon in 2016.

of 1,15 points and never reaches a value higher than 3,43 points. At the same time, the indicator that measures the cultural and social norms presents, according with the experts, an overall minimum of 1,64 points and a maximum assessment of 4,40 points. The indicators that measures the taxes and bureaucracy presents a behaviour similar to the cultural and social norms – the indicator had been assessed by the experts with an overall minimum of 1,28 and a maximum of 4,18 points and presents the higher overall standard deviation value (0,55% for an overall mean of 2,40).

Also for these indicators, it is clear that the differences among groups is bigger than the differences among economies over time – the standard deviation is always bigger among groups of economies than among economies over time. Again, it shows the importance of making a division of economies in groups more homogeneous to understand better how the business environment indicators.

Table 7, presents the results for the overall, between and within mean, standard deviation, minimum and maximum values for the innovation activity in firms engaging in early-stage entrepreneurial activities. The levels of income considered are, by order of appearance in the table: high, low, lower-middle and upper-middle[6].

Table 7. Descriptive panel analysis for the innovation activity, by levels of income

Variable	Level of income	Statistics	Mean	Std. Dev.	Min	Max	Observations
Innovation	High income	overall	29,33	9,60	8,19	57,35	N =225
		between		8,51	12,52	55,17	n =44
		within		4,59	14,80	44,80	T-bar = 5,11
	Low income	overall	20,87	7,61	7,56	36,61	N =30
		between		7,05	8,98	32,41	n =9
		within		4,39	11,88	32,64	T-bar = 3,33
	Lower middle income	overall	20,75	8,94	5,08	51,08	N =44
		between		7,86	6,78	33,83	n =16
		within		4,97	7,86	38,00	T-bar = 2,75
	Upper middle income	overall	22,40	10,46	0,76	58,70	N =134
		between		8,86	9,64	47,99	n =31
		within		6,23	4,89	47,52	T-bar = 4,32

Source: Author's own elaboration

Regarding the descriptive statistics results presented in Table 7 should be first noticed that the group of low-income level countries includes 9 economies, the lower middle-income level economies are 16, the economies in an upper middle-income level are 31 and there are, in full database, 44 economies with a high-income level (the highest amount of economies in a level of income). The group of economies in a

[6] Due to the high amount of statistical information that was needed to present for the nine indicators of business environment, regarding each level of income – nine indicator multiplied by four levels of income, has been decided not to present the descriptive statistics for these indicators and focus the analysis in the variable that is being explained the innovation.

lower middle-income level is the one for each are found more missing values (years without statistical data to analyze by year – just 2,75). The combination of a small number of economies in this level of income and the big amount of missing values just allows a total of 44 observations. The group of countries with the highest levels of income are the ones that present less missing values (in average there is information for 5,11 countries/year) and, therefore, more overall observations (225 observations).

The overall mean of innovation in companies engaged in TEA varies from 20,75% and 20,87% in lower-middle income and low-income economies, respectively, and 22,4% and the maximum of 29,33% for the income levels of upper-middle and high-income countries, respectively.

From the previous analysis is obvious that companies operating in countries with higher levels of income innovate more. However, the standard deviation observed is also high – on these economies the values of innovation run from 8,19% (Panama, in 2014) and 57,35% (Chile, 2011). The overall standard deviation is only bigger in the upper-middle income countries. In these countries, the overall innovation in TEA companies vary from 0.76% to 58,70% (in the countries mentioned in Table 6). Low-income countries are the ones more homogenous regarding the levels of innovation – the range stands between 7,56% and 36,61%. This is the group of countries that innovates, overall, less.

Again, and also for the levels of income, it is possible to observe that the variability among countries, inside each level of income (between values), is higher than the variability of innovation in economies over time (within values). However, such variability is reduced when compared with the values presented in Table 6 when the countries were considered without any income level division. These results show the division of countries in more homogeneous groups is a good solution to deal with the worldwide heterogeneity among 100 countries and may allow to obtain more robust results on the impact of each business environment indicator consider by the GEM's experts on the innovative performance of companies engaged in an early-stage entrepreneurial activity.

3.2. Overall panel data results' analysis: fixed and random effects[7]

Beware of the mentioned above, the purpose of this work is to identify and estimate the relationship between the innovation activity and business environmental factors in countries around the world from the period of time from 2011 to 2017.

In other words, the research is focused on estimating the level of influence of business environmental factors on innovation activity. In order to attain the results, panel data analysis, in particular, fixed and random effects models are going to be implemented. As already has been observed, the countries in analysis presents differences not only in terms of the level of innovation but also in terms of experts' evaluation. Regarding this fact, there is a need to take into account these differences by applying both fixed and random effects panel data models. The fixed effects panel data model is concerned about the

[7] All the results have been obtained using the Stata statistical, 12.0 version.

differences that are present between economies and do not change with time, in a general scope, while random effects panel data model is concentrated mainly on detecting random differences that may appear among those economies. As explained in the methodology the Hausman test will allow to understand which estimates are more efficient and only then will be presented in the next tables. In addition, in respect with the literature review, some hypotheses are going to be tested according with Table 2 presented in the methodology section. The panel data analysis will be implemented for the entire set of countries, as all, and for the same countries but divided by level of income, as explained in the previous subsection.

Regarding each of the independent variables, the hypotheses based on the literature review were postulated and econometric univariate models were formulated. Econometric models indicate how the value of the dependent variable, innovation, in both time and space dimensions, change due to changes in each of the independent variables concerning the business environment, also in both time and space dimensions. Since the dependent variables are measured in a continuous scale of 1 to 5 points, an additional mathematical transformation has been made – the values were logarithmized to flatten all the values for the variables and also to make it easier to read the results, this is, all the results will be read in percentage (the same measurement unit as for innovation) when the logarithmized model's results are presented.

Panel data estimation results will present the estimated coefficients for the fixed or the random effects estimated values, according with the values found for the Hausman test, and the results of the Hausman test to understand if the choice should rely on the estimated fixed or random effects results. While performing the panel data estimations, both values for the standard and converted (logarithmized) independent variables were taken into account.

3.2.1. Hypothesis test results: worldwide

The first hypothesis considered in this research work believes that the availability of financial resources in an economy enhances the innovation activity on that economy. So, the hypothesis to be tested is presented below as well the equations for the econometric models (fixed and random effects models). Table 8 presents the results of the panel data model that, according with the Hausman test, best describe the influence of the indicator on the innovation activity and therefore, the results that allow, or not, accept the hypothesis elaborated.

