Universidade do Minho
Escola de Direito

Elad Sadaan Samuel Correia Rafael

The Impact of Social Capital on Innovation

Universidade do Minho
Escola de Economia e Gestão

Elad Sadaan Samuel Correia Rafael

The Impact of Social Capital on Innovation

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Professor Maria João Cabral de Almeida Ribeiro Thompson

Professor Maria Lurdes Castro Martins

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Abstract

The Impact of Social Capital on Innovation

This dissertation investigates a relatively modern theme in economic science, namely the relationship between social capital and innovation. Social capital encompasses certain aspects such as trust, values and social participation, which can constitute incentive channels for innovative activity, minimizing the costs related to it. The aim of this study is to quantify and analyze the impact of social capital on innovation in a sample of 55 countries from different economic classes in a cross-sectional analysis for the year 2017. Bearing in mind the complexity of the measurability of social capital and of innovation, there was the need to establish proxies for the characterization of both, in order to answer our research question. The regression model was estimated using the Least Squares Method. The results reveal that social capital positively affects innovation in the studied countries in 2017, as expected. Such positive relationship occurs because social capital prevents egoistic behavior through the enforcement of informal norms, we believe. Moreover, if a researcher displays an honest character by signaling the true quality of his ideas, his trustworthiness increases in the eyes of investors, consequently investors may positively change their expectations regarding this researcher and others, which may increase the probability of financing innovation activities in the region.

Keywords: Innovation, R&D, Social Capital, Trust.

Resumo

O Impacto do Capital Social na Inovação

A presente dissertação estuda uma temática relativamente moderna na ciência económica, que é a da relação entre o capital social e a inovação. O capital social engloba determinados aspetos tais como a confiança, valores e participação social que têm vindo a ser fomentadores da atividade inovadora, minimizando os custos relacionados com esta. O objetivo deste estudo é o de quantificar e analisar o impacto do capital social sobre a inovação considerando uma amostra de 55 países com diferentes níveis de desenvolvimento económico numa análise transversal para o ano 2017. Atentando ao facto da complexidade relativamente à mensurabilidade do capital social e da inovação, houve a necessidade de se usar variáveis-proxy para ambas, com o intuito de responder à nossa questão de investigação. O modelo de regressão foi estimado pelo Método dos Mínimos Quadrados. Os resultados revelam que parece haver um efeito positivo estatisticamente significativo do capital social na inovação.. Uma possível explicação para este efeito é a de que o capital social impede o comportamento egoísta através de normas informais. Adicionalmente, se um pesquisador mostra um caráter honesto ao sinalizar a verdadeira qualidade das suas ideias, a sua confiabilidade aumenta aos olhos dos investidores; consequentemente, os investidores poderão mudar positivamente as expectativas em relação a este pesquisador e outros, o que poderá aumentar a probabilidade de financiamento de inovação na região.

Palavras-chave: Capital social, Confiança, I&D, Inovação.

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List of abbreviations

FDI   Foreign Direct Investment

GDP   Gross Domestic Product

ICT   Information and communication technologies

NSI   National System of Innovation

OECD   Organization for Economic Co-operation and Development

OLS   Ordinary Least Squares

R&D   Research and Development

TAATAW   Trust Across America Trust Around the World

U. S   United States

VIF   Variance Inflation Factor

WB   World Bank

WVS   World Value Surveys

1. Introduction

With the development of information and communication technologies (ICT) since the early 2000s, new forms of training and knowledge transfer have emerged and are spreading. Knowledge is accessible anywhere, anytime. Innovation is about translating new ideas into products and services for value addition. This as a process requires all stakeholders (such as individuals, organizations and society) to have a flexible attitude, and willingness to adapt and welcome unprecedented levels of change (Girma et al.,2008).

Innovation as an outcome emphasizes what output is sought, including product innovation, process innovation, marketing innovation, business model innovation, supply chain innovation, and organizational innovation. Innovation as a process attends to the way in which innovation should be organized so that outcomes can come to fruition; this includes an overall innovation process and a new product development process. Innovation as a mindset addresses the internalization of innovation by individual members of the organization where innovation is instilled and ingrained along with the creation of a supportive organizational culture that allows innovation to flourish (Kahn, 2018)

In the knowledge-based economy, innovation is conceived of as a process involving social interaction and is no longer achieved by isolated individuals. Social capital is defined by its purpose. It is not a particular entity, but a diversity of dissimilar entities having two features in common: They all involve some characteristics of a social structure, and they simplify certain actions of individuals who are within the structure. Social organization comprises social capital facilitating the achievement of goals that could not be achieved in its absence or could be accomplished only at a higher amount (Coleman, 2009).

Studies relate that social capital is complementary to R&D in affecting innovation and that same social capital enhances the functioning of externally acquired R&D in the sense that it increases the probability of external R&D leading to product innovation.

Search and trust are fundamental elements of economic exchange (Junkunc, 2007). Zak & Knack (2001) have shown that finding trade partners is costly as agents incur search costs while collecting information regarding the reputation of an agent to assess trustworthiness.

Given the fact that studies regarding social capital and its relationship with innovation are still lacking content for literature, the objective of this thesis is to contribute with knowledge and expertise for the development of this field.

The present dissertation consists of the following chapters: the purpose of the current chapter is to introduce the research topic and present the importance of its study. In chapter 2, the literature review presents the previous theoretical and empirical contributions for the study, initially denoting relevant concepts about innovation followed by its main determinants as well as their forms of measurement, similarly, it is discussed the concepts of social capital, its determinants and ways of measuring it. it is also talked of trust as a proxy of social capital and its effects on a set of macroeconomic variables, including research and development expenditure as a proxy of innovation. Chapter 3 contains the methodology where the objectives of the analysis are stated and the regression model used, having as a dependent variable the innovation used in a linear regression model. Then, Chapter 4 presents the empirical study that aims to answer the research question on the impact of social capital on innovation. Chapter 5 presents the empirical results and their analysis. Last but not least is Chapter 6 which presents the main conclusions of the work as well as its limitations and suggestions for future assignments.

2. Literature review

2.1. The concept of innovation

Besides the idea of transformation, the concept of innovation involves an ambiguity on its wide range of applications. Therefore, its importance cannot be overlooked. The term innovation originates from the word "innavatus" in Latin, which means making something new. Joseph Schumpeter[1] in 1950 noted that the organization should innovate, in order to renew the value of its assets. Accordingly, the impact of innovation in products and technology on an existing structure of an industry substantially reduces the long-run scope and importance of practices that aim, through restricting output, at conserving established positions, and at maximizing the profit accruing for them (Schumpeter, 1942). Additionally, Schumpeter (1950) argued that technological innovation has a significant impact on the production process, which stimulates diversification within the company. Innovation indeed plays a crucial role in the process of economic development through technological progress (Schumpeter, 1942).

Schumpeter (1942) has developed an innovation sequence concept, alias the Schumpeterian trilogy, which divides the technological change process into three stages with very accurate taxonomy. The first stage is: (i) the invention process (the stage where new ideas are generated) presumes that the rate of the invention determined by the scientific knowledge is distributed in almost accidental way in time (Taymaz, 1997). The second stage is: (ii) the innovation process (the stage where new ideas are developed), economic and technological conditions of the firm are the key determinants of that stage, innovation is considered to be the first commercial application of invention (Godin, 2014). The third stage is: (iii) the diffusion stage (the stage where new products and services are distributed across the market), the spread of innovation provides economic growth and a decrease in the unemployment rate (Er, 2013).

Based on the above mentioned, still regarding the concept of innovation, it is very important to distinguish innovation from invention, sometimes the connecting line between both is so strong that it turns the scrutiny very difficult to conduct. There are occasionally time series separating invention from innovation, that can reach a period of a decade or beyond (Rogers, 1995). The transformation of one invention into

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[1] Joseph Schumpeter is regarded as one of the greatest economists of the first half of the twentieth century (Madarasz, 1980)

innovation involves a process that requires a combination of several types of resources. Therefore, comes into play the crucial role of the innovator, individual or firm responsible for combining the needed factors (Fagerberg & Godinho, 2004).

Furthermore, after Schumpeter, several other authors provided definitions of innovation, for instance, Drucker (1985) defines innovation as the essential tool of entrepreneurs, the revenues by which they come across change as an opportunity for a different business or different service. While for Thompson (1965) innovation is the generation, acceptance and implementation of new ideas, process product or services. More recently West & Anderson (1996) proposed to define innovation as the effective application of new processes and products in the organization, designed to benefit the organization and its stakeholders. On the other hand, Kimberly & Evanisko (1981) share a different perspective on the definition of innovation, dividing it in three categories: "innovation as a process, innovation as a discrete item including, products, programs or services; and innovation as an attribute of organization."

The new era perspective on the concept of innovation, defines it as a process that provides added value and degree of novelty to the organization and its stakeholders, developing new procedures, solutions, products and services and new ways of marketing (Knox, 2002). Still in the same line of thinking Andersson, Lindgren, & Henfridsson (2008) define innovation as the new applications of knowledge, ideas, approaches and skills, which are necessary for gaining competitive advantage.

