What is the Role of Social Capital in the Innovation Creation Process? Evidence from the European Union

Emrah Eray Akça[1] and Murat Bayraktar[2]

[1] Department of Economics, Faculty of Economics and Administrative Sciences, Bartin University, Bartin, Türkiye

[2] Department of Economics and Finance, Faculty of Business Administration and Management Sciences, Istanbul Esenyurt University, Istanbul, Türkiye

emrahakca@bartin.edu.tr
muratbayraktar@esenyurt.edu.tr

Abstract: This study empirically analyzes whether social capital has any role in shaping the innovation creation process in 25 members of the European Union over the period 2013-2021. In this context, the innovation model is constructed utilizing balanced panel data and hierarchically estimated with the Poisson Pseudo Maximum Likelihood (PPML) method which is the most appropriate method since the model includes some negative values and count data. The finding strongly supports the encouraging effect of social capital on innovation since it is statistically significant and positive in all model specifications. Besides, the innovation creation process is positively associated with human development, research and development expenditure, population, government effectiveness, and income per capita. When comparatively evaluated estimation results, human development, and social capital lead to forth in terms of contributing more innovation creation process. As a core result of the study, social capital may be considered the workhorse for the innovation creation process since it promotes better coordination of activities through improved interpersonal interactions, increased community trust, and vision-sharing, leading to increased market efficiency and decreased costs. Therefore, it is recommended that these countries develop strategies to enhance their social capital and implement policies to increase especially in bridging and linking social capital, which generates a competitive advantage over their rivals.

Keywords: Social capital, Innovation, European Union, PPML.

1. Introduction

While several academic fields have explored social capital as a research subject, including political science, social psychology, sociology, and economics; social capital has been involved in economic growth sources following the successive emphasis on other capital types such as physical, human, and knowledge capital (Hoff and Stiglitz 2001). Social capital has no single, widely accepted definition; instead, definitions vary widely and are conceptual. Collier (1998) describes social capital as the internal social and cultural coherence of society, norms, and values that direct the interactions among people, and the institutions where the people are embedded. When these interactions produce some externalities and expedite collective action for mutual benefit outside the market, social capital provides an economic payoff. Being a resource that can only be created through social interaction with other people rather than by individuals themselves, social capital may be divided into two pillars; civil social capital and government social capital; the former embodies trust, reciprocity, interpersonal networks, coordination, and cooperation that manage the agents' interactions and yield externalities, and the latter comprises the benefits of law, health, order, education, and good governance. To the degree that social capital cuts down the transaction and information costs and causes more productive physical and human capital, it may be considered a source of total factor productivity.

Social relations provide social capital, which may be used to reach the required resources, connections, or sponsorship. Social capital can be separated into two categories: internal social capital and external social capital; the former refers to the linkages among individuals or groups within the organizations while the latter implies the external linkages to other firms and institutions. In other words, external social capital is the network of connections with outside parties, including customers, suppliers, and public servants. The organization's relationships with outside partners are its external social capital. Businesses with many relations or an external network can obtain vital resources and timely information more quickly, improving performance. Conversely, relationships and networks within a company or department are referred to as internal social capital, which is also necessary to manage the ambiguity and complexity of a project (Cuevas-Rodríguez et al, 2014).

In contrast to conventional capital, social capital is the public good; that is, those who benefit from it can't have this capital. However, similar to other public goods, social capital tends to be provided by private agents, meaning that it is mostly a by-product of social activities. Social capital ordinarily consists of norms, ties, and trust transferable from one social setting to another (Putnam 1993). Wang et al (2021) defined social capital as

a resource in a social network and a basis for creating sustainable competitiveness and advantage for enterprises by way of mainly knowledge transfer that matters for any individual enterprise in terms of achieving competitiveness in the markets. Social capital at the regional or national level is referred to as "societal social capital". It is an explanatory concept that explains resource mobilization, knowledge sharing, and knowledge spillovers and has been found to exist among various informal institutions (Kwon and Arenius 2010). Rutten and Boekema (2007) expressed that social capital differences across countries help to explain the regional economic development differences. Accordingly, regional social capital originates from the embeddedness of firms in regional webs of social relations. The norms, values, and customs of these networks expedite the collaboration for mutual interest. Social capital has the potential to change levels of economic development by playing a role in the creative process of nations. Social capital can produce more and more innovation, and having a significant amount of social capital not only helps societies function well but also fosters innovation in the emerging knowledge economy (Maskell 2001). Social capital increases both quantity and quality of knowledge (Inkpen and Tsang 2005). Zheng (2010) regarded social capital as the bedrock of innovation. Tseng et al (2016) emphasized that knowledge transmission based on closer and tighter connections among businesses and other actors within innovation networks is essential for promoting innovation capability.