H1: Availability of financial resources increases innovation activity.

Fixed effects: $Innovation_{it} = \alpha_i + \beta\, Financing_{it} + e_{it}$

Random effects: $Innovation_{it} = \alpha + \beta\, Financing_{it} + (u_i + e_{it})$ [5]

Table 8. Panel data estimated results for the business environment indicator: financing

Independent variable	Normal model	Logarithmic model
	Random effects results	Random effects results
Financing	3,13**	7,81**
Constant	19,14	19,96
	Statistics	
Number of observation	433	
Number of groups	100	
Hausman test	0,49	0,57

Note: ** indicate statistical significance at 5% level of significance

Source: Author's own elaboration

The more efficient estimated results, according with the Hausman test (which value is not statistically significant), are the results for the random effects panel data model. This is, there are non-observable behaviour difference among the countries that are constant over time and are just captured in the error term. Besides, the pre-existence difference among countries is a random parameter. According with the estimated results, with 95% of confidence, 1 unit more in the experts' evaluation regarding the availability of financial resources, such as equity and debt, for small and medium enterprises (SMEs) including grants and subsidies will make the innovation activity of companies increase 3,13%. In percentage, is possible to say that an increase in 1% in the evaluation's assessment of the financing item, increases the innovation activity in 7,81%. These values show the importance of the availability of financing resources to enhance the innovation activity of companies, over countries, even if there are differences non-observed among them that are not captured by the model. The first hypothesis is accepted and confirmed for a significance level of 5%.

The second hypothesis considered believes that a higher extension of government support and policies for entrepreneurship, since it is considering a relevant economic issue, has a positive relationship with innovation activity in the companies of the country. So, the hypothesis to be tested is presented below as well the equations for the econometric models (fixed and random effects models). Table 9 presents the results of the panel data model that, according with the Hausman test, best describe the influence of the indicator on the innovation activity and therefore, the results that allow, or not, accept the hypothesis elaborated.

H2: The extent of government support and policies has a positive relationship with innovation activity in the company

Fixed effects: $Innovation_{it} = \alpha_i + \beta\ Government\ support\ and\ policies_{it} + e_{it}$ [6]

Random effects: $Innovation_{it} = \alpha + \beta\ Government\ support\ and\ policies_{it} + (u_i + e_{it})$

Table 9. Panel data estimated results for the business environment indicator: governmental support and policies

Independent variable	Normal model	Logarithmic model
	Random effects results	Random effects results
Governmental support and policies	2,37**	5,92**
Constant	21,1	21,64
Statistics		
Number of observation	433	
Number of groups	100	
Hausman test	1,03	1,14

Note: ** indicate statistical significance at 5% level of significance

Source: Author's own elaboration

Like for the previous indicator, the more efficient estimated results, according with the Hausman test (not statistically significant), are the results for the random effects panel data model. With 95% of confidence, 1 unit more in the experts' evaluation regarding the government support and policies towards entrepreneurship will make the innovation activity of companies increase 2,37%. In percentage, is possible to say that an increase in 1% in the evaluation's assessment of the government entrepreneurship and policies, increases the innovation activity in 5,92%. These values show the importance of the availability of financing resources to enhance the innovation activity of companies, over countries, even if there are differences non-observed among them that are not captured by the model. The second hypothesis is accepted and confirmed for a significance level of 5%.

The third hypothesis considers the extent to which taxes or regulations are either size-neutral or encourage new and SMEs increases the innovation activity. It is expected a positive relationship between this explanatory variable and the innovation activity. The hypothesis to be tested is presented below as well the equations for the econometric models (fixed and random effects models). Table 10 presents the results of the panel data model that, according with the Hausman test, best describe the influence of the indicator on the innovation activity and therefore, the results that allow, or not, accept the hypothesis elaborated.

H3: Taxes or regulations either size-neutral or that encourage new and SMEs increases innovation activity.

Fixed effects: $Innovation_{it} = \alpha_i + \beta\ Taxes\ and\ bureaucracy_{it} + e_{it}$

Random effects: $Innovation_{it} = \alpha + \beta\ Taxes\ and\ bureaucracy_{it} + (u_i + e_{it})$ [7]

Table 10. Panel data estimated results for the business environment indicator: taxes and bureaucracy

Independent variable	Normal model	Logarithmic model
	Random effects results	Random effects results
Taxes and bureaucracy	3,69***	9,22***
Constant	15,92	17,34
Statistics		
Number of observation	433	
Number of groups	100	
Hausman test	0,19	0,1

Note: *** indicate statistical significance at 1% level of significance

Source: Author's own elaboration

The Hausman test, as before, indicates the results of the random effects model are the more efficient ones to demonstrate that taxes and regulation that are either size-neutral or encourage new and SMEs increase the innovation activity of an economies' companies. With 99% of confidence is demonstrated the hypothesis H3 is verified and the effect is not only evident but is, also statistically very robust. One unit more in the experts' evaluation indicating that the economy's taxes and regulation are more neutral and encourage more the new SMEs allows the innovation activity in those companies will increase 3,69%. In percentage, is possible to say that an increase in 1% in the evaluation's assessment, increases the innovation activity in almost 10%. These values show the importance to reduce the red tape and the payment of taxes that represent difficulties in the business environment, over countries, even if there are differences non-observed among them that are not captured by the model.

The fourth hypothesis considers the presence and quality of programs directly assisting SMEs at national, regional, and municipal levels of government. After the literature review, and as it has been explained, it is expected a positive relationship between this explanatory variable and the innovation activity. The hypothesis to be tested is presented below as well the equations for the econometric models (fixed and random effects models). Table 11 presents the results of the panel data model that, according with the Hausman test, best describe the influence of the indicator on the innovation activity and therefore, the results that allow, or not, accept the hypothesis elaborated.

H4: The presence and quality of governmental programs directly assisting companies, promote in advancing innovation activity.

Fixed effects: $Innovation_{it} = \alpha_i + \beta\ governmental\ programs_{it} + e_{it}$

Random effects: $Innovation_{it} = \alpha + \beta\ governmental\ programs + (u_i + e_{it})$ [8]

Table 11. Panel data estimated results for the business environment indicator: governmental programs

Independent variable	Normal variable	Logarithmic variable
	Fixed effects results	Fixed effecs results
Governmental programs	1,13	2,99
Constant	22,75	22,91
Statistics		
Number of observation	433	
Number of groups	100	
Hausman test	6,78***	6,18**

Note: *** indicate statistical significance at 1% level of significance

Source: Author's own elaboration

For this hypothesis, the Hausman test value is statistically significant, so it is not possible to accept that the results of the random effects are more efficient. By opposition, the test indicates fixed effects results are more efficient. The estimated coefficients are not statistically significant, both for the normal model and for the logarithmic one, so is not possible to confirm that the presence and quality of governmental programs directly assisting SMEs at national, regional, and municipal levels of government have a positive impact on the companies' innovation.