Currently, one of the main concerns of many nations around the world is to find solutions to provide a better life quality for its citizens, consequently, innovators have to converge their outcomes with the environmental protection policies. In order to elucidate such point of view Abbaszadeh et al. (2013) postulates that innovation is an important tool that allows companies to react rapidly to change, to find and exploit new products and markets and simultaneously to protect the environment. At this stage, the vast literature on innovation is notorious, in this manner it is important to scrutinize the types of innovation (Ettlie & Reza, 1992). Common types of innovation involve new products, material, new processes, new services, and new organizational forms. Recently Fagerberg & Godinho (2004) postulated that the distinction within process and product innovation lays in the assumption that economic and social impact can be dissimilar. Beyond the distinction of product and process innovation, Edquist et al. (2001) suggest the need for dividing process innovation into technological and organizational, while technological process

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innovation relates to machinery, organizational process innovation embraces new methods of organizing the work.

Among distinct types of comparison in the innovation literature, it is important to differentiate radical innovation from incremental innovation, for the sake of economic sustainability of firms in industries that are dependent on competitive research and development for comparative advantage and long-term survival (Koberg et al., 2003). For Cooper (2001), radical innovation projects tend to be inconclusive, very often such projects are forsaken before their conclusion. There are companies that succeed at implementing radical innovation, which leads to market growth and dominance, which is not very common among companies in general. The key determinants of such innovations are the quality of network and of relationships among people, as well as institutions (Swink & Song, 2007). Due to technology development and the rise of international competition, there has been an increase in the need for radical innovation implementation, with modern clients tending to be more active and demanding new releases.

The ambiguity within the concepts of innovation mentioned above must not be ignored, for instance Germain (1996) conducted a study on the impact of factors such as organizational structure and size of the organization, including both incremental and radical innovation in terms of ratio and the type of impact of mentioned factors. He concluded that the size of the organization does not have a direct impact on incremental innovation, but on the other hand, specialization and decentralization in terms of structural dimension do have a significant impact on incremental innovation. In another perspective, for example, Sorescu & Spanjol (2008) state that both radical and incremental innovation impact economic value creation and productivity of organizations positively, with radical innovation having a stronger impact. In agreement, Sood & Tellis (2005) also find that both radical and incremental innovation influence the growth of market and national economic growth, although radical innovation shows a stronger impact on these outcomes.

The existing literature on these two types of innovation covers a wide range of concepts), while incremental innovation is accessible under low risk, it provides small benefits to users, on the other hand, radical innovation is accessible under high uncertainty and risk and relies on market traction. In the radical innovation sector, new technology is applied to meet new and unknown requirements of the

customer and target market (Johnson, 2005). Incremental innovation is an important tool in introducing goods and services to new features or changes in current technologies and products (Valle & Vázquez-Bustelo, 2009).

Incremental innovation focuses on small changes, such as design technology, performance, price, quantity, and performing modifications to satisfy existing customer's needs (Garcia & Calantone, 2002). Radical Innovation involves new and original products or services for both the organization and the market, and since they are based on new generations of goods, they are essential for one organization's maintenance in competitive advantage and sustainability in the long-run (Johannessen, 2009).It is important to mention that, in general, radical innovation constitutes 10% of all innovations, whereas the portion for incremental innovation corresponds to 90%.

Based on the above described, it is clear that distinct types of innovation have different outputs. Some of such outputs are patent in goods or modifications in them, as well as in services, or in the technique of implementing affairs by service providers (Shahin et al., 2017). Therefore, in order for the companies to achieve their desired goals in a changing and dynamic environment, they should invest in several types of innovation in order to obtain different methods and results that may benefit the organization. Table 1 summarizes some of the main ideas on innovation

Table 1: The concept of Innovation

Author	Concept
Schumpeter (1950)	Schumpeter developed a sequence in innovation concept dividing it into three stages: Invention, Innovation, and Diffusion.
Thompson (1965)	Innovation is the generation, acceptance and implementation of new ideas, processes, products or services.
Drucker (1985)	Innovation is an essential tool of entrepreneurs, the revenues by which they come across change as an opportunity for a different business or different service occur.
West & Anderson (1996)	Innovation is the effective application of new processes and products in the organization, designed to benefit the organization and its stakeholders.
Knox (2002).	Innovation is a process that provides value added and degree of novelty to the organization and its stakeholders.
Anderson et al. (2008)	Innovation means new applications of knowledge, ideas, approaches, and skills, which are necessary for gaining competitive advantage.
Abbaszadeh & Shahin(2013)	Innovation is an important tool that allows companies to react rapidly to change, find and exploit new products and markets and simultaneously to protect the environment.

Source: Own adaption, based on the literature review.

2.1.1. Determinants of Innovation

Given the fact that industrial innovation is recognized as the major force that boosts economic growth, there has been a thriving interest in models of economic growth with endogenous technological progress (Romer, 1986). In the present section, the aim is to introduce the most significant determinants in the path of successful innovation.

According to Dosi (1988), expenditure in research and development (R&D) can be considered the most influential determinant in the organization's capabilities to innovate. Investment in R&D allows organizations to maintain competitive edge over their rivals, or at least during the early stages of the innovation diffusion process. Similarly investment in R&D are considered the main indicator of the general level of innovation in a certain department or industry. Investments in R&D are indeed essential for the development of new products, manufacturing processes and improvements in the organization's efficiency (Gustafsson et al. 1998). The presence of R&D activities in one organization generates the capacity to integrate new concepts and its adaptability to market change (Freel, 2000).

Studies reveal that organizations in general that spend significantly on R&D hold better financial performance than organizations that do not. Hall (1993) postulates that companies with high R&D spending have above the average financial performance within the industry. Similarly, Chan et al., (1990) find that there is a positive relationship between a company's R&D budget and the company's value. When knowledge and experience are combined by means of R&D activities, they increase the innovation outcomes of the organization. Investment in R&D allows the organization to acquire new technology and skills that will allow for the creation of new products, processes, and services (Brouwer et al., 1993). According to Tsai & Huang (2002), companies with high investments in technological capabilities tend to have higher proficiency in scrutinizing and reproducing exogenous knowledge and consequently become more innovative.

R&D allows companies to absorb new technology available in the market and to attract collaborative partners (Arvanitis & Seliger, 2014). According to Bozeman (2007), it is particularly in the field of new and emerging technology where R&D plays an important role for innovation, given the fact that new technologies are difficult to acquire whether they are produced by competitors or provided through

interaction with public research organizations. At this stage, we can conclude that R&D is an important determinant of innovation.

Another important determinant of innovation is Foreign Direct Investment (FDI). Stiebale & Reize (2011) state that comparing domestic and foreign-owned firms in terms of productivity, reveals that firms with foreign ownership outperform domestic firms. They believe that local firms might benefit from the participation of foreign resources, justifying the existence of multinational companies by ownership or firm specific assets that are needed to cover the expenses when entering in a foreign market. For instance Bertschek (1995) finds that FDI has a considerable positive impact on product and process innovation which is mainly stimulated by competition within foreign firms which causes innovation in domestic enterprises. FDI has been identified as a crucial mechanism for international technology diffusion (Veugelers & Cassiman, 2004). Companies with higher technology capacity have greater capacity to analyze and reproduce the knowledge acquired from external sources, therefore FDI will stimulate innovation (Tsai, 2001).

The local demand for products and services is also considered one important determinant of innovation, given the fact that there are some markets whereby consumers tend to be more sensitive to sophisticated and innovative goods and services. The demand for this kind of goods and services boosts innovation due to market requirement (Buesa et al., 2010).

Another important determinant of innovation is human capital, which according to Dess & Picken (2000) includes individual's capabilities, skills, knowledge and experience from social learning, from the combination of all these factors and intellectual capital (i.e., knowledge). In the innovation field, knowledge represents a key mechanism resource. Intellectual capital is a crucial factor, which has a positive influence on performance, helping the firm to gain an advantage over its competitors, by stimulating creativity and innovation. The greater the level of human capital within the nation the more likely it is that knowledge will be created and transformed into innovation (Coleman, 1988). Human capital consists of both employees' efficiency and the firm' s culture and values (Coudouel & Paternostro, 2006).

Stewarzt (1998) writes that intellectual capital refers to intellectual resources comprising of human capital, structural capital and customer capital, and used to create wealth. Human capital refers to the

employees' skills, acquired through training and education, that increase one firm's efficiency in providing services to consumers. In this sense, citizens, especially the young people, tend to be unsatisfied with their nation's education system, due to the lack of jobs in their field of study. Suitable education reforms and changes in related resources, systems and strategies can hence have an enormous influence on a nation's expenditure and income.

Among several other determinants of innovation, we must emphasize the National System of Innovation (NSI), which according to Freeman (1987) is defined as the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies. The NSI is a set of institutions whose interactions determine the innovative performance of national organizations (Nelson, 1993). In the same way, the combination of different institutions either in a group or individually contribute to the expansion and stream of new technologies, whereby comes into play the structures which governments create and policies they implement to influence the innovation process. In short, this set of institutions generate, store and diffuse intellectual capital, expertise and products which define new technology (Metcalfe, 1994).