Fountain (1998) expressed that social capital is not yet widely understood as a required, enabler of successful public-private partnerships as well as of a new, more collaborative form of innovation policy. The American biotechnology industry's network structure, Silicon Valley, and California's regional industrial system serve as examples of how social capital influences scientific and technological innovation. One of the most well-known instances of an industry network that performs well is the computer sector in Silicon Valley. There is a strong collaborative culture in the workplace. The trust among decision-makers, or enlightened self-interest, that makes collaboration possible, is the glue that holds together the new political economy. Social capital is a long-term competitive advantage that promotes long-term organizational performance and growth. Building stronger ties with the government is the most crucial social capital for fostering long-term organizational performance and growth in China. Government connections and cognitive social capital both support faster rates of innovation, giving businesses an ongoing competitive advantage that leads to long-term organizational performance (Zhang et al, 2019).

Researchers and practitioners have paid close attention to social capital as a result of changes in information technology and competitive strategies. Many scholars such as Inkpen and Tsang (2005), Gupta et al (2007), and Laursen et al (2012) contend that social capital enhances both the quantity and the quality of knowledge; and consequently, it can result in sustainable innovations and advancements. In an early study, Nahapiet and Ghoshal (1998) created a framework to show how social capital affects the transmission of explicit knowledge, tacit knowledge, and the generation of new intellectual capital. Accordingly, the network members' ability to exchange tacit information improves through increased trust, a remarkable component of social capital. Once the trust is spread across the surrounding area, the development process for inventions is shortened, and networking and social interaction in innovation activities are increased (Pucci et al, 2020). Trust also fosters innovation in both inter-organizational environments and intra-organizations by reducing the need for strict rules and increasing freedom, causing an improvement in idea generation, and efficiency because of especially saving time. Thus, creative entrepreneurship and economic expansion are encouraged in high-trust economies (Cho 2021).

Being a measure of a company's ability to seize opportunities, carry out initiatives for the development of new products, and introduce innovations to the market; innovation speed is closely related to sustainable innovation operations, capabilities, and decision-making, all of which are most likely influenced by social capital (Zhang et al, 2019). Dovey (2009) stated that innovation activities rely on collaborative learning, idea creation, and implementation practices depending on most likely stakeholder networks, trust, and other components of social capital. Similarly, Thompson (2018) expressed that social capital positively affects innovation activities.

As mentioned above, many scholars have agreed with the encouraging impact of social capital on the innovation creation process, indirectly leading to economic growth and development. In light of this possible mechanism, this study revisits the association between social capital and innovation in an empirical setting using panel data from European countries. Following the introduction, the study continues with a review of the literature in the second section. The third section explains the data and models and the analysis process including findings, followed by concluding remarks in the fourth section.

2. Literature Review

The existing literature about social capital intensifies the impact of social capital on economic development, more specifically economic growth, like literature regarding other capital forms. In this context, many studies find the driving force of social capital on economic development through various channels. Among these studies, employing variables of trust and civic norms from the World Values Surveys, Knack and Keefer (1997) inferred that social capital matters for the measurable economic performance of 29 market economies. Accordingly, membership in formal groups which is Putnam's measure of social capital has no significant impact on trust or economic performance. However, trust and civic norms are positively associated with higher and more equal incomes. Considering the newly developed social capital index, Beugelsdijk and Van Schaik (2005) investigated the nexus between social capital and economic indicators of 54 countries from Western European Regions. Results strongly refer to the positive relationship of social capital with higher levels of economic development and regional economic growth.

There is a wide range of literature concerning the nexus between social capital and innovation, particularly after the 2000s. Borgatti and Foster (2003) state that the literature on social capital has expanded quickly due to its significance in comprehending the connection between economic and social life. In this literature, various components of social capital are connected with innovative activities. Analyzing the impact of social capital and human capital on innovation in 59 countries, Dakhli and De Clercq (2004) reached evidence indicating a strongly positive relationship between human capital and innovation, but a modest positive relationship between social capital and innovation. As regards to relationship between sub-indicators of social capital and innovation, while a partial positive effect of trust and associational activity on innovation was detected, norms of civic behavior are negatively associated with innovation. Analyzing data from 93 organizations, Subramaniam and Youndt (2005) found that human, organizational, and social capital bring about incremental and radical innovative capabilities. Cainelli et al (2007) stated that research and development (R&D) and social capital/networking come forward as complementary driving forces of innovation outputs. Accordingly, social capital or networking dynamics might positively progress if only the private opportunity cost of R&D investment is reasonably low.