The fifth hypothesis considers the extent to which training in creating or managing SMEs is incorporated within the education and training system at primary and secondary levels. It is expected a positive relationship between this explanatory variable and the innovation activity. The hypothesis to be tested is presented below as well the equations for the econometric models (fixed and random effects models). Table 12 shows the results of the panel data model that, according with the Hausman test, best describe the influence of the indicator on the innovation activity and therefore, the results that allow, or not, accept the hypothesis elaborated.

H5: The extent to which training in creating or managing SMEs is incorporated within the education and training system at primary and secondary levels may facilitate in improving the level of innovation activity.

Fixed effects: $Innovation_{it} = \alpha_i + \beta\ basic\ school\ entrepreneurial\ education\ and\ training_{it} + e_{it}$ [9]

Random effects: $Innovation_{it} = \alpha +$

$\beta\ basic\ school\ entrepreneurial\ education\ and\ training\ + (u_i + e_{it})$

Table 12. Panel data estimated results for the business environment indicator: basic school entrepreneurial education and training

Independent variable	Normal variable	Logarithmic variable
	Random effects results	Random effects results
Basic school entrepreneurial education and training	2,81**	5,64**
Constant	19,28	21,11
Statistics		
Number of observation	433	
Number of groups	100	
Hausman test	0,77	0,72

Note: ** indicate statistical significance at 5% level of significance

Source: Author's own elaboration

Hausman test indicated that random effects model is the more efficient one. There results - for both models - demonstrate that the extent of basic school entrepreneurial education and training facilitates the improvement of the level of innovation activity. The hypothesis H5 is confirmed for both models with a 95% of confidence level. One unit more in experts´ evaluation demonstrate that the extent to which training in creating or managing SMEs is incorporated within the education and training system at primary and secondary levels rise the innovation activity in SMEs in 2,81%. In percentage, it could be assumed that 1% of increase in the extent to which training in creating or managing SMEs is incorporated within the education and training system at primary and secondary levels promotes the development of innovation activity in almost in 6%.

The sixth hypothesis takes into account the extent to which training in creating or managing SMEs is incorporated within the education and training system in higher education such as vocational, college or business schools (Lundvall, 2016). As in the previous hypothesis, it is expected a positive relationship between this explanatory variable and the innovation activity. The hypothesis to be tested is presented below as well the equations for the econometric models. Table 13 shows the results of the panel data model that, according with the Hausman test, best describe the influence of the indicator on the innovation activity and therefore, the results that allow, or not, accept the hypothesis elaborated.

H6: The extent in post school entrepreneurial education and training may facilitate in improving the level of innovation activity.

$$\text{Fixed effects: } Innovation_{it} = \alpha_i + \beta\ post\ school\ entrepreneurial\ education\ and\ training_{it} + e_{it} \quad [10]$$

$$\text{Random effects: } Innovation_{it} = \alpha + \beta\ post\ school\ entrepreneurial\ education\ and\ training + (u_i + e_{it})$$

Table 13. Panel data estimated results for the business environment indicator: post school entrepreneurial education and training

Independent variable	Normal variable	Logarithmic variable
	Fixed effects results	Fixed effecs results
Post school entrepreneurial education and training	-0,21	-0,75
Constant	26,33	26,50
Statistics		
Number of observation	433	
Number of groups	100	
Hausman test	2,95*	3,03*

Note: * indicate statistical significance at 10% level of significance

Source: Author's own elaboration

Hausman test shows that fixed effects model results are more efficient. However, the estimated coefficients are not statistical significance. Therefore, it is not possible to make conclusions regarding hypothesis H6. If education/ training in creating or managing SMEs is incorporated within the education and training system at primary and secondary levels seems to have an important impact on the innovation behaviour if it is taught in an early age (primary and secondary school), the impact cannot be proved if the same education/training for entrepreneurship is just present at higher level or education and at an older age.

The seventh hypothesis regards the extent to which national research and development will lead to new commercial opportunities and is available to SMEs. It is expected a positive relationship between this explanatory variable and the innovation activity. The hypothesis which is tested is presented below as well the equations for the econometric models (fixed and random effects models, depending of the Hausman test results). Table 14 shows the estimated coefficients selected according with the Hausman test and therefore, the results that allow, or not, accept the hypothesis elaborated.

H7: The extent to which national research and development will lead to new commercial opportunities contributes to the rise of innovation activity.

Fixed effects: $Innovation_{it} = \alpha_i + \beta\ R\&D\ transfer_{it} + e_{it}$

Random effects: $Innovation_{it} = \alpha + \beta\ R\&D\ transfer + (u_i + e_{it})$ [11]

Table 14. Panel data estimated results for the business environment indicator: R&D transfer

Independent variable	Normal variable	Logarithmic variable
	Fixed effects results	Fixed effecs results
R&D transfer	-0,50	-1,78
Constant	26,90	27,22
Statistics		
Number of observation	433	
Number of groups	100	
Hausman test	12,6***	13,71***

Note: *** indicate statistical significance at 1% level of significance

Source: Author's own elaboration

Hausman test indicates the fixed effects model results are considered as the more efficient ones. The findings demonstrate no statistical significance of the extent to which national research and development will lead to new commercial opportunities and is available to SMEs on the level of innovation. Consequently, the outcomes enable to make conclusions regarding the hypothesis H7.

The eighth hypothesis considers the presence of property rights, commercial, accounting and other legal and assessment services and institutions that support or promote SMEs. Regarding this factor, is expected a positive relationship between this explanatory variable and the innovation activity. The hypothesis which is tested is presented below as well the equations for the econometric models. Table 15 demonstrates the results of the panel data model that, according with the Hausman test, best describe the influence of the indicator on the innovation activity and therefore, the estimated coefficients that allow, or not, accept the hypothesis elaborated.

H8: The presence of property rights, commercial, accounting and other legal and assessment services and institutions has a positive influence on innovation activity.