The important role of the National System of Innovation within the nation is to conduct an approach on types of organization and patterns of activity that contribute to innovation performance in certain nations and identify the institutions and players who perform a crucial role in particular industries, stimulating the diversity in the national innovation (Nelson, 1993).

Literature on National Innovation Systems also highlights as crucial to a nation's R&D performance and funding, the following factors: (i) the strong role played by the government's innovation policy; (ii) the role of specific institutions, such as the university system (Rosenberg & Nelson, 1994); (iii) the degree of intellectual property protection (Rosenberg & Nelson, 1994); (iv) the historical progress of one organization's industrial R&D (Mowery, 1984); and (v) the allocation of labor between universities, private companies and government (Mowery, 1998).

The strength of the National Innovation System is that there is a powerful complementary relationship among the components within a system (Fagerberg et al., 2010). According to the OECD (1997), for policymakers an understanding of the National Innovation System might help spot leverage outputs for enriching innovative performance and overall competitiveness. Most certainly, it can help identify

divergences among the system, which can be present within institutions or in government policies, and whose solving can boost technology development and innovation.

Another important aspect of the National Innovation System is the relationship between private and public research sector, whereby the public element includes predominantly public research institutions and universities, and on the other end are the private organizations. The quality of public institutions and their connections to the industry can be one of the most crucial assets of innovation. For Nelson (2013), universities and research institutions supported by the government are the key players of standard research and produce both a body of fundamental knowledge for the industry and also innovative techniques and important skills. Therefore, several types of institutions can cooperate in order to coordinate strategies to shape their field of operation (Garud et al., 2007).

It is also important to highlight that social phenomena can have significant impacts on innovation, for instance, Foo & Hall (1997) recognize social movement as the main reason for the industry to seek for productivity-based innovation. Similarly, Lee & Park (2006) postulate that in society, an innovation-friendly environment plays a crucial determinant of a nation's innovation path. Still concerning social aspects, Efrat (2014) writes that cultural traits also have significant impacts regarding the evolution of innovation tendencies.

2.1.2. Measuring Innovation

One of the most difficult tasks in the field of innovation research is the setting of the measurement procedure. Innovation can be quantified according to Schumpeter (1983) by establishing dimensions for innovation, whereby innovation can emerge by means of a new product, a new process, as well as by the search of new markets, development of new sources of raw materials and new market structures. In this last case, innovation involves a wide range of organizational learning which is difficult to measure.

R&D expenditure is one economic indicator that also constitutes one of the most used indicators of innovation (Smith & Tranfield, 2005). R&D expenditure is the most traditional and widespread database providing information about innovation. However recent studies conducted by Hall et al. (2009) show that R&D and innovation activities are difficult to finance in a freely competitive market. The main

argument is provided by Arrow (1972) who says that the main output provided by R&D expenditure is the knowledge of how to produce new goods and services, hence the use of the knowledge by one organization does not stop others from using it. It is very difficult or even impossible to maintain knowledge in secrecy, the incomes from investment in knowledge cannot be totally seized by the organization that conducts such investment, consequently some firms will be uncertain regarding investing in R&D. In this sense, organization leaders tend to be more averse to risk than shareholders, avoiding R&D projects that will increase the insecurity of the organization (Hall et al., 2009).

The main operational issue of using R&D expenditure as an indicator for innovation is that it only measures an input to innovation (Lehtoranta, 2000). Even though R&D expenditure serve as an input of innovation, it can also constitute an instrument for scrutinizing knowledge in order to improve external knowledge absorption. In this sense, it can be equated to investing in education to increase the nation's knowledge absorption ability (Cohen & Levin, 1989). The recent global 2008[2] crisis significantly affected the overall R&D expenditure in a negative way, having taken about three years for economies to reload with acceptable R&D investment levels. In 2010 and 2011, in both public and private sectors the growth of R&D was 3% and 4.5%, respectively, which is a considerably good recovery (Arulrajah & Senthilnathan, 2016).

Another indicator used to measure innovation output is the registered number of patents. In parallel with the literature on the outputs of R&D, another line of research has developed the estimation of a knowledge production function, combining knowledge in form of R&D returns and knowledge in form of patents (Mohnen, 2019). The same author categorizes patents as a measure of knowledge output that can be used to explain other economic variables such as productivity or market value. Still, patents and R&D have an almost contemporaneous relationship (OECD, 2005).

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[2] The Subprime Crisis, which started in 2007, with the granting of high-risk mortgage loans, ended up extending to Europe with the Sovereign Debt Crisis from 2008, proving the synergistic effect of the financial crises (Ribeiro, 2019)

Due to the high financial costs and time investment involving the patenting process, patents provide a minimum level of originality and also a significant probability of becoming an innovative product (Buesa, 2001). The output obtained from patents is more associated to innovation than to invention. Patenting is a measure of protecting intellectual property that can stimulate the development of new products or processes in the market (Mohnen, 2019). In nearly all kinds of technological fields, the use of patents is present. The availability of data for a long period of time and for different sectors and different geographical levels gives an advantage to patents in comparison with other instruments for measuring the innovative output. Another advantage of patents in terms of geographical levels is that they can be assigned to locations where they were created, avoiding the headquarters effect given the fact that they are spotted in the inventor's place of residence.

According to Goto (2010), patents are not only limited to the recording of a patent allowance, but they also include information such as number of claims, citations to previous patents and publications and so on. Each patent is most likely associated with one innovation hence the number of patents is the most frequently used proxy for innovation. Measuring the linkage between patents and innovation is critical to understanding both the social benefits of the patenting system and the usefulness of the patent-based approach to innovation analyses.

It is still important to mention the influence of R&D expenditure on the quality of patents. For instance, countries with low R&D/GDP ratios, like Italy and Turkey, tend to produce relatively fewer high-quality patents, while countries with high R&D/GDP ratios, like Japan and South Korea, tend to produce many more high-quality patents (Shambaugh et al., 2017).

2.2. The Concept of Social Capital.

Although social capital has been studied for almost a century, only recently has it become contemplated as one determinant of innovation. The reason for this concept's recent popularity in the economics of innovation research area can be attributed to Robert Putnam (Ponthieux, 2004).

According to Guiso et al. (2004), the history of social capital goes back to classical economists, who provided cultural explanations to economic phenomena. The concept of social capital in the field of

economic studies started to attract the attention of several researchers for the past three decades. Research shows an increase in political and sociological literature regarding the concept of social capital as well as its abundant effects. Its scientific study is modern, but the literature in the field is vast. Still there is yet no single or universal definition for social capital.

Coleman (1988) defines social capital through the identification of its functions such as obligations, expectations, trust, and information flows. Social capital is not a single entity, but instead a set of different entities with similar characteristics - properties of social structure -, and it facilities certain actions of individuals who are within that structure.

Jacob (1961) describes social capital as "neighborhood network", while Putnam (1995) describes it as "feature of social life-networks, norms, and trust that enable participants to act together more effectively to pursue common objectives". Coleman (1990) identifies trust as a product of social capital, while Fukuyama (1997) equates trust with social capital.

Putnam et al. (1993) and Fukuyama (1995) denote that the range of people´s participation in social activities and sharing mutual trust varies extremely within regions and countries. Social capital represents the set of social networks that might provide access to social aid resources. For Furstenberg (2005), the concept of social capital relies on the assumption that citizens live in a high demand system of rules and obligations set by a social consensus. Social capital can also be defined as a sympathy of a person or a group toward another person or group that may create significant value and favorable treatment for another person or group beyond the expected in an exchange relationship,(Robison et al., 2002). It can provide immediate benefits to individuals in the form of information or help from friends (Svendsen & Svendsen, 2006).

Some authors view social capital as a shared asset that resides in a homogenous collective entity, a group of people with the same interests and values. Others have focused on trust and tolerance and another group have focused on the degree of civic and social engagement as the driving force of such social capital. The nature of social capital and trust diverge among authors. For instance, Rothstein & Stolle (2003) offers a very distinct definition that social capital consists of individual assets that come from access to networks and social connections.

Large economic organizations also provide their adaptions on the definition of social capital, for instance, the OECD (2001) defines social capital as a set of networks with common norm, values, and understanding that improve cooperation within groups. The World Bank defines social capital as the institutions, relationships and, norms that define the degree of quality and quantity of social interaction (World Bank, 2007).

The reviewed literature shows the influence of social structures, cultural norms and institutions on economic behavior through multiple direct and indirect channels. They are crucial in understanding sustainable economic development. Many social scientists argue that although social capital lacks some basic properties of classical capital, it shares many important features of classical capital. Social capital has some similar characteristics with other forms of capital, like physical or human capital. It can accumulate over time, is capable of improving economic performance, can be invested with expected future returns (Bhandari & Yasunobu, 2009). Due to its significant influence on social and economic phenomena, investments in social capital are indeed relevant. Table 2 summarizes definitions of social capital.