Analyzing data spanning from 1990 to 2002 belonging to 102 European regions, Akçomak and Weel (2009) investigated the interactions among innovation, social capital, and per capita income. According to the results, higher innovation performance is conducive to higher per capita income growth, and social capital indirectly plays an important role in this causality relationship by fostering innovation. Making a comprehensive literature review regarding the social capital and innovation relationship, Zheng (2010) expressed that the structural components of social capital such as ego network size, tie strength, structural holes, and centrality are positively associated with innovation. A similar situation might be observed for relational components of social capital. But then, social capital's cognitive components are not detected to have enough contribution to innovation.

Investigating a wide range of samples, Kwon and Arenius (2010) found evidence that a resident of a country with higher generalized trust and breadth of formal organizational memberships may most likely perceive entrepreneurial opportunities. According to Dutta's (2013) study, social capital increases corporate innovation to a certain extent; in other words, it follows a non-linear relationship with the innovative capability of firms. Addressing the issue from a different window, Laursen et al (2012) investigated the relationship between social capital and investment in foreign markets for goods and technology, using data from 2000 Italian firms. The findings and highlights in the study are fairly interesting and contribute to international business literature since they draw attention to a distinctive aspect of social capital. Accordingly, domestic geography, defined with a localized potential social capital, first, might catalyze individual firms' awareness of business opportunities, including the accessibility of knowledge regarding involvement in the foreign markets for goods and technology, but later, once potential social capital reaches a threshold value, it might act as a trapping element for individual firms, leading to reducing involvement in foreign markets. At this point, it is highlighted that R&D investment might play a moderating role between social capital and involvement in foreign markets. However, this moderating role works positively for the goods markets and negatively for the technology markets.

Developing a "social capital-innovation speed-performance" framework and applying it to 125 Chinese firms, Zhang et al (2019) investigated the mechanism of how different types of social capital influence innovation speed. Results refer to the positive effect of structural social capital on sustainable organizational performance but no significant effect on sustainable innovation speed. On the other hand, relational social capital has no significant effect on sustainable organizational performance while it is negatively associated with innovation speed. Lastly, both cognitive social capital and government ties positively affect not only sustainable organizational performance but also innovation speed. Handling a sample of 1476 firms from China over the

period 2008-2014, Zheng et al (2019) demonstrated that the top management team, an indicator of global social capital, is a driving force of innovation. Using data from the 2005-2008 period for the United States and the 2007-2013 period for Australia, Linder et al (2020) proved the critical role of human and social capital in the survival of enterprises in contrast to the trivial role of overreliance on financial capital. Obtaining 145 samples from Indonesia, Putra et al (2020) empirically tested the impact of social capital, business strategies, and innovation capabilities on business success. As per the results, being a cheap and fast information tool, social capital creates and expands knowledge about customers, raw materials, and competitors, paving the way for the innovation creation process, and ultimately business success. Conducted a survey analysis from 145 firms, Pucci et al (2020) investigated the impact of firms' relationships on their innovation performance represented by R&D effectiveness. Results showed an inverted U-shaped association between relationships within the cluster and innovation effectiveness while a positive association with relationships outside the cluster. Additionally, family involvement has a positive moderation effect in association between local relationships and innovation effectiveness.

Investigating the relationship between social capital and innovation in high-performing East Asian countries, Cho (2021) concluded that social trust among individuals does not encourage innovation. However, other elements of social capital like trust in formal institutions and shared social norms have more important impacts on innovation. Collected 235 questionnaires from China to examine the impact of social capital on innovation performance in construction enterprises, Wang et al (2021) unveiled the significant and encouraging role of structural and cognitive social capital on the innovation performance of these enterprises, however, could not be found a similar result for the relational dimension of social capital. Presutti et al (2022) proposed more investment in social capital as a reliable and profitable resource for born-global companies to become more innovative overseas. Constructing a structural equation model with data from Turkish public hospitals, Ozgun et al (2022) examined the mediation role of social capital in the relationship between innovation activities and the depth of intellectual capital and deduced that social capital plays a vital role in this relationship by boosting social interaction, fostering trust and cooperation.