Fixed effects: $Innovation_{it} = \alpha_i + \beta\ commercial\ and\ professional\ infrastructure_{it} + e_{it}$ [12]

Random effects: $Innovation_{it} = \alpha + \beta\ commercial\ and\ professional\ infrastructure + (u_i + e_{it})$

Table 15. Panel data estimated results for the business environment indicator: commercial and professional infrastructure

Independent variable	Normal variable	Logarithmic variable
	Fixed effects results	Fixed effecs results
Commercial and professional infrastructure	-0,01	-1,28
Constant	25,75	27,13
Statistics		
Number of observation	433	
Number of groups	100	
Hausman test	9,02***	9,8***

Note: *** indicate statistical significance at 1% level of significance

Source: Author's own elaboration

Again, the results of Hausman test reveal fixed effects models results are more efficient. Again, also, the results of panel analysis claim that there is no statistical significance of the presence of property rights, commercial, accounting and other legal and assessment services and institutions that support or promote SMEs for the innovation activity in SMEs. Hence, no conclusion can be taken considering the hypothesis H8.

The ninth hypothesis takes into account the extent to which new firms are free to enter existing markets. There is expected a positive relationship between this explanatory variable and the innovation activity. The hypothesis which is tested is presented below as well the equations for the econometric models. Table 16 demonstrates the results of the panel data model that, according with the Hausman test, best describe the influence of the indicator on the innovation activity and therefore, the results that allow, or not, accept the hypothesis elaborated.

H9: The extent to which new firms are free to enter existing markets supports innovation.

Fixed effects: $Innovation_{it} = \alpha_i + \beta\ internal\ market\ openness_{it} + e_{it}$

Random effects: $Innovation_{it} = \alpha + \beta\ internal\ market\ openness + (u_i + e_{it})$ [13]

Table 16. Panel data estimated results for the business environment indicator: internal market openness

Independent variable	Normal variable	Logarithmic variable
	Fixed effects results	Fixed effecs results
Internal market openness	3,03*	6,70
Constant	17,95	19,49
	Statistics	
Number of observation	433	
Number of groups	100	
Hausman test	3,48*	3,96**

Note: * indicate statistical significance at 10% level of significance, ** indicate statistical significance at 5% level of significance

Source: Author's own elaboration

Based on the outcome of Hausman test, the estimated coefficients of the fixed effects model are the more efficient ones. That means that the hypothesis H9 is confirmed with statistical importance, the results are presented with 90% of confidence level. One unit more in experts' evaluation indicate that the extent to which new firms are free to enter existing markets increases the innovation in SMEs in 3,03%. This is possible to assume, that with the elimination of market entrance barriers, the level of innovation in the SMEs will grow.

The tenth hypothesis considers the level of change in markets from year to year. It is expected a positive relationship between this explanatory variable and the innovation activity. The hypothesis which is tested is presented below as well the equations for the econometric models (fixed and random effects models). Table 17 show the results of the panel data model that, according with the Hausman test, best describe the influence of the indicator on the innovation activity and therefore, the results that allow, or not, accept the hypothesis elaborated.

H10: The level of change in markets from year to year has a positive influence on innovation.

Fixed effects: $Innovation_{it} = \alpha_i + \beta\ internal\ market\ dynamics_{it} + e_{it}$

Random effects: $Innovation_{it} = \alpha + \beta\ internal\ market\ dynamics + (u_i + e_{it})$ [14]

Table 17. Panel data estimated results for the business environment indicator: internal market dynamics

Independent variable	Normal variable	Logarithmic variable
	Random effects results	Random effects results
Internal market dynamics	-3,18**	-9,33**
Constant	32,44	35,16
Number of observation	433	
Number of groups	100	
Hausman test	1,95	2,08

Note: ** indicate statistical significance at 10% level of significance

Source: Author's own elaboration

As had happened before, Hausman test indicates random effects results are more efficient than the fixed effects ones. The hypothesis H10 is confirmed with 95% of confidence. It should be mentioned that one unit more in experts' evaluation shows that the level of change in markets from year to year decreases the innovation activity in companies. A very high turnover in the business fabric seems to be a factor of limitation of the innovation process. Some stability seems to be important for companies to decide engage in an innovative process.

The eleventh hypothesis considers the ease of access to physical resources such as communication, utilities, transportation, land or space at a price that does not discriminate against SMEs. It is expected a positive relationship between this explanatory variable and the innovation activity. The hypothesis which is tested is presented below as well the equations for the econometric models (fixed and random effects models). Table 18 presents the results of the panel data model that, according with the Hausman test, best describe the influence of the indicator on the innovation activity and therefore, the results that allow, or not, to accept the hypothesis elaborated.

H11: Ease of access to physical resources such as communication at a price that does not discriminate against SMEs positively correlates with innovation growth.

Fixed effects: $Innovation_{it} = \alpha_i + \beta\ physical\ and\ sevices\ infrastructure_{it} + e_{it}$

Random effects: $Innovation_{it} = \alpha + \beta\ physical\ and\ sevices\ infrastructure + (u_i + e_{it})$ [15]

Table 18. Panel data estimated results for the business environment indicator: physical and services infrastructure

Independent variable	Normal variable	Logarithmic variable
	Fixed effects results	Fixed effecs results
Physical and services infrastructure	-2,50*	-9,30*
Constant	35,12	37,97
	Statistics	
Number of observation	433	
Number of groups	100	
Hausman test	11,83***	11,34***

Note: *** indicate statistical significance at 1% level of significance, * indicate statistical significance at 10% level of significance

Source: Author's own elaboration

Hausman test indicate that fixed effects model is deemed to be more efficient and also that the ease of access to physical and services infrastructure positively correlates with innovation growth and with 95% of confidence it may be claimed that the ease of access to physical resources such as communication at a price that does not discriminate against SMEs negatively correlates with innovation growth. In percentage, it is possible to indicate that 1% of increase in ease of access to physical resources will make innovation activity to drop by the 9%.

The last hypothesis, the twelfth hypothesis regards the extent to which social and cultural norms encourage or allow actions leading to new business methods or activities that can potentially increase personal wealth and income. It is expected a positive relationship between this explanatory variable and the innovation activity. The hypothesis which is tested is presented below as well the equations for the econometric models (fixed and random effects models). Table 19 presents the results of the panel data model that, according with the Hausman test, best describe the influence of the indicator on the innovation activity and therefore, the results that allow, or not, accept the hypothesis elaborated.

H12: The extent to which social and cultural norms encourage or allow actions leading to new business methods or activities has a positive impact on innovation activity.