Table 2: Concepts of Social Capital

Author	Concept
Coleman (1990)	Social capital a network set by obligations, expectations, trust, and information flows.
Putnam (1993)	Social capital is the range of people´s participation in social activities and sharing mutual trust.
Robinson et al. (2002).	Social capital is a sympathy of a person or a group toward another person or group.
Rothstein & Stolle (2003)	Social capital consists of individual assets that come from access to networks and social connections

OCDE (2001)	Social capital is a set of networks with common norm, values, and understanding that improve cooperation within groups.
World Bank (2007)	Social capital represents the institutions, relationship, and norms that define the degree of quality and quantity of social interaction.

Source: Own adaptation, based on the literature review.

2.2.1. Determinants of Social Capital

Research shows numerous and varied categories of aspects that directly or indirectly may affect the evolution path of social capital. For instance, Uslaner (2004) acknowledges trust as a crucial indicator of social capital, as mutual trust allows for resolution of interests.

Income and education play a significant role in social-economic factors of social capital. Knack & Keefer (1997), provides empirical evidence that a higher level of income and education is associated with one individual's progress regarding group membership and interpersonal trust. According to Soroka et al. (2003), education may reinforce trust and civic norms by two channels: Firstly, the learning process helps decrease the uncertainty about the behavior of others. Secondly, students are taught the same norms and values, they all learn the same inter-relational culture. Still, for instance, regarding institutional trust, empirical results are non consensual. Halman & Luijkx (2006) show that institutional trust is statistically significantly and positively influenced by education, whereas Oorschot & Gelissen (2006) find the same effect to be negative.

In addition to income and education, several other social and demographic aspects such as gender, marital status, age, and others can be important determinants of social capital. However, the literature on such determinants still lacks information and empirical analysis.

Table 3: Hierarchical distinction of social capital

Macro Social Capital	Meso Social capital	Micro Social Capital
- Institutional relationship and structure that governs the political regime - Civil society - Rule of law - Government	- Networks of vertical relationships and association - Firms - Non-governmental organizations - Vertical relationship	- Norms - Values - Network of horizontal relationships among individuals

Source: *Adaption from* Bhandari & Yasunobu (2009).

Bhandari & Yasunobu (2009) find that the size of one town has a significant impact on the components of its social capital. Living in a small or medium-sized town tends to decrease both formal and informal participation in social activities[3] Religiosity is also found to have, in general, a positive influence in both formal and informal networks, norms and institutional trust. However, belonging to different religions can have different results in terms of social capital. Putnam et al. (1993) defends that the level of trust is lower in countries with dominant hierarchical religions like Catholic, Orthodox Christian or Muslim- On the other hand, authors like Fukuyama (1995) state that Protestantism associates score higher levels of trust. Table 3 describes the levels of social capital.

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[3] Formal and informal social networks are distinguished in traditional sociological literature (organic and mechanic solidarity) but also in the multidimensional definition of social capital (bridging and bonding social capital). The formal social network dimension is marked by membership and participation in associations, a measure of engagement in social activities (Paxton, 1999)

Labour market participation captures the existence of a relationship between work involvement and willingness to participate in voluntary associations, network with family and friends, and trust in others and in institutions.

Another determinant of social capital is the employment status. One unemployed person tends to experience strong difficulties and disincentives to participate in social groups, because of hers/his mistrust towards society.

Numerous influential studies like Fukuyama (1995); Putnam et al. (1993) have suggested that cultural evolution lies in the foundations of social capital. Culture is the field whereby solidarity values, empathy values, cooperation and responsibility are generated. Values of participation are rooted in a well-known concept - "civic identity" -, which promotes commitment towards the community (Kliksberg, 2002).

2.2.2. Measuring Social Capital

The process of measuring social capital tends to be challenging, sometimes even more difficult than measuring human capital. Alike human capital, social capital contains numerous aspects and each measure is bound to capture only some. Measuring social capital directly is difficult, if not impossible, hence, in order to measure social capital for empirical purposes, the use of a proxy indicator is necessary (Collie, 2003).

Social capital is a very multifaceted concept and cannot be represented by one single indicator. The complexity of such variable requires a set of indicators for its measurement. Attempts of measuring social capital involves conceptual debates about social capital itself, especially when it is to be measured at an individual or community level. Durlauf (2002) suggest that combining the diversity of casual and functional definitions of social capital is necessary for successful empirical analysis. The measurement of social capital is often among studies, given the abstract nature of its varying definitions.

Agranat et al. (2002) refer to some applicable proxies through which social capital can be expressed, such as attitudes and expectations; through reported, recorded and observed actions and activities, and

by paralleling individuals' interpretations of how things happened or are estimated to happen. It is worthwhile matching social capital measures with the conceptual structure of the specific study.

Cavaye (1999), develop a structure of crucial components that can guide the process of selecting ideal indicators to measure social capital. It includes: a specific target for the variable to be measured; measurability i.e. ease of measurement; comprehensiveness, in other words, it must use measures of a range of social characteristics; reliability and rigor; continuity and ability to translate across situations and to be consistent either in local states or in national frameworks.

Stating the right definition and measurement is not highly relevant from an empirical point of view. In terms of principal and practice, they are all correlated. For instance, when studying sub-national governments in Italy, Putnam (1993) showed that social trust in the Italian region is closely correlated with several measures of civic engagement. Knack & Keefer (1996) postulate that trust in people is correlated with civic norms. Based on the General Social Survey data from 1972 to 1994, Brehm and Rahn (1997) also find that civic and interpersonal trust are correlated.

For Ring & van de Ven (1994), informal personal connections between and across organizations play an important role in determining the governance structures used to organize their transactions. Gulati (1995) pointed to the fact that both transaction cost elements as well as social factors, are relevant and important in studying inter firm relationships and co-operation. Frequent ties between firms promote trust, which is manifested in the form of the contracts used to organize subsequent alliances. Trust and the associated information flow within social networks provide options for control through third parties and serve therefore as a substitute for a legal system. Trust is related to the reduction of transaction costs, or the costs of running the economic system. Moreover, trust is linked with the facilitation of highly uncertain and complex transactions. It does reduce the uncertainty of these kinds of transactions.

In a study on the apparel industry in New York, Uzzi (1997) shows that through trust, there is exchange of resources and information, which are crucial for high performance, although difficult to value and transfer via market relationships. As Malecki (2000) puts it, "through the economic and social relations in the network, diverse information becomes inexpensive to obtain". Regarding alliances, Gulati (1998) argues that "trust not only enables greater exchange of information, but it also promotes ease of

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interaction and a flexible orientation on the part of each partner". It operates as a mechanism that facilitates communication and co-operation between firms.

2.2.3. Societal trustworthiness

According to Putnam (1993), trust is one of the most crucial attitudinal elements of social capital and of social organization in general. Generalized trust enables interpersonal co-operation and enhances the general feeling of community and belonging. In terms of comparative research, generalized trust measurement is used to differentiate societies according to their levels of social capital (Kääriäinen & Lehtonen, 2006). Uslaner (2002) considers generalized trust as an essential attitudinal element of social capital and social cohesion in general. However, there are some critics regarding the purposes of generalized trust previously mentioned by Newton (1999) Generalized trust is predominant in societies of individuals with high income, being easier for them to express trust in their fellow citizens. Arneil (2006) argues that generalized trust might serve as a social lubricant in homogeneous settings but is less useful as an indicator of social cohesion in an ethnically and culturally diverse social context.

In the literature on social capital, Putnam (1993) is a pioneer, with his work on civic traditions in modern Italy. He states that the existence of social capital, measured as the incidence of generalized trust, network of civic engagement and norms of reciprocity, all combined will define the performance of a local, regional government. The concept of social capital surfaced in the international literature when Putnam (2000) analyzed social capital in the United States, claiming that social capital levels are decreasing intensely, especially within younger people in the US.

More empirical issues of social capital have been on demand. Since there is a connecting bond between social capital and durable networks, the development of this approach required research into voluntary organizations. Membership in voluntary organizations has been seen as the crucial empirical factor for analyzing social capital in survey research (Stolle & Hooghe, 2004). For this reason, voluntary organizations are also known as small-scale democracies in which people are grouped into norms like trust and reciprocity. Nevertheless, Putnam himself presented the difference between private (networks) and public (norms of reciprocity and trust) aspects of social capital (Putnam, 2000). Scholars began to

arouse interest in a conceptualization of the behavioral side of social capital as well. Consequentially they embraced the concept of generalized trust.

Research shows significant and resilient differences between countries regarding the concept of generalized trust in a comparative approach. As per Newton (1999), there are very high social trust levels in the Scandinavian countries, with lower levels in the Catholic countries of Western and Central Europe, with the lowest levels observed in Sothern Europe. Based on the World Values Survey, Delhey & Newton, (2005) state that results presented by the Scandinavian are an outcome of Protestant traditions in those countries, as well as the fact that they are more ethnically homogenous.