Gathering data from 197 energy firms in Spain, Sánchez-García et al (2023) questioned the impact of regional specialization on innovation in enterprises by focusing on the mediation effect of cognitive social capital and absorptive capacity. Evidence shows a significant and positive association between the degree of regional specialization and firms' innovative performance. Moreover, cognitive social capital and absorptive capacity act as substantial and positive mediation roles, which confirms the mechanism, moving from cognitive social capital and absorptive capacity toward the innovation creation process through knowledge diffusion. Kobeissi et al (2023) showed that regional social capital is positively associated with the quantity, quality, and novelty of county-level innovation by private enterprises. Besides, regional social capital generates significant spillover effects in accelerating the innovation activities of neighboring countries. Conducted a questionnaire-based survey analysis using data from 295 firms in Türkiye, Ince et al (2023) concluded that entrepreneurial orientation and social capital have positive impacts on innovation performance.

3. Data, Model and Analysis

The study analyzes whether social capital has any role in the innovation creation process in the member countries of the European Union from 2013 through 2021. In the empirical setting, just two countries, Ireland and Slovenia, are excluded from the analysis due to missing data and hence the sample of the study consists of 25 European countries[1]. Here the study period initiates with the year 2013 since data on social capital exists as of 2012 and the last attendance to the European Union occurred in 2013, and ends with the year 2021 because of the missing data. In this context, the study builds the following empirical model:

$$Innov = f\ (SocCap, HumDev, Pop, GDPpc, GovEff, ResDev) \qquad (Eq.\ 1)$$

In Eq. 1, our dependent variable is innovation (Innov) represented by patent applications by residents, retrieved from World Bank-World Development Indicators (2024). The number of patent applications is thought to be a significant indicator of innovation outputs and hence is the most commonly used measure of innovation in the literature since it captures an important aspect of the level of technological activity (see. Dakhli and De Clercq

[1] Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Spain, Sweden.

2004; Zheng et al, 2019). Patent applications are worldwide patent applications filed through the Patent Cooperation Treaty procedure or with a national patent office. Our independent variable is social capital (SocCap) which is an important component of the global sustainable competitiveness index consisting of six pillars of equal importance; that is natural capital, resource intensity and efficiency, social capital, intellectual capital, economic sustainability, and governance performance, that is prepared by SolAbility Sustainable Intelligence (2023) as a non-commercial project and consists of five pillars. Accordingly, the social capital of a nation is the sum of the social stability and well-being of the entire population and covers several parameters like health, security, freedom, equality and life satisfaction, facilitating development. Not being a tangible value and thus hard to measure numerically, social capital creates social cohesion and a certain level of consensus, leading to potentially in turn a more stable environment for the economy and less exploited natural resources. The absence or deterioration of social cohesion in turn gives rise to lower productivity (health), rising crime rates, and potentially social unrest, paralyzing economic development and growth. When looking through the global statistics in 2023, the highest value belongs to Finland (65.8) followed by Iceland (64.9), Slovenia (63.7), Japan (63.6), Norway (63.5), and Sweden (62.4) while the lowest value of Afghanistan (26.4) followed by Haiti (26.7), Equatorial Guinea (27.8), Angola (28.6), Djibouti (29.4), and Yemen (29.7).

The study hierarchically includes to the model several control variables, which are human development (HumDev), population (Pop), gross domestic product per capita (GDPpc), government effectiveness (GovEff), and R&D expenditure (ResDev). While data on human development is retrieved from the United Nations Development Program (2024), others are taken from World Bank-World Development Indicators (2024). Measuring as an index spanning from 0 to 1, human development reflects a summary of average achievement in the main components of human development, which are long and healthy life, being knowledgeable, and having a decent standard of living. This index is the geometric mean of normalized indices for each of the three components. Population is in total, GDP per capita is at constant 2015 US dollar, government effectiveness is an indicator of governance quality, and R&D expenditure is expressed as a percent of GDP. All of the variables are transformed into logarithms, except for human development and government effectiveness which are in the index forms. Herewith, econometric model to be estimated is presented below:

$$\ln Innov_{it} = \beta_0 + \beta_1 \ln SocCap_{it} + \beta_2 HumDev_{it} + \beta_3 \ln POP_{it} + \beta_4 \ln GDPpc_{it} + \beta_5 GovEff_{it} + \beta_6 \ln ResDev_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (Eq.\ 2)$$

In Eq. 2, μ_i and λ_t are country-specific and time-specific effects respectively, and ε_{it} is the composite error term. Before passing on to the estimation process, descriptive statistics and correlation matrix are provided in Table 1.