Fixed effects: $Innovation_{it} = \alpha_i + \beta\ cultural\ and\ social\ norms_{it} + e_{it}$

Random effects: $Innovation_{it} = \alpha + \beta\ cultural\ and\ social\ norms + (u_i + e_{it})$ [16]

Table 19. Panel data estimated results for the business environment indicator: cultural and social norms

Independent variable	Normal variable	Logarithmic variable
	Random effects results	Random effects results
Cultural and social norms	1,94	6,02*
Constant	19,44	18,74
Statistics		
Number of observation	433	
Number of groups	100	
Hausman test	0,07	0,25

Note: * indicate statistical significance at 10% level of significance

Source: Author's own elaboration

According to the results of the Hausman test, it was revealed that the estimated coefficients obtained from the random effects model is more efficient. With the confidence level of 90%, logarithmic model claims that 1% of the extent to which social and cultural norms encourage or allow actions leading to new business methods or activities that can potentially increase personal wealth and income may increase innovation activity in about 6%.

Table 20 summarises the estimated results for the total twelve hypotheses, regarding which factors are identified as having a statistical significant impact on innovation and the relationship that was found between each one of the factors of business environment considered and the changes in innovation activity in TEA companies, to be possible to compare the results obtained with the ones that were expected, according with the literature review.

Table 20. Research study hypothesis, expected and estimated results

Environmental factor	Hypothesis	Expected relationship	Estimated relationship
Financing for entrepreneurs	H1: Availability of financial resources increases innovation activity	+	+
Governmental support and policies	H2: The extent of government support and policies has a positive relationship with innovation activity in the company	+/-	+
Taxes and bureaucracy	H3: Taxes or regulations either size-neutral or that encourage new and SMEs increases innovation activity.	+	+
Governmental programs	H4: The presence and quality of governmental programs directly assisting companies, promote innovation activity.	+	not possible to conclude
Basic school entrepreneurial education and training	H5: The extent in basic school entrepreneurial education and training may facilitate the improvement the level of innovation activity.	+	+
Post school entrepreneurial education and training	H6: The extent in post school entrepreneurial education and training may facilitate the level of innovation activity.	+	not possible to conclude
R&D transfer	H7: The extent of R&D transfer contributes to the success of innovation activity.	+	not possible to conclude
Commercial and professional infrastructure	H8: The presence of commercial and professional infrastructure has a positive influence on innovation activity.	+	not possible to conclude
Internal market openness	H9: The extent of internal market openness supports innovation.	+	+
Internal market dynamics	H10: The level of internal market dynamic has a strong influence on innovation.	+	-
Physical and services infrastructure	H11: Ease of access to physical and services infrastructure positively influences innovation activity.	+/-	-
Cultural and social norms	H12: The extent of cultural and social norms has a positive impact on innovation activity.	+	+

Source: Author's own elaboration

Based on the framework of the expected and estimated relationship regarding the twelve studied hypotheses, Table 20 indicates that:

- Hypothesis H1, that analyzes the relationship between the availability of financial resources such as equity and debt for small and medium enterprises (SMEs) including grants and subsidies, statistically confirmes the literature support;

- Hypothesis H2, that according with the literature review may support or limit innovation if different authors are followed, has, in the present study, confirmed that the relationship between the public policies that support entrepreneurship and innovation is positive;
- Hypothesis H3, which analysis the extent to which taxes or regulations are either size-neutral or encourage new and SMEs, is confirmed empirically and the results are statistically robust;
- Hypothesis H4 could not be accepted. So was not possible to conclude that the presence and quality of programs directly assisting SMEs at national, regional, and municipal levels of government has a literature support, is positively related with innovation activities;
- Hypothesis H5 which takes into account the extent to which training in creating or managing SMEs is incorporated within the education and training system at primary and secondary levels is accepted confirming the what had been expected after the literature review;
- Hypothesis H6 which considered the impact of the extent to which training in creating or managing SMEs is incorporated within the education and training system in higher education such as vocational, college, business schools, could not be confirmed;
- Hypothesis H7 considering the extent to which national research and development will lead to new commercial opportunities and is available to SMEs could not, also, be confirmed;
- Hypothesis H8 was not also confirmed, so was not possible to conclude the presence of property rights, commercial, accounting and other legal and assessment services and institutions that support or promote SMEs, enhance innovation;
- Hypothesis H9, which takes into account the extent to which new firms are free to enter existing markets has been confirmed with statistically robust results;
- Hypothesis H10 regarding the level of change in markets from year to year is accepted by the theoretical framework, was expected a positive effect on innovation, however, the results from this study analysis reached an opposite conclusion. Innovation seems to be limited by yearly changes in markets;
- For hypothesis H11 two possible results were expected since no agreement was found in the literature review on the impact of the ease of access to physical resources such as communication, utilities, transportation, land or space at a price that does not discriminate against SMEs. The present research found a negative statistical significant impact of this business environment factor on innovation;
- Hypothesis H12 which examines the extent to which social and cultural norms encourage or allow actions leading to new business methods or activities that can potentially increase personal wealth and income is accepted by the literature support, and based on the analysis is confirmed.

Finally, to complete the analysis of the worldwide economies, it is important to estimate the impact of the twelve factors altogether, since in a country there is not only one business environment indicator running alone at a given period of time. So have been estimated a multivariate normal and a logarithmized

models. Indeed, while performing the panel data estimations, both values for the standard and converted (logarithmized) independent variables were taken into account. Table 21 presents those estimated results. The panel data estimation results will present the estimated coefficients for the fixed or the random effects estimated values, according with the values found for the Hausman test, the results of the Hausman test to understand if the choice should rely on the estimated fixed or random effects results, the R-square within, R-square between and R-square overall for the overall set of independent variables. The R-square overall is the analogous version of the R-square for the traditional Ordinary Least Squares (OLS) regression model and its analysis will be presented. The R-square within and between are less intuitive results that will not be considered since their results are more mathematical results without any special economic meaning.