Another indicator of a country's level of generalized trust is the degree of corruption. The ambiguous empirical literature on political corruption shows both interpersonal and political trust to be both the cause and the consequence of corruption. The lack of trust fed by corruption undermines government efforts to mobilize society to help fight corruption and leads the public to routinely dismiss government promises to fight corruption (Morris & Klesner, 2010). It is a vicious circle. Based on that, the same authors believe that lack of trust in others within society and/or in government inhibits the adoption of a global ethos and cooperative behavior, favoring instead instrumental an individualistic approach to problems. Della Porta (2000) agrees, stating that the lack of confidence in government stimulates corruption insofar as it transforms citizens into clients and bribers who look for private protection to gain access to decision-makers. Conducting a dual empirical approach, Anderson & Tverdova (2003) find that the higher the perception of corruption among individuals, the lower their support of democratic political institutions, whereas at a macro level, societies with higher levels of corruption tend to exhibit more negative attitudes toward civil servants. Analyzing the problem of political corruption, Morris & Klesner (2010) concluded that, particularly in countries where corruption is endemic, there is a vicious circle wherein corruption breeds a climate of distrust that in turn feeds corruption. The regression analysis, in turn, shows that trust in political institutions influences perceptions of corruption but that although participation in corruption influences perceptions of corruption, it does not necessarily have a strong impact on feelings of trust in public institutions.

Tables 4 and 5 provide the ranking of the 5 highest and 5 lowest countries in terms of corruption perception, based on Transparency International[4], which ranks 180 countries and territories by their perceived levels of public sector corruption according to experts and business people, using a scale of 0 to 100, where 0 is highly corrupt and 100 is very clean.

Table 4: Top 5 highest Corruption Perception Index countries

Country	CPI Score	Number of Sources	Rank
Denmark	88	8	1
New Zealand	87	8	2
Finland	85	8	3
Singapore	85	9	3
Sweden	85	8	3

Source: An adaption from: *"Corruption Perceptions Index 2018 - Transparency International," n.d)*

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[4] Is a global movement with one vision, to set the world free of corruption. In more than 100 countries and an international secretariat in Berlin, leading the fight against corruption.

Table 5 : Top 5 Lowest Corruption Perception Index countries

Country	CPI Score	Number of Sources	Rank
Korea North	14	4	176
Yemen	14	7	176
South Sudan	13	5	178
Syria	13	5	178
Somalia	10	6	180

Source: An adaption from: *"Corruption Perceptions Index 2018 - Transparency International," n.d)*

After analyzing the role of corruption in trust, another societal trustworthiness indicator must come into consideration, which is competitive advantage. In order to understand this relationship, one must comprehend the concept of competitive advantage which, according to Al-daibat (2017), constitutes the leverage that one business has over its competitors, that can be gained by offering clients better value, for instance, products or services with lower prices or higher quality which on the other hand interests customers. As was mentioned previously, social capital represents the set of resources mobilized through a more or less extensive and attainable network of relationships, and this provides competitive advantage by ensuring higher returns for investments (Lane, 2000).Taking diamond dealers from New York as an example, Coleman refers that there is a high degree of trust between merchants, which allows them to exchange without further (costly) formalities very valuable diamonds for expertise (Ponthieu, 2004). With the goal of exploring the direct impact of social capital and moderating impact of marketing capability on societies' competitive advantage, Pratono & Mahmood (2016) conducted a study, concluding that there is a significant statistical relationship between social capital and competitive advantage. Table 6 lists the 5 highest competitive countries, and opposite the 5 lowest competitive countries, in a scale of 1 to 7.

Table 6 : Global competitiveness index per countries 2017-2018

A (Highest 5)

Economy	Score	Global Position
Switzerland	5.86	1
United States	5.85	2
Singapore	5.71	3
Netherland	5.66	4
Germany	5.65	5

B (Lowest 5)

Economy	Score	Global Position
Mauritania	3.09	133
Liberia	3.08	134
Chad	2.99	135
Mozambique	2.89	136
Yeman	2.87	137

Source: Adaption from Scwab (2018)

Every country wishes to gain reputation in the eyes of the world. In this sense, the main business elites' and institutions' reputations of a country play a crucial role in the level of societal trustworthiness. Social capital helps to increase people's accountability for their actions, mitigating moral hazard as economic decisions are placed within the context of a long-term relationship, and where reputation is important (Al-daibat, 2017).

Research also shows that higher levels of sustainability generally contribute positively to social capital. The opposite occurs with unsustainable economic behavior that tends to deplete natural resources, leaving fewer for future generations. Bebbington & Perreault (2008) conceptualized sustainable development as a type of capital and explored ways in which social capital contributes to sustainable development in a theoretical framework. Even though the literature on social capital, natural capital and sustainability has been growing significantly over the last few years, its development is still embryonic. Folke et al. (2005) lead the main relevant studies in the field and the fact that they are highly cited gives relevance to this topic. A very common methodology for scrutinizing research output in topics like social capital and sustainable development is bibliometrics, which consists of a cross-disciplinary analysis that searches bibliographic data through mathematical and statistical tools. Attempting to analyze the relationship between social capital and sustainability, Garrigos et al. (2018) conducted a study whose

results show that the diversity of perspective defines its high potential. Figures 1 and 2 rank 10 countries in terms of sustainability, which is measured based on three dimensions, in a scale of 0 to 10.

Figure 1 : Ranking of the 5 highest countries in sustainability
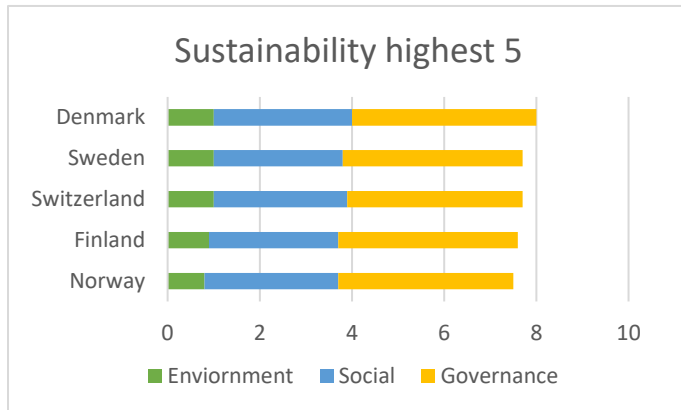
Source: Robecosam (2017)

Figure 2 : Ranking of the 5 lowest countries in sustainability
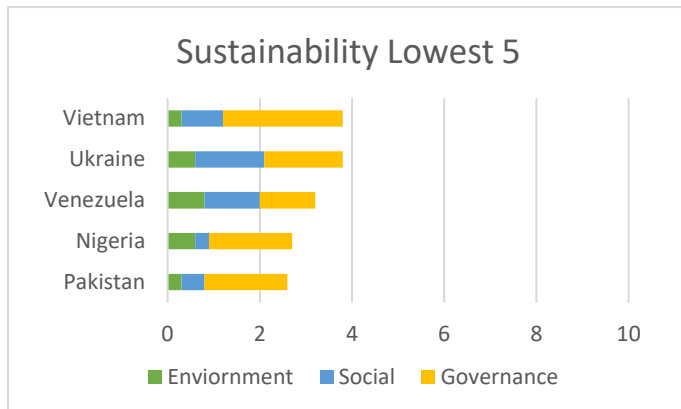
Source: Robecosam (2017)

In the center of the attentions, among all the other societal trustworthiness indicators, is one country's health system, given the fact that it directly affects the lives of susceptible patients (and their families) and benefits from the largest public expenditure portion in several developed countries. This implies that

all efforts in improving one country's health system can be considered a good indicator of societal trustworthiness in that country. Similar to social capital, the literature on trust and the health system is a modern line of research. According to Gilson (2006), uncertainty and mistrust about the effective, efficient and equitable use of health care funds leads the public to transfer their mistrust in the health care system into general mistrust in the government and politicians. Because publicly funded health systems comprise such a large degree of state-citizen interaction, mistrust in health systems may contribute to a general mistrust in government. Hence the health system contributes to the construction of broader social values and trust, because of the direct interaction between citizens and their health system (Gilson, 2006). Observing the Canadian Health Care Values, Abelson et al. (2009) concluded that it provides deep insights into the vulnerability of trust relationships and suggests an alternative depiction of interpersonal–institutional relationships in the context of health system trust relationships. Additionally, it offers a more complete picture of the pathways leading to and between trust, distrust and mistrust. Table 7 displays the Top 10 countries with the best health care system, based on quality of heath, patient experience, finance, governance, personal and communication health care data, in a scale of 0 to 100.