Table 1: Descriptive statistics and correlation matrix

Descriptive Statistics (non-log)							
Statistics	*Innov*	*SocCap*	*HumDev*	*Pop*	*GDPpc*	*GovEff*	*ResDev*
Mean	3589.3	53.7	0.889	17471973.9	30415.5	1.029	1.633
Std. dev.	9251.1	6.4	0.038	22379.4	20977.8	0.568	0.907
Min.	1	40.7	0.796	425967	6700.5	-0.287	0.382
Max.	48480	74.6	0.951	83196078	110425.9	2.182	3.489
Correlation Matrix (log)							
	Innov	*SocCap*	*HumDev*	*Pop*	*GDPpc*	*GovEff*	*ResDev*
Innov	1.000						
SocCap	0.293*	1.000					
HumDev	0.242*	0.408*	1.000				
Pop	0.274*	0.063	-0.005	1.000			
GDPpc	0.259*	0.637*	0.545*	0.025	1.000		
GovEff	0.202*	0.669*	0.581*	0.141*	0.831*	1.000	
ResDev	0.613*	0.567*	0.571*	0.274*	0.656*	0.695*	1.000

Note: * refers to the statistical significance at the level of 5%.

When looking at the statistics in Table 1, quite a big difference among countries in terms of innovation stood out (minimum and maximum values are 1 and 48480, respectively). In this respect, in the study sample, Germany leads to the head while Cyprus ranked last. As for social capital, while the mean value is 53.7, higher than the global average value in 2023 (44); Finland, Denmark, Luxemburg, and Sweden are located at the top of the list. A striking point is that all independent variables have a positive and statistically significant correlation relationship with innovation. Although this gives us an intuitive comprehension of the nexus between innovation and its determinants, it needs to be empirically analyzed to make a clear implication. For this purpose, the econometric model in Eq. 2 is estimated by the Poisson Pseudo Maximum Likelihood (PPML) which is the most appropriate method for especially estimation of models involving count data and/or negative values like here. The study follows a hierarchical estimation technique in order to reach more robust findings. Hierarchical order has been determined by considering correlation coefficients among independent variables. Since our data dimension is not sufficiently long, even a modest correlation relationship among variables matters for getting robust findings. Therefore, in the process of determining variables for model specifications, the variables that have no high or modest correlation relationships are preferred. In this context, table 2 presents the findings from the PPML method.

Table 2: Hierarchical regression analysis results of the innovation model

Variables	(I)	(II)	(III)	(IV)	(V)	(VI)
SocCap	2.018* (0.341)	1.612* (0.381)	1.466** (0.358)	--	--	--
HumDev	--	1.392* (0.479)	1.512* (0.463)	--	--	--
Pop	--	--	0.152* (0.024)	0.154** (0.023)	0.143* (0.023)	0.064* (0.025)
GDPpc	--	--	--	0.333* (0.053)	--	--
GovEff	--	-	--	--	0.101* (0.028)	--
ResDev	--	--	--	--	--	0.813* (0.099)
Constant	-2.482* (0.593)	-3.019* (0.626)	-3.923* (0.637)	-1.523* (0.251)	-0.088 (0.164)	0.426* (0.159)
Wald(X^2)	35.10*	43.70*	79.42*	108.41*	51.82*	134.23
Observations						225

Note: * and ** indicate the statistical significance at the level of 1% and 5%, respectively. Values in parenthesis are the robust standard errors.

According to the hierarchical regression analysis results, social capital has a strongly positive impact on innovation since its coefficient is statistically significant and positive in all model specifications. Additionally, control variables, human development, population, income per capita, government effectiveness, and R&D expenditure are positively associated with the innovation creation process. Yet, it may be deduced that social capital and human development have turned out to be workhorses of the innovation creation process.

4. Concluding Remarks

Social capital has been expected to encourage innovation activities through a variety of channels like knowledge transfer, increased trust, vision-sharing, and saving time. From this strong expectation, here was empirically analyzed whether social capital has any role in shaping the innovation creation process in 25 members of the European Union over the period 2013-2021. The finding strongly supports the encouraging effect of social capital on innovation since it is statistically significant and positive in all model specifications. The innovation creation process is enhanced by social capital's role in fostering an atmosphere where entrepreneurs and capitalists may work out the finest agreements. Besides, the innovation creation process is positively associated with human development, population, income per capita, government effectiveness, and R&D expenditure. As a core result of the study, social capital may be considered the workhorse for the innovation creation process since it promotes better coordination of activities through improved interpersonal interactions, increased community trust, and vision-sharing, leading to increased market efficiency and decreased costs. Therefore, it is recommended that these countries develop strategies to enhance their social capital and implement policies to increase especially in bridging and linking social capital, which generates a competitive advantage over their rivals.

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