Table 21. Estimated results for the multivariate models including all set of business environment indicators

Independent variables	Normal model	Logarithmic model
	Fixed effects results	Fixed effects results
Financing	2,98*	7,91*
Governmen support and policies	0,81	1,84
Taxes and bureaucracy	3,67**	9,12**
Government programs	-0,61	-1,62
Basic school entrepreneurial education and training	0,71	1,78
Post school entrepreneurial education and training	-0,64	-2,23
R&D transfer	-5,09*	-12,71**
Commercial and professional infrastructure	-5,2	-2,53
Internal market dynamic	-2,42*	-7,03*
Internal market openess	2,52	5,36
Physical and services infrastructure	-2,41	-8,01
Cultural and social norms	0,49	3,47
Constant	31,35***	28.86***
Statistics		
Number of observation	433	
Number of groups	100	
Hausman test	22,99***	33,89***
R2 Within	0,0673	0,0415
R2 Between	0,0007	0,1500
R2 Overall	0,0179	0,1577

Source: Author's own elaboration

Table 21 demonstrate a multivariate model with the conditions, where all twelve business environment factors simultaneously have impact on innovation activity. Regarding the results of the panel analysis with the application of Hausman test, it can be concluded that the extent to which taxes or regulations are either size-neutral or encourage new and SMEs is the most relevant indicator, with 95% of

confidence, in determining the scope of impact on innovation activity. To be more precise,1 unit of the extent to which taxes or regulations are either size-neutral or encourage new and SMEs will promote the rise of innovation activity in 3,67%. Statistical significance of the availability of financial resources such as equity and debt for small and medium enterprises (SMEs) including grants and subsidies indicate 90% of confidence as well as the extent to which national research and development will lead to new commercial opportunities and is available to SMEs and internal market dynamics. Although, the extent to which national research and development will lead to new commercial opportunities negatively impacts on the innovation activity by decreasing it by almost 13%. The same negative impact (7%) to innovation activity in SMEs is the level of change in markets from year to year. Based on the analysis presented in the Table 21, the rest of the business environment indicators evidence no statistical significance. Consequently, the findings pointed out on the significance of financial aspect for SMEs including the presence of conditions under which the taxes or regulations are either size-neutral or encourage new and SMEs, engaging in innovation activity (Law et al., 2018).

Regarding the values for the overall R-square, the value found in the normal model indicates the variation that may happen in the independent variables just explain approximately 1,8% of the variations that occur in the innovation activity. For the logarithmic model, the overall R-square indicates the variation that happens in the independent variables explain almost 16% of the variation that occur in the innovation activity. The logarithmic model seems a better model than the normal one, in terms of the explanatory results, but less indicators present a statistical significance.

3.2.2. Hypothesis test results: by income level

In order to achieve a more profound and detailed analysis, the following analysis subsection presents the results of the hypothesis tests considering the division of countries by their income level, which is based on the World Bank (2018) classification. The income level classification includes low income, lower middle income, upper middle income and high-income levels. Table 22 presents the panel data estimated results for each indicator, just considering univariate models. In each model are presented the results for the fixed or random effects models taking in consideration the statistical significance of the Hausman test, which results are also presented in the table.

The estimated results identify which indicators of business environment have influence on the innovation activity in countries with the four different levels of income and if they present a statistical significance impact, how much is such impact.

Table 22. Panel data results on all the independent variables by income level

Independent variables	Levels of income							
	Low		Lower middle		Upper middle		High	
	Normal model	Logaritmic model	Normal model	Logaritmic model	Normal model	Logaritmic model	Normal model	Logaritmic model
	random effects	random effects	random effects	random effects	random effects	random effects	random effects	random effects
Financing	-0,45	-2,68	5,81*	15,38*	5,34**	12,57**	0,18	0,66
Hausman test	0,18	0,31	0,18	0,14	1,28	1,09	1,41	1,5
	random effects	random effects	random effects	random effects	random effects	random effects	fixed effects	fixed effects
Governmental support and policies	-1,77	-5,53	2,31	7,02	5,76**	13,44**	-0,76	-2,21
Hausman test	0,03	0	0,34	0,66	2,04	1,7	10,36***	11,40***
	random effects	random effects	random effects	random effects	random effects	random effects	random effects	random effects
Taxes and bureaucracy	1,12	3,27	-1,48	-3,62	5,63**	12,25**	4,16**	10,36***
Hausman test	0,96	1,22	0,42	0,83	1,5	0,66	0,33	0,37
	random effects	random effects	random effects	random effects	random effects	random effects	fixed effects	fixed effects
Governmental programs	-1,43	-3,97	0,87	3,02	3,26	7,36	-0,68	-1,77
Hausman test	0,01	0	0,06	0,01	0,34	0.16	8,96***	8,73***
	random effects	random effects	random effects	random effects	random effects	random effects	random effects	random effects
Basic school entrepreneurial education and training	1,53	4,85	7,26**	14,11**	5,18*	9,26	1,23	2,20
Hausman test	0	0,01	0,8	1,19	1,35	1,17	0,53	0,74
	random effects	random effects	random effects	random effects	fixed effects	fixed effects	fixed effects	fixed effects
Post school entrepreneurial education and training	-0,46	-1,54	5,12	14,83	0,89	-11,69	-0,29	-1,01
Hausman test	0,04	0,04	1,92	2,48	3,49*	3,42*	4,97**	5,34**
	random effects	random effects	random effects	random effects	random effects	random effects	fixed effects	fixed effects
R&D transfer	-0,62	-2,55	6,67*	15,25*	-0,72	-1,78	-0,76	-2,24
Hausman test	1,03	1,29	0,35	0,3	0,1	0,15	5,83**	6,53**
	random effects	random effects	random effects	random effects	random effects	random effects	random effects	random effects
Commercial and professional infrastructure	-2,08	-7,27	-1,26	-4,33	0,44	0,89	3,39*	9,19
Hausman test	0,01	0,02	0,04	0,06	1,06	1,24	2.1	2,51
	random effects	random effects	random effects	random effects	random effects	random effects	random effects	random effects
Internal market openness	-2,28	-8.4	2,10	5,86	4,06	8,19	5,27**	13,75**
Hausman test	0,05	0,06	0,34	0,36	0,12	0,39	1.23	1,24
	random effects	random effects	fixed effects	fixed effects	random effects	random effects	random effects	random effects
Internal market dynamics	-1,04	-4,13	-6,51	-20,06	-3,52*	-11,11*	-3,56**	-10,10**
Hausman test	0,16	0,06	6,46**	6,20**	1,87	2,3	1.67	1,83
	random effects	random effects	random effects	random effects	random effects	random effects	----	random effects
Physical and services infrastructure	-0,23	-1,09	1,20	4,78	-5,81**	-22,87**	----	8,14
Hausman test	0	0,05	1.07	0,85	1,06	1,23	Not possible to conclude	2,55
	fixed effects	fixed effects	random effects	random effects	fixed effects	fixed effects	random effects	random effects
Cultural and social norms	3,89	10,01	8,97**	25,81**	3,01	-1,05	2,04	6,54
Hausman test	10,59	11,28***	1.66	1,94	3,39*	2,87*	0.04	0,16
Number of groups	44		16		31		9	
Number of observations	225		44		134		30	