Table 7: Top 10 countries with better health care system quality

Country	Overall Score	1. Quality of Health care	2. Patient Experience	3. Finance	4. Governance	5. Personal Healthcare Data	6. Communication of healthcare Data
Denmark	74	67	62	83	94	93	50
Finland	72	48	46	83	88	86	93
Sweden	71	81	69	75	69	79	50
Norway	69	67	62	83	81	71	50
UK	69	57	85	83	81	57	57
Australia	68	52	62	83	88	64	64
New Zealand	67	38	54	83	94	64	79
Netherland	67	57	85	75	69	50	71
Portugal	64	48	46	83	63	86	71
Singapore	63	57	77	83	81	43	43

Source: Adaption from Britnell et al. (2017)

Several classical sociological theorists have mentioned the importance of religion in shaping societies' values and behaviors. For instance, Max Weber[5] in De Hart et al. (2013) states that the protestant ethics underlined the importance of trust and trustworthy behavior, suggesting direct accountability to God, which meant that less than diligent behavior would be noticed from "above" and be punished. Laermans & Verschraegen (2001) argues that religion and religious codes of behavior reduce uncertainty in human relations. Less uncertainty in human relations theoretically should encourage social trust. Several studies point out that compared to other countries, Nordic European countries occupy prominent positions in terms of political trust and national institutions Listhaug & Ringdal (2008). Religiosity seems to have a determinant impact on other forms of social capital. For the United States of America, Putnam & Campbell (2010) emphasize the important role that religion plays in constructing social capital and societal cohesion.

2.2.4. Social Capital as a source of Innovation

The present section motivates for the specific objective of our study, which is to analyze the impact of social capital on innovation.

Social capital helps innovation in reducing transaction, search and information costs, and in facilitating bargaining and decision-making (Landry et al., 2000). It is important to mention here that the impact of social capital on innovation varies with the level of analysis, national versus regional. The present study takes a national point of view. We believe that previous studies have not yet developed sufficiently accurate indicators for social capital per country. Several authors have adopted the concept described earlier in our review of literature, but there is still lack of agreement when it comes to measure or quantify social capital. One explanation for this matter, provided by Beugelsdijk & Schaik (2005), is the multidimensional character of social capital.

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[5] Max Weber became one of the most influential social scientists of the 20th century in large measure because of the intellectual interests and professional needs of successive generations of social scientists (Roth, 2002)

According to Akçomak & Weel (2009), enabling and promoting cooperation, interaction and sharing of social capital among individuals fosters innovation activities, which consequentially triggers economic growth.

In the past few years, countries such as the United States, Sweden, and Finland embraced innovation as a key factor for growth, in their pursuit for sustainable sources of economic growth. More industrialized and emerging countries are predictable to become innovations economies.

Innovation in its modern concept is not only limited to technological and R&D activities performed only by certain academic researchers. Innovation consists nowadays in the introduction of a new product or service (Bloch, 2007). Given its emerging complexity, the process of innovation requires a productive structure that facilitates collaboration and information sharing among inventors and among investors. In order for such innovative productive structure to achieve its objectives, social capital is required in the innovation economy.

Social capital represents the set of norms and networks that enable cooperation and organized actions (Puntnam 1993). In the same network that enables cooperation, trust streams transitively. Trust and cooperation share a positive correlation. According to the World Bank, social capital is the set of norms and networks that enable collective action.

Some authors are of the opinion that social capital arises from the moral conception, for instance, Fukuyama (1995) states that social capital is trust rooted in ethical and reciprocal moral habits and obligations common to all members of society. Trust can be considered the expectation that one has toward another's reliability regarding obligations, cooperative behavior and fairness in actions and negotiations (Paldam & Svendsen, 2000). In addition, Crudeli (2006), postulate that constant trustful interaction among random citizens within a country increases the level of generalized trust. Consequently, from Durlauf & Fafchamps (2004), social capital can be defined as the set of network-based processes, developed based on generalized trust, that triggers the ability of a country's citizens to share, cooperate and coordinate actions. Concisely, social capital lies in generalized trust and its respective links.

Uzzi (1996); Gulati (1998), exemplify that through trust-networks, several and crucial pieces of information are freely shared. Information is a powerful tool for innovation activities, it improves people's capabilities of critical analysis.

Maskell & Malmberg (1999), there are several methods whereby social capital stimulates innovation such as: reducing transaction costs between firms and between firms and other actors, as well as reducing search and information costs, regulating and enforcement costs. The literature on social capital as a source of innovation is transiting from its embryonic stage as several authors are now sharing their thoughts on the importance of social capital for innovation activity and output. The success of financing one risky innovation project very often depends on the level of trust between the researcher and the capital provider, consequently, the higher the level of trust in one economy, the more successful research projects are carried out, and the higher the number of patent applications (Aghion & Howitt, 1992).

In order to study the effects of social capital on innovation, Akçomak & Weel (2009) conducted a study using OLS estimations. Their estimates suggest that a region's innovative output is higher when its level of social capital is higher. Fritsch (2004) acknowledges that cooperation increases the efficiency of R&D activities, which most likely yields higher numbers of successful innovations and patents. All regressions produce a trust coefficient significant at the 5% level. The regressions do not suffer from weak instrument problems and the null hypothesis that the over-identifying restrictions are valid and never rejected. The authors show the means in that social capital improves innovation. Their model focuses on differences in social capital across regions and shows that higher stocks of social capital increase innovation. It also shows that the positive relationship between social capital and innovation stimulates the production process and increases per capita income. The empirical contributions of this study is to provide for 102 regions of the EU-14 the early institutions that shape current social capital. Another empirical analysis, conducted by Dakhli & Clercq (2003) with the aim to demonstrate the impact of trust on innovation, finds a positive result, using the number of registered patents as a proxy for innovation, in a multidimensional regression model with 59 observations.

Zak & Knack (2001) also find a positive relationship between trust and innovation as well as between trust and the investment to GDP ratio, for 1970-1992, with a cross-country regression model (N=41). These authors used the first three waves of the World Values Surveys (WVS) to measure the level of trust,

concluding that high trust levels reduces costs and stimulates investments. Similarly, Valickova et al. (2013) used more than 40 regressors for nearly 50 countries to illustrate that trust is a robust determinant of long-term economic growth between 1960 and 2005. More recently, case studies conducted by Klijn & Koppenjan (2016) on Taiwan, Spain and the Netherland, using participant questionnaires, conclude that there is a positive relationship between trust and innovation on a national level, arguing that high levels of trust foster the flows of information and knowledge exchange, due to their cost reduction, and thus increase the learning process.

Besides all the positive results mentioned above, some authors do present dissimilar results to the previously stated, for instance Hauser et al. (2007) test whether social capital, including the degree of trust, affects innovative activity measured by patent application in Europe. They conclude that trust did not have statistically significant impact on innovation patent application from 1997 to 2001.

3. Methodology

The aim of the present chapter is to describe the approach adopted in order to answer our main research question. The chapter covers in detail the source of data used to answer the research question. This assignment analyses social capital as a determinant of innovation assuming a linear relationship among the variables.

3.1. Analysis objective

Akçomak & Weel (2009); with their study conducted in 102 regions of the EU-14 from 1990 to 2001, have tremendously contributed to the elaboration of this dissertation. The authors show that social capital has been one of the core factors for social exchange and communication. Individuals, firms and organizations within a country need to have mutual trust if they want to increase efficiency and productivity by reducing monitoring time and costs. Their findings also suggest that backward regions cannot improve fast in terms of innovation and per capita income growth, because the shaping of social capital is crucial and takes longer to develop. It should be noted that the period of the study carried out by the authors in the 102 regions of the EU-14 combines the two phases in which the euro was introduced as the region's single currency, shortly after the Maastricht [6] Treaty and towards the later stages. We must highlight, here, the fact that this study was conducted at the time of the introduction of the Euro, when many critics believed that such a large-scale monetary union would make no sense. Such a period of economic speculation could somehow cause changes in trust levels of the regions studied by the authors.

This motivational context aroused our interest to investigate the impact of social and political factors, in particular of social capital, on the level of innovation of a country.

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[6] In 1992, European leaders signed the Treaty on European Union in Maastricht, the Netherlands. The Treaty contains the necessary provisions to implement monetary economic union (EMU) Leaders agree on the criteria that each country must meet in order to adopt the currency. European Commission (2020).

3.2. Econometric model

In order to test the effect of social capital on innovation, we used the statistical software STATA and the chosen model was the multiple linear regression model that allows us to explain and make predictions for an explained (or dependent) variable, based on two or more explanatory (or independent) variables. The base linear model has the following generic form:

$$y_{i,t} = \beta_0 + \beta X_{i,t} + \varepsilon_{i,t},$$

where variable $y_{i,t}$ represents the dependent variable for country i in time period t, β_0 is a constant, β are the regression coefficients and estimates associated with each of the explanatory variables, $X_{i,t}$ is the set of all the model explanatory variables, for country i in the time period t, and then there is the perturbation term $\varepsilon_{i,t}$ which is an unknown random variable representing all the variations that occur in the explained variable that are not captured by the explanatory variables in each country i and for the t period.

In a more detailed form we can specify our model as:

$$R\&D_{i,t} = \beta 0 + \beta 1\, Trus_{i,t} + \beta 2\, Techexp_{i,t} + 4\, Ggdp_{i,t} + \beta 5\, FDI_{i,t} + \varepsilon_{i,t}$$

Where:

- $R\&D_{i,t}$ is a proxy for innovation, expressed as a percent of GDP. It includes both capital and current expenditures in the four main sectors: Business enterprise, Government, Higher education and Private non-profit. R&D covers basic research, applied research, and experimental development. As was mentioned in the literature review, for Dosi (1988), expenditure in research and development (R&D) can be considered the most influential determinant in the organization's capabilities to innovate. Investment in R&D allows organizations to maintain competitive edge over their rivals, or at least during the early stages of the innovation process.

- $Trus_{i,t}$ is a vector of social capital and, similar to what was mentioned earlier, it represents the level of trustworthiness within country *i* for period *t*. The present dissertation expects a positive relationship between social capital and innovation. The investigation conducted by Akçomak & Weel (2009) identifies a robust relationship between Trust and innovation, in the same study over 80 percent of the estimated coefficients of Trust are significant at least at 10 percent level. The variable trust is obtained from a system of ranking of countries according to their level of trust, combining relevant indicators of societal trustworthiness of a country such as: corruption, competition, reputation, sustainability, economic freedom, healthcare and women's rights. We followed the strategy of aggregating recent data from the source Trust Across America – Trust Around the World (TAATAW), the source measures countries' institutions on five indicators of trust using independent third-party data.

- $Techexp_{i,t}$ is one variable assessing the quality of communication technologies, computers, etc., here proxied by a control variable which represents the parcel of a country service's exports. Aw et al. (2005) postulates that exporting firms that do not invest in R&D or training have lower productivity rates than firms investing in R&D. They conclude that exporting firms, in particular, need to produce effective R&D or training in order to be more efficient.

- $Ggdp_{i,t}$ this variable shows the annual percentage growth rate of GDP for country *i* in period *t*. A positive sign for its estimated coefficient is expected, thus showing a positive relationship between innovation and growth. Porter (1985) states that innovation has been one of the most important driving forces of economic growth, therefore the growth rate of GDP and the percentage of GDP invested in technological development are key factors in the process of measuring and determining innovation.

$FDI_{i,t}$ is foreign direct investment and it is **calculated** by the sum of equity capital, reinvestment of earnings, other long-term capital and short-term capital shown in the balance of payments. Sandu & Ciocanel (2014), **for instance,** confirm that FDI is **determinant for**

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increasing production capacity of high-tech products and the number of patent applications and, also, for improving the national intellectual capital via R&D by the innovative foreign enterprises.

3.3. Time and data

The present thesis concerning social capital and innovation lays its foundations on a set of available statistical information about several countries, selected by the data source "Trust Across America-Trust Around The World". The study is cross-sectional and covers a database for the year 2017 (t=2017 in the model specified previously) for the following countries: Argentina, Australia ,Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Croatia, Czech Republic, Denmark, Egypt, El Salvador, Finland, France, Germany, Greece, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, Kazakhstan, Malaysia, Morocco, Mexico, New Zealand, Norway, Pakistan, Peru, Philippines, Poland, Portugal, Romania, Russia, Saudi Arabia, Singapore, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Thailand, Turkey, Ukraine, United Kingdom, Unites States of America. The majority of the variables used in the present study were collected from the World Bank database, namely Research and Development Expenditures, Foreign Direct Investment, GDP growth rate. Institutional trust is the indicator used to measure social capital.

For a complete analysis of the model, a brief description of each of the variables is now presented on Table 8 (Table b1 attached is also a contribution in this sense), as well as the characteristic of the sample and the correlation matrices for the model.

Table 8 : Independent variables expected signs.

Variable	Source	Authors	Expected Sign
Trust	TAATWA	(Maskell, 2001; Landry et al., 2002) (Akçomak & Weel, 2009)	+

Technology export (TechX)	World Bank	(Aw et al., 2005) (Salomon & Shaver, 2005)	+
Foreign Direct Investment	World Bank	(Sandu & Ciocanel, 2014)	+
Growth Rate of GDP	World Bank	(Poter, 1985)	+

Source: Own elaboration.

3.3.1. Sample Characterization

Here we present descriptive statistics of the variables used in the model. Table 9 summarizes the descriptive analysis of our study's data.

Table 9 : Descriptive analysis of model variables

Variables	Observations	Mean	Standard Deviation	Minimum	Maximum
R&D	55	0,0146	0,0113	0,0008	0,0457
Trust	55	0,2945	0,1645	0,02	0,57
Techexp	55	0,4162	0,1990	0,0111	0,7655
Ggdp	55	0,0304	0,0224	0,035	0,0814
FDI	55	0,0312	0,05	0,0926	0,02801

Source: Own elaboration.

From the descriptive analysis of the model, it is possible to conclude that variable Technology Export is the one with the greatest difference between the minimum and maximum value, followed by Trust, which reflects a great variability of values and translates into high standard deviations. The volatile behavior of both Trust and Technology Export variables is influenced by our sample of very heterogeneous countries for the study, varying from developed economies to heavily indebted countries.

3.3.2. Linear Correlation between the Variables under Study

After the descriptive analysis of the variables, it is now important to assess if they are correlated. For this purpose, Table 10 here presents the correlation matrix, showing us how correlated are the variables included in our model. The values of the correlation coefficients vary between -1 and 1. The closer the correlation coefficient is to the extremes, the greater the (negative or positive) the linear association between the variables, respectively. A negative correlation value indicates an inverse relationship (when one variable increases the other decreases) and a positive value indicates a similar relationship (when one variable increases the other also increases). Gujarati et al. (2013), for instance, indicate that special attention should be paid to results above 0.80, as they may reveal the existence of multicollinearity in the model. Attention to the correlations that have very low values should be paid, as well.

Table 10: Correlation matrix between model variables

	R&D	Trust	Techimp	Ggdp	FDI
R&D	1				
Trust	0,6254	1			
Techimp	0,3718	0,1936	1		
Ggdp	-0,0688	-0,0910	0,2073	1	
FDI	0,1010	0,2284	0,1269	0,1719	1

Source: Own elaboration. Correlations where obtained using the statistical software STATA15.

Analyzing Table 10, we observe that variables Trust, Technology Exports, and Foreign Direct Investment are positively correlated with R&D Expenditure. On the other hand, variable Economic Growth is inversely correlated with the model's dependent variable. As expected, Trust is the variable that has the highest positive linear correlation with R&D Expenditure, of approximately 0.663. Conversely, Economic Growth is the variable with the greatest negative linear correlation with Innovation exhibiting a value of -0,69. From the analysis of the correlations matrix of the model, we conclude that overall there is absence of high correlation between the explanatory variables since almost all have correlation coefficients below 0.80. Still, we will run a specific statistical test for the presence of multicollinearity in model.

4. Empirical Study

4.1. The effect of social capital on innovation – Ordinary Least Squares Method

To estimate the regression model, the Ordinary Least Squares Method (OLS) was initially applied. The implicit procedure for this estimation method consists of minimizing the sum of the square of the residuals, in order to model a relationship between the dependent variable and the independent variables. Before proceeding with the interpretation of the results, it is necessary to verify that the regression models satisfy a set of conditions so that the OLS does not produce skewed estimates of the coefficients. In other words, it is essential to carry out some econometric tests in order to detect possible problems of multicollinearity, heteroscedasticity, and non-normality of the residues.

Multicollinearity means the existence of an exact linear relationship between some or all of the explanatory variables in the regression models. According to Verbeek (2014), there is nothing wrong with including correlated variables in the models, which is an important reason for using multiple linear regression models in which the explanatory variables that affect the dependent variable are mutually correlated. However if the correlation between them is too high, it can generate unreliable estimates, such as unexpected signs. Intuitively, for example, in a wage regression which includes age and experience as explanatory variables, if age and experience are highly correlated with each other (which is natural, since older people usually have more experience), it can be difficult for the model to identify the individual impact of each of the explanatory variable on the wage.

In order to avoid this type of problem, the ideal is that the explanatory variables do not have a very strong relationship between each other, being independent. Some authors, including Wooldridge (2013) point to the Variance Inflation Factor (VIF) as a good method for testing the presence of multicollinearity. According to the author, if the VIF is greater than 10, it indicates a problem. As shown in Table 11, the VIF values in the model are 1.12; 1.10; 1.10 and 1.10. Thus, since the VIF values are all below 10, the absence of high multicollinearity is confirmed.

In turn, heteroscedasticity means that the error variance is not the same for all observations. The ideal is the presence of homoscedasticity, which means that the variance of each error term is constant and equal to $\sigma 2$ and that the data are more homogeneous and less dispersed around the model's regression

line (Verbeek, 2014). To test for the existence of heteroscedasticity, the Breusch-Pagan test is undertaken, whose null hypothesis is constant error variance. As shown in Table 11, based on the P-value of the Breusch-Pagan test, the null hypothesis is not rejected, so we are facing a desirable situation of homoscedasticity of errors.