Note: * indicate statistical significance at 10% level of significance; ** indicate statistical sigfnificance level at 5% level of significance and *** indicate statistical significance level at 1% level of significance

Source: Author's own elaboration

With the purpose of not to overload the work with an extensive analysis, only the results which are in percentage are going to be examined. According to the results of statistical analysis represented in the Table 22, it can be indicated that, despite on the largest amount of observations for the low-income countries, none of the factors presents evidence that is as an important one to explain the innovation activities in TEA companies in low-income level's economies. It is believed that this can be due to the neglect of the SMEs in attempt to implement any innovation based on the primitive and top-priority willing of the survival of the company. Similarly, Lima and da Silva Müller (2017) concluded that for all entrepreneurs studied, a need for survival was determined as an influencing factor on innovation activity in small businesses in Brazil.

For the economies with a lower middle-income level, the availability of financial resources such as equity and debt for small and medium enterprises (SMEs) including grants and subsidies are believed to increase the innovation activity to about 15%. A growth in 1% of the extent to which training in creating or managing SMEs is incorporated within the education and training system at primary and secondary levels promote innovation activity in companies to go up to about 14%. These findings determine the importance of creating improvements and ease the access of entrepreneurial education in the institutions of primary and secondary levels. Moreover, for the economies with lower middle level, the extent to which national research and development will lead to new commercial opportunities and is available to SMEs makes the innovation grow to about 15%. Surprisingly, an increase in 1% of the extent to which social and cultural norms encourage or allow actions leading to new business methods or activities that can potentially increase personal wealth and income facilitates the advancing of innovation activity to almost 26%. Based on this knowledge, in order to enhance the innovation activity in the economies with lower-middle income, a particular attention should be paid to transform social and cultural norms of the society.

Economies with an upper middle level of income indicated a rise of innovation approximately to 13% by rising the financing for entrepreneurs for 1%. For the same income level countries, the extent to which public policies support entrepreneurship - entrepreneurship as a relevant economic issue facilitates the growth of innovation in about 13%. Moreover, the rise of 1% of the extent to which taxes or regulations are either size-neutral or encourage new and SMEs increase innovation activity in SMEs of upper middle level of income countries to 12%. The level of change in markets from year to year and the ease of access to physical resources such as communication, utilities, transportation, land or space at a price that does not discriminate against SMEs both influence innovation activity in the companies in a negative way, thus decreasing it respectively to 11% and to about 23%. Consequently, it can be assumed that in order to contribute to the development of the innovation activity the physical infrastructure utilities in the countries with upper middle level have to be financially available.

For the counties with the high-income level, the extent to which taxes or regulations are either size-neutral or encourage new and SMEs advances innovation activity in 10%. Another factor which rise the innovation activity in the high-level income economies for almost 14% is the extent to which new firms

are free to enter existing markets. According to this statement, in order to enhance innovation activity, all the entrance barriers should be eliminated. Although, the level of change in markets from year to year indicate a negative impact on innovation activity by decrease it to 10%.

Table 23 presents a summary of the results obtained for each hypotheses based on the estimates coefficients obtained in the panel analysis. The table reveals which hypotheses were confirmed having in account the income level of the countries. Additionally, Table 23 indicates the level of statistical significance of each hypothesis confirmed.

Table 23. Hypotheses results based on the panel analysis by the income level

Hypothesis	Level of income			
	Low	Lower middle	Upper middle	High
H1: Availability of financial resources increases innovation activity	-	+(*)	+(**)	-
H2: The extent of government support and policies has a positive relationship with innovation activity in the company	-	-	+(**)	-
H3: Taxes or regulations either size-neutral or that encourage new and SMEs increases innovation activity.	-	-	+(**)	+(**)
H4: The presence and quality of governmental programs directly assisting companies, promote innovation activity.	-	-	-	-
H5: The extent in basic school entrepreneurial education and training may facilitate the improvement the level of innovation activity.	-	+(**)	+(*)	-
H6: The extent in post school entrepreneurial education and training may facilitate the level of innovation activity.	-	-	-	-
H7: The extent of R&D transfer contributes to the success of innovation activity.	-	+(*)	-	-
H8: The presence of commercial and professional infrastructure has a positive influence on innovation activity.	-	-	-	+(*)
H9: The extent of internal market openness supports innovation.	-	-	-	+(**)
H10: The level of internal market dynamic has a strong influence on innovation.	-	-	+(*)	+(**)
H11: Ease of access to physical and services infrastructure positively influences innovation activity.	-	-	+(**)	-
H12: The extent of cultural and social norms has a positive impact on innovation activity.	-	+(**)	-	-

Note: * indicate statistical significance at 10% level of significance; ** indicate statistical sigfnificance level at 5% level of significance

Source: Author's own elaboration

In general, in respect with the analysis on statistical significance of business environment factors on innovation activity by income level, as noted before, none of the factors presents a statistical significant impact for the economies with a lower income level. None all of the hypothesis of the study are confirmed for these countries.

For the other levels of income the following conclusions, considering each one of the hypothesis could be presented:

- Hypothesis H1, that considers the availability of financial resources such as equity and debt for small and medium enterprises (SMEs) including grants and subsidies, is confirmed just for lower middle and upper-middle-income level countries. It should be noted that these findings are corresponding to the ones found in the theoretical framework (Bayarçelik, Taşel, & Apak, 2014);
- Hypothesis H2, that considers the public policies that support entrepreneurship as a relevant economic issue, is confirmed only for the upper-middle-income level economies. Current findings are supported by the work of Jiao et al. (2015);
- Hypothesis H3, which is about the extent to which taxes or regulations are either size-neutral or encourage new and SMEs is accepted for the upper middle and high-income level economies. Reported results are equivalent to the findings of Howell (2016);
- Hypothesis H4 regarding the presence and quality of programs directly assisting SMEs at national, regional, and municipal levels of government is unconfirmed for all of income levels. Although, the results of the work of Baldwin and Gellatly (2003) differ from the current one;
- Hypothesis H5, regarding the extent to which training in creating or managing SMEs is incorporated within the education and training system at primary and secondary levels, is confirmed by lower middle and upper middle countries (Lundvall, 2016);
- Hypothesis H6 regarding the extent to which training in creating or managing SMEs is incorporated within the education and training system in higher education such as vocational, college, business schools, etc. (Mihaela & Ţiţan, 2014);
- Hypothesis H7 considering the extent to which national research and development will lead to new commercial opportunities and is available to SMEs is confirmed for lower middle-income level countries. This results, at the light of the work of Hametner et al (2018) were expected;
- Hypothesis H8, that considers the presence of property rights, commercial, accounting and other legal and assessment services and institutions that support or promote SMEs is confirmed only for the countries with high-income level.The same conclusion had been found by Adams, Bessant and Phelps (2006);
- Hypothesis H9, which takes into account the extent to which new firms are free to enter existing markets is approved just for the economies with high-income level, as mentioned by Baldwin and Gellatly (2003);
- Hypothesis H10 regarding the level of change in markets from year to year is approved for the countries with the upper middle and high-income level. These findings are similar to the ones found, recently, by Anzola-Román et al. (2018) and Distanont and Khongmalai (2018);
- Hypothesis H11, which considers the ease of access to physical resources such as communication, utilities, transportation, land or space at a price that does not discriminate against SMEs is accepted for the upper middle level. The finding regarding Hypothesis H11, do

not confirm, however, the recent scientific work of Schmidt, Balestrin, Engelman and Bohnenberger (2016);

- Hypothesis H12, which considers the extent to which social and cultural norms encourage or allow actions leading to new business methods or activities that can potentially increase personal wealth and income is confirmed for the economies with lower middle level. The current results are consistent with findings of Delmas and Pekovic (2018).

Shortly, summarising all the above results, it is possible to observe a logical and distinguishing tendency by the division of countries according to the income level – the hypotheses which were accepted for the counties with the high-income level concurrently were not accepted with the countries with the low and lower-middle-income levels. Correspondently, the hypotheses which were confirmed for the countries with low-income level, at the same time were not accepted for the countries with upper middle and high-income level. Furthermore, some hypotheses which were confirmed for the lower middle-income level also were accepted for the countries with upper-middle-income level. The results also reveal that some factors that influence the innovation activity in high-income countries are deemed to have an impact also in upper middle-level countries. Therefore, this means that economies with a similar income pattern tend to experience the similar conditions influenced by factors of business environment, and vice versa. In other words, the analysis of business environment factors that influence innovation activity concluded regarding the division by income level of countries demonstrated that, while analyzing innovation activity worldwide it is crucial to take into account the differences of the studied countries, which are determined by the financial opportunities background. As the process of implementing innovation activity foresees financial investments and a need for purchasing high-tech equipment (Howell, 2016).

Conclusions, Limitations and Future Research Lines

Generally speaking, it has to be noted that, while investigating the subject of innovation activity it is vital to observe the environment, which consist of business influencing factors, and which determines innovation. In other words, a particular attention should be paid to drivers and barriers of innovation activity. Consequently, this enables to identify the key impacts for innovation activity in the companies, and later respectively, strengthen or reduce them. Studying factors which form the area of influence on innovation activity gives a knowledge, which could be applied for enhancing innovation activity in organizations in general as well as in business companies. Regarding the studied topic of the innovation activity, current research greatly contributes to the scientific literature. Furthermore, based on the scarcity of the works dedicated to the investigation of factors that influence innovation, especially the ones that are based upon using GEM secondary database (Bergmann et al., 2014), a current research is considered to be valuable scientific work.

In respect with the results concluded by descriptive statistics, it was indicated that, while examing the innovation activity worldwide, it is significant to take into account the differences between the countries and study them in more homogeneous groups, like level of income. In addition, based on the acquisition of the resources needed to successfully implement innovation, not all the countries will have the same financial, political, educational, business or cultural patterns. Thus, these patterns will differently correlate with the innovation activity in each country.

To sum up, on the general analysis of innovation activity, it should be mentioned that, in average, about 26% of companies worldwide, involved in early-stage entrepreneurial activities (TEA) indicate that their product or service is new to at least some customers and few or no businesses (at all) offer the same product. Results also showed the noticeable variance of values indicating innovation activity – with a minimum value of about 1% and a maximum one of almost 59%. Regarding factors that determine business environment in general, findings present that the indicators related to physical and services infrastructure and the internal market dynamics showed the highest degree of influence, and the indicators related with the basic school entrepreneurial education and training, the R&D transfer and taxes and bureaucracy evidence the lowest degree of impact.

When considering the analysis by the division of countries by income level, it should be noted that companies operating in countries with higher levels of income tend to innovate more. According to the results, despite on the largest amount of observations, none of the factors presents evidence to explain innovation activity in low-income level countries. Perhaps, this occur because of top-priority willing of the

survival of the company, which leads to the neglect of the SMEs in implementing any innovation (Lima & da Silva Müller, 2017). For the economies with a lower middle income level, the indicators related with financing, basic school training and education, R&D transfer, and cultural and social norms have a positive influence on innovation activity, which signify the importance of creation improvements and facilitation of the access of basic entrepreneurial education as well as transformation of social and cultural norms of the society, into the ones which encourage innovating. For the economies with an upper middle level of income indicators related with financing, governmental support and policies, taxes and bureaucracy, and basic school training and education indicated a positive correlation with innovation activity. Although, indicators related with market dynamics and physical services and infrastructure were found to decrease innovation. Hence, to grow the innovation, the physical infrastructure utilities in the countries with upper middle level should be financially affordable. For the counties with the high-income level indicators related with taxes and bureaucracy, commercial and professional infrastructure and market openness are deemed to enhance innovation activity. Whereas, the indicator related with market dynamics shapes the development of innovation activity negatively. Therefore, to increase innovation activity in high-income level countries, all the entrance barriers have to be erased.

Undoubtedly, current work has a set of limitations, which alternatively makes it possible to highlight the future research lines. The first limitation is connected with the huge amount of number of missing observations, in other words, the secondary panel data which was used is unbalanced. In the future, with the help of balanced panel data, it is achievable to receive a more profound and more statistically robust analysis. Secondly, another limitation for this research was a lack of scientific works with a same background, in order to make a comparison with. With the purpose of obtaining more homogenous results, more extensive data set could be applied. This shapes another future research opportunity. Finally, in the future with the enlargement of the GEM database and statistical information, would be possible to make an analysis country by country, regarding the innovation activity. Such analysis, even if desirable was not possible to be done in the present research work, but will also serve as a topic for another definable and valuable research scientific work.

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