The possibility of missing variables in the models is also tested using the "ovtest" command in the STATA15 program. The null hypothesis of this test is that the model does not have important variables omitted and the alternative hypothesis is that it does. As shown in Table 11, the P-value of this test has values greater than 0.05, which means that the null hypothesis is not rejected and, therefore, there are no important omitted variables that should be included in the model.

Table 11: The impact of Social Capital on Innovation- Least Squares Method

Independent Variable	Expected Sign	First regression	VIF
Constant		-0.002 (0.68)	
trust	+	0.040 (5.27)**	1.12
techExp	+	0.016 (2.58)*	1.10
Ggdp	+	-0.033 (0.60)	1.10
FDI	+	-0.013 (0.51)	1.10
R^2		0.4645	
R^2 Adjusted		0.4217	
F test for global significance		*P-value* = 0,0000	

BreuschPagan Test		*P-value* = 0.0869	
Omitted Variables Test		*P-value* = 0.2765	

A relevant coefficient in the interpretation of the data is R^2 also called the determination coefficient. This coefficient varies between 0 and 1, and when multiplied by 100 it indicates as a percentage how much the explanatory variables can explain the dependent variable. Therefore, the greater its value, the greater the explanatory power of the model. According to Colton & Bower (2002), the low values of R^2 can be related to a reduced amount of data, incorrect sampling techniques, problems of high multicollinearity or a significant number of explanatory variables that were not included. In the present model, the R^2 has considerable value (0,46, respectively) so the model does not seem to have such problems. This R^2 value mean that 46% of the variations in Innovation, in Table 11 respectively, are explained by the average variations recorded by the explanatory variables of the model.

The inclusion of many variables, although with little explanatory power over the dependent variable, increases the value of R^2, which often leads to the indiscriminate addition of explanatory variables in the models. To avoid this tendency, the adjusted R^2 or adjusted determination coefficient is also calculated, which penalizes the inclusion of variables with little explanatory power. As shown in Table 11, the value of the adjusted R^2 is 0,42 meaning that the selected independent variables are relevant for explaining variations in Innovation.

Additionally, the combined statistical significance of the estimated coefficients of the model was tested using the F test for global significance. The null hypothesis of this test is that the regression coefficients as a whole are equal to zero. As shown in Table 11, the P-value for models is below the 0.05 threshold, so the null hypothesis is rejected and it is possible to conclude that the variables as a whole have, in fact, explanatory power over the behavior of the dependent variable. Subsequently, the individual

statistical significance of the coefficients is also tested in order to understand whether the variables are individually relevant in explaining Innovation. In the regression, the statistically significant and therefore relevant variables are Trust and Technology Exports.

5. Analysis and Discussion of Results

Our empirical study has been conducted with the goal of answering the proposed research question about the impact of social capital on innovation around the world. For this purpose, we will now present the main results obtained from the estimation of our model.

From the analysis of Table 11, which shows results from the OLS Method, it can be seen that the variables Trust and Technology Exports are the ones which better explain the variations that occurred in Innovation. Both presenting a positive sign as expected. Such result meets the study conducted by Dakhli & De Clercq (2004) that confirms the existence of a positive impact of trust towards the R&D expenditure. Their study confirms the important role of trust as a driver of innovation, by facilitating exchange of information, ideas and resources and by reducing the need for time consuming and costly monitoring. Trust fosters more extensive and unconstrained co-operation, freer exchange of information, which may stimulate more R&D related activities and output. This positive relationship between Trust (Social Capital) and Innovation thus confirms our starting point arguments.

Regarding Technology Exports, the impact of this variable towards R&D expenditures is positive as expected, as the more a country exports technology, the higher its level of incentives for and creation of innovation. For example, Girma et al. (2008) find that exports indeed enhance the innovative capability trough increasing R&D activities. Developed countries such as Ireland exhibit positive learning-by-exporting effects. Several other studies found a positive impact of a country's total exports on innovation. However, considering the importance of innovation for the present dissertation, we have chosen variable Technology Exports for our analysis. According to its coefficients, on average, it is estimated that the increase of 1 percentage point in Technology Exports increases approximately 0.016 percentage points in R&D expenditure.

The estimated coefficients for variable FDI are negative and not significant for the model, which makes very uncertain the process of deriving conclusions regarding the role of FDI in influencing R&D expenditures. We estimated that on average the increase in the FDI by 1 percentage point reduces about 0.013 percentage points in innovation. Although literature provides several cases of positive influences of FDI on innovation, a specific case conducted by Subash & Vinish (2008) could not find any evidence of complementary or substitution effect of FDI inflow on the decision to invest in R&D.

Our results regarding the impact of Economic Growth on R&D activities, and the incentives to these, show a negative sign. The increase of 1 percentage point in Economic Growth reduces the R&D expenditure by 0.033 percentage points. Most of the cases presented in the literature expect economic growth to be one of the engines influencing innovation, given the fact that the greater the economy, the greater the demand for sophisticated goods and services. Regarding the present analysis, the main reason for not obtaining results similar to the majority of studies is the sample of countries used in this work, we believe. As previously mentioned the selected countries are provided by the database "Trust across America -Trust around the World", from which we extracted data for the explanatory variable Trust, which is the most relevant variable for the model. The country selection encompasses a range of countries at various points in the scale of economic development. Spending on R&D varies considerably depending on the level of development of each country. Such variation may be caused by the concentration of R&D expenditure in specific productive sectors. Consequently, less developed countries may experience lesser effects in activities related to R&D.

The same reasoning applies to the obtained results for the FDI variable. Investment from foreign countries to less developed countries is in most cases catalyzed to other purposes - and not so much for investment in R&D -, such as epidemics, investment in war material, economic inclusion and stability, and so on.

Therefore, the lack of stimulation and creation of new local technologies results in less developed countries continuing to import technologies from more developed countries.

6. Conclusions

The difficulty of the measurement of social capital has drawn the attention of several researchers about the need to create new ways of quantifying it, in order to facilitate studies in this field. The present study was carried out with the sample of countries offered by the database "Trust Across America - Trust Around the World". We hope that this dissertation can make an additional contribution for the study of the relationship between social capital and innovation activity. The literature suggests that the effort of collaboration provided through social capital improves the performance of innovation activities, especially when there is trust in the main institutions of a nation. Trust in the main institutions is influenced negatively by the corruption perception, and positively by the institutions level of sustainability, as well as the quality of the health and education systems. Institutional trust facilitates the exchange of experiences, technical resources and knowledge. Investments in technology often present certain difficulties because of the high costs involved in the process. Social capital acts in this aspect as a facilitator of bureaucratic and high-cost operations. In short, it can be stated that institutional trust generates transparency that will facilitate the exchange of information that can consequently increase R&D related to innovative activities.

Thus, it is possible to conclude, through the estimation made by OLS, that an increase in the level of institutional trust positively affects innovation and will subsequently result in economic growth. This result is in line with the studies presented in the literature review that prove that there is a linear relationship between trust and innovation, especially in countries that have high trust in the key institutions of the country.

However, not all results go according to expected in the literature review. For instance, results obtained for the variables FDI and GDP growth rate do not meet what was pre-established in the literature review.

As mentioned above, the difficulty in the measurement of social capital limits the existence of databases for studies, so much that in this work it was only possible to study the impact of social capital on innovation by transforming a ranking of countries scaled by trust levels, the ranking involves for each country the quality of the main public institutions.

The limitations experienced in the present study involved the lack of updated data sources. We had to resort to using the ranking by WSV for 2017. We would have liked to work with more up-to-date data and

results, since the WSV database which is normally used for the extraction of social variables will only be launching its seventh Survey Wave in the second half of the year 2020.

For future studies, it is recommended the use of WSV, since it deals with relevant dada for the purpose of studying social, political and economic phenomena.

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8. Appendixes

Table B1: Dependent and explanatory variable with respective descriptions, sources, authors and expected signs.

Dependent Variable	Description	Source
R&D expenditure	The variable expenditures on research and development (R&D) is a proxy for innovation, ta expressed as a percent of GDP. They include both capital and current expenditures in the four main sectors: Business enterprise, Government, Higher education and Private non-profit. R&D covers basic research, applied research, and experimental development.	World Bank

Independent Variable	Description	Source	Authors	Expected Sign
Trust	The variable trust identifies a system of ranking by countries, combining relevant indicators of societal trustworthiness	Trust Across America	(Maskell, 2001; Landry et al., 2002) (Akçomak & ter Weel, 2009)	+
Technology Exports (TechX)	Communications, computer, information, and other services residents and nonresidents	World Bank	Aw et al. (2005) Salomon and Shaver (2005)	+

Table B1: Dependent and explanatory variable with respective descriptions, sources, authors and expected signs (continuation)

GDP Growth Rate (Ggdp)	Annual percentage growth rate of GDP at market prices based on constant local currency. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.	World Bank	Poter (1985)	+
Foreign Direct Investment (FDI)	The variable Foreign Direct Investment (FDI) is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments.	World bank	(Sandu & Ciocanel, 2014)	+

Source: from the dissertation's author.